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PROCEEDINGS

of the American Academy of Forensic Sciences

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Alden Leeds, Inc., nu-clo® Concentrated Granules
Clorox Company Clorox® Automatic Bowl Cleaner
Global Household Brands X-14 Anti-Bacterial Toilet Bowl Cleaner
Housechem American Fare® Automatic Toilet Bowl Cleaner with Bleach
Housechem RiteAid Automatic Toilet Bowl Cleaner with Bleach
Rickett & Colman Sani-Flush® Bleach Puck Plus® Automatic Toilet Bowl Cleaner
WD-40 Company 2000 Flushes® Bleach Automatic Bowl Cleaner
Richard W. McLay, PhD, PE - W7
Stark rxp (Other Financial/Material Support)
Sara McNorton, MS - B58
Atomobile Body Fillers
Automobile Spot Fillers
Terry Melton, PhD - B131
Mitotyping Technologies (Employee)
James R. Millette, PhD - C42
Microscopical Analysis (provided by MVA Scientific Consultants)
Lisa M. Misner, MS - B127
National Institute of Justice (Grant/Research Support)
Andre A. Moenssens, JD, LLM - W7
Stark rxp (Other Financial/Material Support)
Shirly Montero, PhD
NITECRIME (European Union Funded Network) (Grant/Research Support) – W10
Agilent – W10
Foster & Freeman Grim II – B159
New Wave (Demonstration Equipment) – W10
New Wave UP-213 Laser Ablation System – B159
Perkin Elmer ICP DRC Plus – B159
Stephen L. Morgan, PhD - B151
Federal Bureau of Investigation (Grant/Research Support)
Keith Morris, PhD - W3
Prentice Hall/Pearson Education (Other Financial/Material Support)
Robert J. Morton, MS - D41
Federal Bureau of Investigation (Other Financial/Material Support)
Robert F. Mothershead II, MA - W16
3SI Security Systems FlexPac™
3SI Security Systems Octapus™
3SI Security Systems Scorpion®/Currency Guard
United States Currency Protection Corporation
Dawn M. Mulhern, PhD - W2
Leica Microsystems Microscopes (Demonstration Equipment)
Stacey Murnyak, BS - B146
NYC OCME Department of Forensic Biology (Employee)
Applied Biosystems, Inc. ABI Prism® 3100 Genetic Analyzer
Applied Biosystems, Inc. Quantiblot
Bio RAD Micro Bio-Spin Chromatography Columns
Promega DNA IQ
Promega PowerPlex®16

N

Huma Nasir, BS - B140
Applera Corporation Quantifiler™Y
Reliagene Technologies, Inc. Y-Plex™12
Adam Negrusz, PhD, DSc - W15
SPE Products & Techniques (Unlabeled/Investigational Use)
Varian, Inc. (Employee)
Varian, Inc. SPE Phases
Kristin N. Nestor, BS, BS - B15
TSWG (Grant/Research Support)
Alexander A. Nieuwland, PhD - B150
Federal Bureau of Investigation (Grant/Research Support)
Beckman-Coulter Biomek 2000 Workstation
Beckman-Coulter P/ACE MDQ Capillary Electrophoresis System
Waters Micromass Q-Tof Micromass Spectrometer
Henry C. Nipper, PhD - K5
Zeneca Pharmaceuticals Seroquel (Quetiapine Fumarate)
H. Dale Nute, PhD - B47
Florida State University, Panama City (Employee)
Metal Detector (Unlabeled Pharmaceutical/Investigational/ Medical Device)

O

William R. Oliver, MD - D27
Multiple Web Pages
Databases
Kerry L. Opel, MA, BS - B147
NIJ 2002-IJ-CX-K007 (Grant/Research Support)
Corbett Research Rotor-Gene RG3000
Millipore Microcon® YM-30
Stephen D. Ousley, PhD
University of Tennessee, Knoxville (Consultant) - H22
FORDISC (provided by the University of Tennessee) – H22, W20
SAS (provided by the University of Tennessee) – W20
SYSTAT (provided by the University of Tennessee) – W20

P

Robert R. Paine, PhD - W2
Leica Microsystems Microscopes (Demonstration Equipment)
Frank J. Pappas, DDS - F18
Adobe® Photoshop® (provided by the OCME City of New York)
WinID (provided by the OCME City of New York)
Robert F. Pastor, PhD - H35
The British Academy (Grant/Research Support)

Gabor Patonay, PhD - B102
Clorox® Bleach
Fluorescein (provided by Gabor Patonay/Georgia State University)
JOY® Dishwashing Detergent
Jeanette M. Perr, BS - SS2
Florida International University (Other Financial/Material Support)
Donn N. Peterson, MSME, PE - W7
Stark rxp (Other Financial/Material Support)
Joseph L. Peterson, DCrim - B62
Bureau of Justice Statistics (Grant/Research Support)
Jerome L. Podorski, BS - SS2
Florida International University (Other Financial/Material Support)
Natasha H. Poe, BS - B82
Applera Corporation Quantifiler™ Human DNA Quantification Kits
Applied Biosystems, Inc. ABI Prism® 3100 Genetic Analyzer
Applied Biosystems, Inc., Inc. AmpF*l*STR® Profiler Plus™
Applied Biosystems, Inc., Inc. AmpF*l*STR® Coflier™ PCR Amplification Kits
Applied Biosystems, Inc. GeneScan® Analysis Software
Applied Biosystems, Inc. Genotyper® Analysis Sofware
Applied Biosystems, Inc. Quantiblot® Human DNA Quantification Kits
The Bode Technology Group, Inc. Buccal DNA Collector
Fitzco, Inc. Omni Swab Collector
Fitzco, Inc. Sampact™
Pur-Wrap® Sterile Dacron® Swab (provided by Fitzco, Inc.)
Qiagen, Inc. QIAmp® DNA Mini Kit
Whatman® Indicating FTA® Micro Card (provided by Fitzco, Inc.)
Mark M. Pollitt, MS - D13
University of Tulsa (Consultant)
Maja Popovic, PhD - B75
ReliaGene Technologies, Inc. (Employee)
Applied Biosystems, Inc. ABI Prism® 3100 Genetic Analyzer
Applied Biosystems, Inc. 9700 GeneAmp® PCR System
Applied Biosystems, Inc. Genotyper®
Qiagen BioRobot 8000 DNA Extraction System
Qiagen Biorobot Liquid Handling System
Wallace DBS Puncher (provided by Perkin Elmer)
Klaus Poulsen, MD - G85
Siemens CT-Scanner Somatom Plus4
Chang En Pu, MS - D53
Investigation Bureau, Ministry of Justice, Taiwan (Speaker's Bureau)
Genotyping Results (provided by Applied Biosystems, Inc.)
Ken Pye, PhD - W10
NITECRIME (European Union Funded Network) (Grant/Research Support)
Agilent
New Wave (Demonstration Equipment)

Q

Thomas Quatieri, PhD - D33
United States Government TSWG Air Force contract F19628-00-C-0002 (Grant/Research Support)

R

J. Graham Rankin, PhD - B116
National Institute of Justice (Grant/Research Support)
Machelle A. Reid, MFS - J15
Hewlett-Packard Company
Pamela C. Reynolds, BS - W16
3SI Security Systems FlexPac™
3SI Security Systems Octapus™
3SI Security Systems Scorpion®/Currency Guard
United States Currency Protection Corporation
Michael P. Rickenbach, PhD - W16
3SI Security Systems FlexPac™
3SI Security Systems Octapus™
3SI Security Systems Scorpion®/Currency Guard
United States Currency Protection Corporation
Bernd Rieger, Dipl.-Phys. - D28
Adobe® Photoshop®
Microsoft® Windows®
Lovelle M. Rimando - D49
USDE Grant #P217A030070. (Grant/Research Support)
Applied Biosystems, Inc. 377 XL DNA Sequencer (provided by the University of Hawaii
BLAST Search Engine (Unlabeled Pharmaceutical/Investigational/Medical Device)
GenBank (Unlabeled Pharmaceutical/Investigational/Medical Device)
Carol J. Ritter, MS - B108
Cedar Crest College (Grant/Research Support)
Promega SE33 Kit
James M. Robertson, PhD - B12
Federal Government (Grant/Research Support)
James M. Robertson, PhD - B104
Federal Government (Grant/Research Support)
Bayer Actril®
Susan J. Roe, MD - G18
Bush Foundation Medical Fellows Program (Grant/Research Support)
G. Sue Rogers, MSFS - B111
National Institute of Justice (Grant/Research Support)
Applied Biosystems, Inc. AmpF*l*STR®
Applied Biosystems, Inc. GeneScan®
Applied Biosystems, Inc. Genotyper®
Applied Biosystems, Inc. ABI Prism®
Hitachi FMBIO®
Promega PowerPlex®
Douglas E. Rohde, MS - K39
Merck Merckoquant® Cyanide Test
Ann H. Ross, PhD - H18
North Carolina State University Grant (Grant/Research Support)
Linda C. Rourke, MSFS, MPhil - B168
Amersham Biosciences 500 GenomiPhi Kit
Lenny Rudin, PhD - D16
Cognitch (Grant/Research Support)
Investigator Services (provided by Cognitech)
Susanna Rudy, RN, MSFS
Labock Technologies, Inc. One-Way(TM) Bullet Resistant Glass – B112
Pyng Medical Corporation F.A.S.T. 1™ Intraosseous System – D2

S

Kenneth Saczalski, PhD - C11
Bruce R. Pfaff & Associates (Grant/Research Support)
Butler, Wooten, Fryhofer, Daughtery, & Sullivan (Grant/Research Support)
Douthit, Frets, Rouse & Gentile (Grant/Research Support)
Lowe, Eklund, Wakefield & Mulvihill (Grant/Research Support)
Stong & Associates (Grant/Research Support)
Nermin Sarajlic, MD - H70
International Commission on Missing Persons (Employee)
Vincent J. Sava, MA - W23
JPAC Central Identification Laboratory (Employee)
Michael I. Schaffer, PhD - K31
Psychemedics Corporation (Employee)
Hair Analysis (provided by Psychemedics Corporation)
Heather J. Schafstall, MS - W3
Prentice Hall/Pearson Education (Other Financial/Material Support)

Kenneth G. Schoenly, PhD - G50
National Institute of Justice (Grant/Research Support)
Susan Scholl, MS - W3
Prentice Hall/Pearson Education (Other Financial/Material Support)
Rebecca L. Schuler, BS
ChemImage Corporation (Employee) – D23, D71
ChemImage Corporation CI Print Macroscopic Chemical Imaging System - D71
ChemImage Corporation Fiber Database – D23
Microtrace Corporation Fiber Database – D23
Jeffrey Schweitzer, PhD - B162
National Institute of Justice (Grant/Research Support)
National Aeronautics and Space Administration (Grant/Research Support)
David V. Scott, JD - W7
Stark rxp (Other Financial/Material Support)
Ronald Scott - W16
3SI Security Systems (Employee)
3SI Security Systems FlexPac™
3SI Security Systems Octapus™
3SI Security Systems Scorpion®/Currency Guard
United States Currency Protection Corporation
Jennifer Sears - B108
Cedar Crest College (Grant/Research Support)
Promega SE33 Kit
James A. Sebestyen, BS - B65
Office of Chief Medical Examiner (Speaker's Bureau)
Dacron® (provided by Office of the Chief Medical Examiner)
Corbett Research Rotor-Gene™ 3000 (provided by Office of the Chief Medical Examiner)
Beckman-Coulter Biomek 2000 (provided by Office of the Chief Medical Examiner)
Microcon 100 (provided by Office of the Chief Medical Examiner)
Ismail M. Sebetan, MD, PhD - B109
Applied Biosystems, Inc. ABI Prism® 310 Genetic Analyzer
Applied Biosystems, Inc. AmpFlSTR® Profiler Plus® PCR Amplification Kit
Applied Biosystems, Inc. GeneScan®
Carl M. Selavka, PhD - B162
National Institute of Justice (Grant/Research Support)
National Aeronautics and Space Administration (Grant/Research Support)
Arijana Selmanovic, BS - B4
International Commission on Missing Persons - ICMP (Employee)
Applera Corporation Quantifiler™ Human DNA Quantification Kits
Applied Biosystems, Inc. ABI Prism® 310 DNA Sequencers
Applied Biosystems, Inc. ABI Prism® 3100 DNA Sequencers
Applied Biosystems, Inc. ABI 7000 Sequence Detection System
Promega® PowerPlex®16
Roche Molecular Systems, Inc. Taq Gold®
Heather J. Seubert, BS - B102
Clorox® Bleach
Fluorescein (provided by Gabor Patonay/Georgia State University)
JOY® Dishwashing Detergent
Kimberley Sharpe, MSc - B74
Applied Biosystems, Inc. AmpFlSTR® Profiler Plus®
Applied Biosystems, Inc. ABI Prism® 377 DNA Sequencer
Applied Biosystems, Inc. Genescan® Analysis
Applied Biosystems, Inc. Genotyper® Software
Kai-Ping Shaw, MD, PhD - G70
IFM 91-T06 (Grant/Research Support)
Claire E. Shepard, MS - SS2
Florida International University (Other Financial/Material Support)
Robin Shick - B108
Cedar Crest College (Grant/Research Support)
Promega SE33 Kit
Michael E. Sigman, PhD - B41
National Institute of Justice (Grant/Research Support)
Michael E. Sigman, PhD - B49
National Institute of Justice (Grant/Research Support)
Kelli Sikorski - W3
Prentice Hall/Pearson Education (Other Financial/Material Support)
Ronald L. Singer, MS - SS2
Florida International University (Other Financial/Material Support)
David E. Sipes, MS - B98
Tecan Genesis Robot
Qiagen DNA Extraction Kit
Lejla Smajlovic, BS - B6
International Commission on Missing Persons (Employee)
Applera Corporation Quantifiler™ Human DNA Quantification Kit
Applied Biosystems, Inc. ABI Prism® 3100 Genetic Analyzer
Applied Biosystems, Inc. ABI Prism® 7000 Sequence Detection System
Applied Biosystems, Inc. ABI GeneAmp® PCR System 9700
Promega PowerPlex® 16
Keri L. Smith - B13
San Jose State University College of Applied Sciences and Arts (Grant/Research Support)
Sorenson Microcentrifuge Tubes
Amanda C. Sozer, PhD - B77
Louisiana State Police Crime Laboratory (Grant/Research Support)
Pur-Wraps® sterile Dacron® Polyster-Tipped Applicator (provided by Fitzco, Inc.)
Non-Contact Buccal Swab Laser-Cutting Instrument (Unlabeled Pharmaceutical/Investigational/Medical Device)
Henry A. Spiller, MS - K20
Pfizer Visine®
M. Kate Spradley, MA - W20
FORDISC (provided by the University of Tennessee)
SAS (provided by the University of Tennessee)
SYSTAT (provided by the University of Tennessee)
Nicole Stalter - D47
USDE P217A990159 (Grant/Research Support)
Lateefah A. Stanford, BS - C38
National Science Foundation (Grant/Research Support)
Amy R. Stefan, BS - B149
Federal Bureau of Investigation (Grant/Research Support)
Beckman-Coulter Biomek 2000
Beckman-Coulter P/ACE MDQ Capillary Electrophoresis System
Thora S. Steffensen, MD - B21
The Icelandic Ministry of Justice (Grant/Research Support)
Robin T. Stoehr, BS - B153
National Institute of Justice Award 2001-RC-CX-K003 (Grant/Research Support)
K. Alan Stormo, MD - G62
Quick2000 Biohazard Escape Hood
Samuel D. Stout, PhD - W2
Leica Microsystems Microscopes (Demonstration Equipment)
Amanda B. Sturdevant, BS - B94
ATF-NLC (Other Financial/Material Support)
3M Scotch-Hutchinson Tape
Other Scotch Hutchinson Tape Products
Dale A. Sutherland, CChem - B119
Activation Laboratories, Ltd. (Employee)
Anjali R. Swienton, MFS, JD - D59
National Insitute of Justice (Grant/Research Support)
Jennifer A. Synstelien, MA - H86
Department of Justice Law Enforcement Innovation Center (Grant/Research Support)

T

Sabrina C. Ta'ala, MA - H14
Joint POW/MIA Accounting Command Central ID Lab (JPAC/CIL) (Employee)
Allan Tereba, PhD - B73
Promega (Employee)
Promega Differential Extraction System
Mark D. Timken, PhD - B135
National Institute of Justice (Grant/Research Support)
Applied Biosystems, Inc. STR Genotyping Kits
Mitochon Amp Kits
Roche Applied Biosciences qPCR Quantification Kits
Bridget M. Tincher, MSFS - B79
National Institute of Justice (Grant/Research Support)
Applied Biosystems, Inc. ABI Prism®
Applied Biosystems, Inc. AmpFlSTR®
Applied Biosystems, Inc. GeneScan®
Applied Biosystems, Inc. Genotyper®
Hitachi FMBIO®
Promega PowerPlex®
Richard E. Tontarski, PhD - W3
Prentice Hall/Pearson Education (Other Financial/Material Support)
Hugh Tuller, MA - H24
International Commission on Missing Persons - ICMP (Employee)
Andrew J. Tyrrell, PhD - W23
JPAC Central Identification Laboratory (Employee)

U

Douglas H. Ubelaker, PhD - W2
Leica Microsystems Microscopes (Demonstration Equipment)
Noelle J. Umback, PhD - B141
Office of Chief Medical Examiner (Employee)
Sayuri Umpierrez, BS - B39
Foster & Freeman (Other Financial/Material Support)
Foster & Freeman LIBS System
New Wave Research Laser Ablation System
Perkin Elmer SCIEX ICP-MS System

V

Gerard J.Q. van der Peijl, PhD - B37
Alunite (provided by Riaza Mine in Spain)
Alunite (provided by Rodalquilar Mine in Spain)
Chatwood Safe
EDAX Eagle m-XRF Instrument
Europa Scientific Geo 20-20 IRMS Instrument
Botanical Services (provided by National Herbarium of the Netherlands)
IRMS Analyses (provided by Iso-Analytical, Ltd.)
Perkin Elmer ELAN 6100 DRC Plus ICPMS Instrument
Perkin Elmer OPTIMA 3000 ICP AES Instrument
Stojko Vidovic, PhD - B7
International Commission on Missing Persons - ICMP (Employee)
Promega PowerPlex® Human Identification Kit
William Vilensky, DO, RPh - G89
Reckitt Benckiser (Grant/Research Support)
Jessica C. Voorhees, MSc - B105
Federal Bureau of Investigation (Grant/Research Support)

W

Timothy W. Waldeck, JD - W7
Stark rxp (Other Financial/Material Support)
Margaret M. Wallace, PhD - B173
PSC-CUNY #66248-00 35 (Grant/Research Support)
Heather A. Walsh-Haney, MA - H77
University of Florida (Grant/Research Support)
Tani G. Watkins, BA - B102
Clorox® Bleach
Fluorescein (provided by Gabor Patonay/Georgia State University)
JOY® Dishwashing Detergent
John Watling, PhD - W10
NITECRIME (European Union Funded Network) (Grant/Research Support)
Agilent
New Wave (Demonstration Equipment)
Gabriel D. Watts, BA - J19
Federal Bureau of Investigation Laboratory (Speaker's Bureau)
Matthew J. Weber, BSE - C2
Accident Reconstruction Computer Software
Douglas White - D14
National Institute of Standards and Technology (Employee)
Commercial Software Applications
Freeware Computer Applications
Richard Winegar, PhD - B64
Federal Bureau of Investigation (Grant/Research Support)
Amicon® Microcon® YM-10 Centrifugal Filter Devices
Amicon® Ultrafree®-CL Centrifugal Filter Devices 0.45 mm
Amicon® Ultrafree®-CL Centrifugal Filter Devices 5.0 mm
Bio-Rad iQ™ Supermix
Bio-Rad iQ™ SYBR Green Supermix
Copan Enviro PBS TL Swab
EpiCentre® BuccalAmp™ DNA Extraction Kit
Machery-Nagel Nucleospin® DNA Trace Kit
Millipore Multiscreen™ PCR Cleanup Plate
MoBio UltraClean™ Mega Prep Soil DNA Kit
MoBio UltraClean™Soil DNA Kit
NIST Standard Reference Material® Urban Particulate Matter
Qiagen DNeasy® Tissue Kit
Qiagen QiaQuick® PCR Purification Kit
Pluronic®F-68
Matt C. Wood, BS - C47
3-D Dispersion Modeling (provided by CTEH)

Z

Kathryn Zimmerman - G5
Millersville University Student Research Grant (Grant/Research Support)
Jerry A. Zweigenbaum, PhD - K27
Agilent Technologies, Inc. (Employee)
Agilent Technologies, Inc. LC/MSD TOF

Special Sessions

SS1 The Big Bad Wolf is Worse Than Ever: Exploitation and Abuse of the Elderly

Carla M. Noziglia, MS, 8513 Northwest 47 Street, Coral Springs, FL 33067-3403; Michele E. Kestler, MS, Los Angeles Police Department, 555 Ramirez Street, Space 270, Los Angeles, CA 90012; Kathy Bell, MS, RN*, Tulsa Police Department, 600 Civic Center, Tulsa, OK 74103; William L. Leaver, BS*, Los Angeles County Sheriff's Department, 7717 Golondrinas Street, Downey, CA 90242; Ashraf Mozyani, PharmD, PhD*, Harris County Medical Examiner's Office, 1885 Old Spanish Trail, Houston, TX 77054; Douglas H. Posey, Jr., MD*, JAJ Forensic Center, Harris County, Texas, 1885 Old Spanish Trail, Houston, TX 77054; and Joseph N. Soos, BS*, Gray Murders/Gray Crimes Project, 1981Powell Creek Court, Charlottesville, VA 22911*

Upon completion of this session, the participant should be able to clearly identify exploitation and abuse of the elderly and understand the scientific tools available for more effective prosecution.

This presentation will impact the forensic community and/or humanity by better arming participants to combat elder abuse and exploitation in investigation, evidence analysis and prosecution.

The generation labeled by Tom Brokaw as 'the greatest generation' has survived the horrors of a world war, the holocaust, the great depression and the atomic bomb. But another horror looms as the unscrupulous target these vulnerable silver citizens with fraud, robbery and, at times, murder.

This workshop will provide insight in the identification of elderly exploitation and abuse, and discuss scientific and investigative tools, and methods which are effective to use. Too often, crimes against the elderly are categorized as abuse when, in fact, they can be much more. The topics focus on how the justice system, social services and the medical community are missing homicides and other crimes against the elderly. This workshop will also demonstrate the potential unintended and intended toxic effects of common prescription and over the counter medication with emphasis on the pharmacokinetics and pharmacological changes in elderly. Detecting forged signatures on documents such as wills, trusts and deeds will be presented. The indicators and evaluation of abuse of elderly noted in the emergency room as a result of sexual assault. The findings at post-mortem examination: contracture, shaken adult syndrome, dehydration and malnutrition will be shown. The symposium will conclude with at discussion of the investigation into the death of an 87-year-old woman who was murdered for her estate.

Elder Abuse, Crimes Against Elderly, Elder Sexual Assault

SS2 Young Forensic Scientists Forum: Forensic Science Outside The Box

Claire E. Shepard, MS, 416 East Ponce De Leon Avenue, Decatur, GA 30030; Sheila M. Estacio Dennis, BA*, Office of the Chief Medical Examiner, 520 First Avenue, New York, NY 10016; Karly Buras, MA, Graduate Student, LSU, 3911 South Post Oak, New Orleans, LA 70131; Allison M. Curran, BS, Florida International University, 201 Southwest 116th Avenue, Apartment 304, Pembroke Pines, FL 33025; Amanda K. Frohwein*, 1663 Main Street Road, State Center, IA 50247; Christopher M. Gojcz, BS*, Drug Enforcement Administration, Special Testing & Research Laboratory, 22624 Dulles Summit Court, Dulles, VA 20166; Marrah E. Lachowicz, MFS*, 1300 East Orange Street, Tempe, AZ 85281; Jeanette M. Perr, BS*, Florida International University, 201 Southwest 116th Avenue, Pembroke Pines, FL 33025; Robert E. Barsley, DDS, JD*, Louisiana State University, School of Dentistry, 1100 Florida Avenue, Box 512, New Orleans, LA 70119-2714; Adam C. Becnel, BS*, Louisiana State Police Crime Laboratory, 376 East Airport Road, Baton Rouge, LA 70806; James J. DiSarno, MS*, Drug Enforcement Administration, Northeast Laboratory, 99 Tenth Avenue, Suite 721, New York, NY 10011; Kenneth G. Furton, PhD, Director, International Forensic Research Institute, Florida International University, University Park, Miami, FL 33199; Kenneth W. Goddard, MS*, National Fish and Wildlife Forensic Laboratory, 1490 East Main Street, Ashland, OR 97520; Dave Kontny*, Director, National Explosives Detection Canine Program, Department of Homeland Security, Law Enforcement - Aviation Operations, 15500 Laurel Ridge Road, Montclair, VA 22026; Vahid Majidi, PhD*, Department of Justice, 950 Pennsylvania Avenue, NW, Washington, DC 20530; Mary H. Manhein, MA*, Forensic Anthropology and Computer Enhancement Services Laboratory, Louisiana State University, Baton Rouge, LA 70803; Jerome L. Podorski, BS*, Drug Enforcement Administration, Mid-Atlantic Laboratory, 1440 McCormick Drive, Largo, MD 20774; and Ronald L. Singer, MS*, Tarrant County Medical Examiner's Office, 200 Feliks Gwozdz Place, Fort Worth, TX 76104*

Following the completion of this special session, the participants should be aware of the diversity of careers in forensic science, should understand how to compete for the FSF Emerging Forensic Scientist Award, should recognize the motivation behind and the guidelines for accreditation of forensic science academic programs, and should be aware of the realities in the field of forensic science according to young forensic scientists and crime laboratory directors. A breakfast session and an evening session will allow participants to mingle with students and emerging scientists from across the nation and to establish relationships with members for mentoring and networking. While at the breakfast session, participants will also have a chance to learn about resumé building and are encouraged to bring their own resumés to be critiqued. While at the evening session participants will be able to view graduate student posters and to mingle with their peers in a comfortable environment.

As its role in society evolves, the field of Forensic Science continues to grow and incorporate the skills and knowledge of many different experts and disciplines. This year's special program will bring to the forefront some emerging forensic science fields, and consists of presentations by established members of the forensic science community. Emphasis has been placed on areas such as: the processing of clandestine labs, forensic odontology, wildlife forensics, forensic anthropology, and the importance of forensic science publications. The session will also stress the role of forensic science in homeland security, and will serve to make emerging forensic scientists aware of the opportunities available to them. Complete with a discussion panel on "Forensic Science in Louisiana," the session will give students and emerging Forensic Scientists an open forum atmosphere in which to discuss the realities of working as a forensic scientist, and the qualifications necessary to pursue this exciting career.

This program should appeal to individuals with a strong desire to enter the field of forensic science as well as those with a few years of experience within the field and looking to get ahead. The session aims to cover a wide range of emerging fields through presentations, discussions, and interactions with new and established members of the forensic community. This program will provide a well-rounded understanding of different areas within forensic science.

The objectives of this year's special session are as follows:

- To introduce emerging fields in forensic science
- To provide an understanding of the Emerging Forensic Scientist Award
- To introduce not only emerging forensic scientists but also prospective forensic scientists to established forensic scientists through interaction, discussions, and presentations
- To provide an opportunity for an open-forum discussion about the opportunities for forensic science in Louisiana
- To increase involvement within the Young Forensic Scientists Forum.

Education, Young Forensic Scientist Forum, Careers

SD1 Accreditation of Forensic Science Academic Program Through the AAFS FEPAC

José R. Almirall, PhD, Florida International University, Department of Chemistry, International Forensic Research Institute, Miami, FL 33199; Charles "Chris" Tindall, PhD*, Metropolitan State College, Department of Chemistry, PO Box 173362, Camput Box 52, Denver, CO -8021; Betty J. Horton, RR2, Box 145, Tower Hill, IL 62571, Max M. Houck, MA*, West Virginia University, 886 Chestnut Ridge Road, Suite 309, PO Box 6216, Morgantown, WV 26506-6216; Susan Hart Johns, MA, Illinois State Police, Division of Forensic Services, 630 East Washington Street, Springfield, IL 62701-1304; Karen W. Kershenstein, PhD, 11842 Clara Way, Fairfax Station, VA 22039; Peter M. Marone, MS, Division of Forensic Science, 700 North 5th Street, Richmond, VA 23219; Carl Selavka, PhD*, Massachusetts State Police Crime Laboratory, 59 Horse Pond Road, Sudbury, MA 01776; and Jay A. Siegel, PhD*, Indiana University, Purdue University, Chemistry, School of Science, 402 North Blackford, LD 326 D, Indianapolis, IN 46202*

After attending this presentation, attendees will understand the process of accreditation through the AAFS FEPAC mechanism and be able to participate in the process as a reviewer of academic programs. Academic programs will also learn about the process of accreditation from different perspectives.

This presentation will impact the forensic community and/or humanity by providing participants with a better understanding of the accreditation process and to encourage academic institutions to participate in the accreditation process. We also expect to encourage practitioners to invest in the process by volunteering to act as site reviewers. Forensic Science education will ultimately benefit from a bona fide accreditation process.

The mission of the FEPAC is to maintain and enhance the quality of forensic science education through a formal evaluation and recognition of college level academic programs. The primary function of the committee is to develop and maintain standards and administer an accreditation program that recognizes and distinguishes high quality undergraduate and graduate forensic science programs.

Attendance to this session will assist academic institutions who offer undergraduate and graduate degree programs in forensic science to prepare for the AAFS accreditation process through the Forensic Science Education Programs Commission (FEPAC). The session will also assist future site reviewers (academic and practitioners) in the preparation for the on-site reviews of academic programs.

Accreditation of Academic Programs in Forensic Science, FEPAC/AAFS, Special Session

ES1 Complex Forensic Science Issues in Highly Controversial Cases

Michael M. Baden, MD, New York State Police, Building 22, State Campus, Albany, NY 12226; Henry Lee, PhD*, Division of Scientific Services, Connecticut Department of Public Safety, 278 Colony Street, Meriden, CT 06456; and Cyril H. Wecht, MD, JD*, Allegheny County, 542 Fourth Avenue, Pittsburgh, PA 15219*

The goals of this presentation are to assist attendees with the ability to objectively review and analyze forensic scientific issues; and to provide a better understanding of potential pitfalls involved in complex civil and criminal trials.

This presentation will impact the forensic community and/or humanity by increasing understanding of relationships among forensic scientists, law enforcement agencies and attorneys.

There are varying degrees of exactitude associated with each of the acknowledged fields of forensic science. However, none of these areas of professional expertise constitutes an absolute science. Accordingly, conflicting views, even to the point of seemingly antithetical conclusions and opinions, may be encountered in any particular civil or criminal lawsuit.

For various reasons, the more multi-faceted, controversial, and nationally publicized a particular case may be, the more likely are there to be highly conflicting opinions from acknowledged medical and forensic scientific experts. While this may be a source of consternation and even intellectual concern to many people, there is nothing inherently inappropriate or professionally unethical in such a situation. Reasonable, intelligent, and highly experienced experts may arrive at different conclusions in any particular case. Of course, the fact that the adversarial system is the universally accepted method of litigation trial technique in the United States, undoubtedly serves to foment and exaggerate these divergent viewpoints.

This discussion will be designed to illustrate and perhaps explain how serious and significant differences among various forensic science experts may arise in nationally prominent cases. Presentations will include factual analyses of several such matters of recent vintage, including the Scott Peterson, Kobe Bryant, Jayson Williams cases and several others.

Different perspectives will be discussed in order to ensure objectivity and fairness.

Forensic Scientific Analysis, Complex Litigation, Adversarial System

ES2 Requirements for Investigations into Allegations of Serious Negligence or Misconduct in Forensic Science Laboratories

Joseph P. Bono, MA, Office of Forensic Sciences, Drug Enforcement Administration, 2401 Jefferson Davis Highway Alexandria, VA 22301; Kenneth E. Melson, JD, United States Attorney's Office, 2100 Jamieson Avenue, Alexandria, VA 22314; Barry Scheck, Cardozo Law School, 55 Fifth Avenue New York, NY; and Peter Neufeld; Attorney at Law; 99 Hudson Street; New York, NY

During the past few years there have been a number of accusations directed at forensic science laboratories. These accusations have involved claims of negligence, misconduct or technical/analytical mistakes in the analyses of physical evidence with the result being possible miscarriages of justice. To the credit of many laboratories, there is a practice of self-disclosure when evidence of such impropriety exists. In most cases, the problems are addressed, notifications are made, justice is served and the integrity of the laboratory stays intact. In other cases, that is not the outcome.

Now the federal government has mandated formal state government oversight to resolve these accusations. The Paul Coverdell Forensic Sciences Improvement Grant Program (FSIGP) was expanded by the 108th Congress to require that a state, as a condition of receiving federal funding for crime laboratories, certify that a formal, governmental process is in place to conduct independent external investigations of its laboratories. These investigations are to occur when there are allegations of serious negligence or misconduct substantially affecting the integrity of the forensic results committed by employees or contractors of any forensic laboratory system, medical examiner's office, coroner's office, law enforcement storage facility, or medical facility in the state that receives a grant under the Program.

This presentation will offer an open and full discussion of the requirement for external investigations, the type of government entities that will oversee the investigations, the parameters of the investigations, and the effect on other quality assurance program obligations. The panel will consist of representatives of the Innocence Project at Cardozo Law School, who participated in drafting the amendment's language, and of ASCLD/LAB.

Negligence, Misconduct, Forensic Science Laboratories

Breakfast Seminars

BS1 The One Drop Rule: Is It Time For Science Rather Than Law to Define Race in America?

Ingrid A. Gill, JD, 4835 North Kenmore Street, Chicago, IL 60640*

After attending this presentation, attendees will learn the history of Louisiana's race classification laws and their impact on people of mixed heritage today. The presenter will draw on her tri-racial heritage in America and her Certificate of Ancestry by DNA Print Genomics to discuss the sensitive topic of race in America.

This presentation will impact the forensic community and/or humanity by demonstrating evolving DNA technologies that can change the social and legal landscape of America. However, is the legal community ready to take up the challenge?

Since this nation's inception, you have been defined as black if you had any known African black ancestry. This became known as the "one drop rule," meaning that a single drop of black blood makes a person black. Some courts have referred to it as the "one black ancestor rule" or the "traceable amount rule." Anthropologists have designated it as the "hypo-descent rule," meaning that racially mixed persons are assigned the status of the subordinate group.

During the Jim Crow era, many southern states had race classification statutes. Louisiana's race classifications statute in 1970 defined anyone as black whose ancestry is more than one thirty second black. Sussie Phipps challenged this law in the suite filed as Jane Doe v. State of Louisiana. Despite her blond hair and blue eyes, Ms. Phipps' birth certificate indicated that she was "colored" which contradicted the white classification she had checked off on her passport application. Her relatives admitted in depositions that they considered themselves colored. In 1983, district court declared her legally black. The Louisiana State Fourth Circuit Court of Appeals upheld the district court's decision. The court ruled that a party could not change their racial designation or their parents: "That Appellants might today describe themselves as white does not prove error in a document which designates their parents as colored. Of course, if the parents designation as 'colored' cannot be disturbed, their descendants must be defined as black by the traceable amount rule." Although noting expert testimony to the effect that the race of an individual cannot be determined with scientific accuracy, the court said the law of racial designation is not based on science, that "individual race designations are purely social and cultural perceptions and the evidence conclusively proves those subjective perspectives were correctly recorded at the time the appellant's birth certificate was recorded." At the rehearing, the appellate court affirmed the necessity of designating race on the birth certificate for public health, affirmative action, and that equal protection had not been violated. The Louisiana Supreme Court in 1986 declined to review the lower courts decisions. In December of 1986, the U.S. Supreme Court dismissed the appeal for want of a substantial federal question. Consequently, the one drop rule still legally determines who is black in America.

Today, racial classification laws are voluntary. However, race information is still used for affirmative action and other important programs. Science does exist now where an expert can testify to the effect of the race of an individual based on Ancestry Informative Markers. The question is whether the one drop rule is ripe for reconsideration?

Louisiana Race Laws, Legal Issues, Ancestry Informative Marker (AIM)

BS2 The Pseudo-Medical Examiner and the Determination of Mode of Death: A Case History

Emanuel Tanay, MD, 2977 Philadelphia Drive, Ann Arbor, MI 48103*

After attending this presentation, attendees will learn that mode of death, unlike cause of death, cannot be determined by examining the body of the deceased. They will gain the conviction that mode of death determination, just like cause of death, is a subject that requires academic credentials and clinical experience.

This presentation will impact the forensic community and/or humanity by inspiring the forensic community to establish professional criteria for the position of medical examiner. Mrs. Yvette Sherman and Dr. Tanay hope to increase the empathy of the forensic community for the parents of a child who suffered untimely death as the result of his or her own behavior.

A County executive appointed a fireman (medic) to be the interim medical examiner for Brown County, WI. Raymond Sherman, the Green Bay Packers coach, and his wife, Yvette Sherman, had a fourteen-year-old son, Raymond, Jr. The father found his son in the garage with a fatal self-inflicted gunshot wound to the head. The medical examiner, Mr. Klimek, subsequent to an autopsy, issued a press release declaring that the youngster's death was suicide. Police investigation, forensic psychiatric reconstruction by Dr. Tanay, and the evaluation by a forensic pathologist, concluded that it was an accident. Mr. Klimek continued to insist to news media that it was suicide. A subsequent hearing before a trial judge determined that mode of death was accident. Nevertheless, Mr. Klimek issued another press release indicating that young Raymond's death was suicide. Mr. Klimek's sixteen-year-old daughter wrote a letter to the local paper, which was published, praising her father's courage to resist powerful forces in his effort to uphold the truth and professionalism. The controversy has had a great emotional impact upon the Sherman family, particularly Mrs. Sherman, the mother.

Retrospective diagnosis of the suicidal state of mind of someone who is deceased depends primarily upon information from those who have known the victim. Physical evidence and autopsy results may be consistent with suicide but are not diagnostic. Psychosocial information is essential for the making of a diagnosis of depressive illness, which is the underlying cause of suicide.

The gathering and interpretation of relevant psychosocial data requires a skilled professional. Such information has to be gathered and interpreted by professionals. Mrs. Sherman will discuss the impact this controversy has had upon her family and the community of Green Bay.

Medical Examiner, Mode of Death, Suicide

BS3 Follywood — Forensic Fakes or Real Cases: How Movies Manipulate Forensic Truth

Haskell M. Pitluck, JD, 573 Lake Avenue, Crystal Lake, IL 60014; Linda Kenney, JD*, 15 West 53 Street, Apartment 18 B, New York, NY 10019; James E. Starrs, LLM*, The George Washington University, 720 20th Street, NW, Washington, DC 20052*

After attending this presentation, attendees will understand the foibles of Hollywood influence on public thinking.

This presentation will impact the forensic community and/or humanity by presenting the deluge of forensic cases as epitomized by the movie studios to show to the audience that not only are movies are not real life, but you can't always believe what you see on television or in the movies.

Having received the Oscars for the last three years, the production team of Pitluck, Kenney, and Starrs – no guest appearances – will premiere their new movie "Follywood: Forensic Fakes or Real Cases; How Movies Manipulate Forensic Truth."

This year's breakfast will impart the audience with a deluge of forensic cases as epitomized by the movie studios. Is Oliver Stone's JFK real or false? Does the "Texas Chainsaw Massacre" or "Silence of the Lambs" capture the demented mind of Ed Gein? Is the "Ghost of Mississippi" a tale or a truth? This presentation will also veer into a Follywood stage set and discuss the news media. Do courtroom scenes as commented on by news anchors depict fact or fiction? Is the news coverage of events in the Middle East truth or lies? The audience this year will see the gamut from comedy to drama to documentary/docudrama. The viewer will determine whether Follywood is a mockumentary or reality.

Forensics, Reality, Manipulation

BS4 Houston, We Have a Problem: Burying Medical Examiner Mistakes

J.C. Upshaw Downs, MD, Coastal Regional Laboratory, Georgia Bureau of Investigation, 925A Mohawk Street, Savannah, GA 31419*

After attending this presentation, attendees will understand the history of medical examiner accreditation and certification and be familiar with the nature of practice standards in forensic pathology.

This presentation will impact the forensic community and/or humanity by assisting attendees to recognize danger signs of poor quality in forensic exams, specifically regards those conducted by the medical examiner. By developing a better understanding of the accreditation and certification processes, practitioners will develop an enhanced appreciation for and understanding of continued quality assurance efforts.

The public often perceives the forensic lab in general and the medical examiner (ME) in particular as infallible. Recent high profile cases have centered on the dangers inherent in such a false sense of confidence, particularly in homicide cases. In any human-based system, errors are inherent.

In the realm of the forensic pathologist, mistakes may well go unrecognized, as the proof of error is literally buried with the body. This is all the more tragic in that one of the arguments for establishment of a medical examiner system is the presumed reduction of incorrect death certification by lay coroners, the system supplanted by the ME.

In this era of "evidence-based medicine," one might reasonably ask what standards exist in the field (a point of significant interest within the ME community at present) to ensure that errors are detected before the evidence is "consumed in testing." What is the evidence that the pathologist got the right answer? Particularly in the current period of intense public interest in and enthusiasm for forensics as a whole, efforts to ensure adequate funding for the crime lab and medical examiner office are endangered by low-quality exams by unqualified and/or charlatan practitioners.

Utilizing several case studies, some common and not-so-common errors will be presented. The management dilemma in approaching recognized errors and "the problem scientist" will be addressed, specifically regards the approach to minimizing future mistakes and maximizing good science, to the benefit of all concerned parties.

Benefit: Attendees will understand how to recognize danger signs of poor quality in forensic exams, specifically regards those conducted by the medical examiner. By developing a better understanding of the accreditation and certification processes, practitioners will develop an enhanced appreciation for and understanding of continued quality assurance efforts.

Accreditation, Certification, Errors

BS5 The Death of Sir Harry Oakes

Ronald L. Singer, MS, Tarrant County Medical Examiner's Office, 200 Feliks Gwozdz Place, Fort Worth, TX 76104-4919; Richard C. Froede, MD*, 3930 N Placita de la Escarpa, Tucson, AZ 85750; Suzanne M. Froede, MA*, 3930 North Placita de la Escarpa, Tucson, AZ 85750*

The goal of this presentation is to describe the elements of inadequate investigation; understand the components of team investigation determine evidence and its value; and show what inadequate investigation anc court room preparation can do to a case.

This presentation will impact the forensic community and/or humanity by showing what inadequate investigation and court room preparation can do to a case.

Murdered in bed in his home in Nassau, Bahamas between midnight and dawn on the morning of July 9, 1943, Sir Harry Oakes was 68 years old at that time ass well as being one of the richest men in the world. His son-in-law, Alfred de Marigny, was accused of the murder, but later acquitted. The Duke of Windsor, who was the Royal Governor of the Bahamas, played a part in covering up clues that would have led to the real murderers. Harold Christie, a sometimes business partner of Oakes and the Duke, also appeared to be involved in the murder.

Oakes was shot four times in the head and the bed set on fire. The body was badly scorched. Incompetent and dishonest detectives from Miami were brought in by the Duke of Windsor. de Marigny was accused of the murder and made to stand trial. However, without any evidence the jury could not convict him.

Alfred de Marigny did escape a sentence in the Bahamas, but was forced to leave the islands. He had a difficult life and several attempts were made on his life. He was eventually allowed to enter the United States and became a citizen in 1975.

A number of books have been written about the murder: King of Fools (1988), Who Killed Sir Harry Oakes (1983), The Life & Death of Harry Oakes (1959), sometimes with conflicting information and interpretation. In the latest book, Alfred de Marigny has written the story of his life: A Conspiracy of Crowns. The book was co-authored with Mickey Herskowitz and published by Crown Publishers, Inc., in New York, in 1990. Not only does he describe his fascinating life before moving to the Bahamas, but also writes about the death of Sir Harry Oakes and of suppressed evidence and silenced witnesses. The information of the FBI and other American agencies about the characters involved add extra interest to the account.

Scotland Yard was never called in on the case and the British government has refused to reopen the case in spite of new evidence that has surfaced.

The facts and idea will be presented using narrative and slides.

Sir Harry Oakes, Investigation, Acquittal

BS6 Bacon, Eggs, and Arsenic

Suzanne Bell, BS, MS, PhD, Bennett Department of Chemistry, West Virginia University, 217 Clark Hall, Morgantown, WV 26505-6045*

After attending this presentation, attendees will have an understanding of one important aspect of the history of forensic science.

Arsenic has been called "inheritance powder" because of its nefarious uses. It is an ideal poison because it can be given in incremental small doses. The symptoms, when they appear, mimic those of infectious diseases that were rampant before the introduction of antibiotics. This is ironic given that arsenic preparations were used effectively as anti-microbial agents for thousands of years. Ancient Egyptians and 18th century Parisians valued the pale look that only an arsenic face cream could supply; Lewis and Clark packed along arsenic-based treat-

ments for diseases that resulted from their enthusiastic hands-on diplomacy along their journey.

This non-technical talk will tell the story of arsenic and how it defined early forensic science and forensic chemistry from Roman times to the Lafarge case, the first time chemical analysis was accepted by a court of law. This ground-breaking case was also the first time the testimony of a forensic scientist was commissioned and accepted by a court. This case did not stop homicidal poisoning, but it did bring it to light and demonstrated the value of everything from postmortem toxicology to quality assurance practices. It also drove poisoners to try different brews ranging from antimony and atropine to thallium and zinc. But once the race was on, chemists and toxicologists kept pace and as a result, poison is no longer the murder weapon of choice, having been replaced by high velocity lead poisoning. As will be seen, arsenic still has a devoted, if small, following. One of the most recent cases involved a poisoned breakfast.

History of Forensic Science, Toxicology, Chemistry

BS7 Sniper: How Digital Evidence Can Help Track and Convict the Bad Guy

Richard W. Vorder Bruegge, ScM, PhD, Federal Bureau of Investigation, Forensic Audio, Video and Image Analysis Unit, Engineering Research Facility, Quantico, VA 22135; Dara Sewell, BS*, Federal Bureau of Investigation, Computer Analysis Response Team, Engineering Research Facility, Quantico, VA 22135; Kenneth W. Marr, BSEE, MS*, Federal Bureau of Investigation, Forensic Audio, Video and Image Analysis Unit, Engineering Research Facility, Quantico, VA 22135*

After attending this presentation, attendees will understand how computer forensics, audio analysis, video analysis, and image analysis of digital evidence can be applied, including precautions, safeguards, and limitations when analyzing digital evidence

Many existing forensic disciplines employ newly developed digital techniques to conduct forensic examinations. Therefore, this presentation will impact the forensic community and/or humanity by providing recognition of the sources of digital evidence and describing the use of proper safeguards when examining digital evidence are of great importance to the forensic examiner.

Digital evidence is taking a more important role in law enforcement, especially in high visibility criminal prosecutions and in counterterrorism. Many existing forensic disciplines employ newly developed digital techniques to conduct forensic examinations. Digital evidence has been recognized as a forensic discipline by the American Society of Crime Laboratory Directors, Laboratory Accreditation Board (ASCLD/LAB). Therefore, recognition of sources of digital evidence and use of proper safeguards when examining digital evidence are of great importance to the forensic examiner.

This seminar describes several digital evidence examinations which when combined can provide crucial investigative insights and compelling criminal evidence. A fictional sniper case is presented with emphasis on several digital evidence examinations. The investigative process can use digital evidence results to identify links and associations that might otherwise have been overlooked; including, stolen identities, bank account passwords, encrypted file passwords, hidden computer data, surveillance video analysis, audio analysis of recorded background noise, and image enhancement.

Computer forensic examiners gather and analyze evidence from a suspect's computer hard drive and digital storage devices. Forensic principles of write-protection, imaging of computer data, precautions and limitations will be reviewed. Computer data analysis may reveal hidden or encrypted files stored on hard drives. Detection, recovery, and analysis of these hidden files require extensive training and experience of the CART examiner.

Audio analysis of a suspect's recorded telephone threat and other audio surveillance recordings, as well as digital audio files can provide significant investigative guidance. Some handheld digital recorders now interface with computers to download files of recorded conversations that in turn can be attached to email messages and distributed over the Internet. Header information in the digital audio files can reveal descriptors for file size and characteristics indicating possible hidden, embedded information in the files.

Video and image analysis employ digital evidence techniques during examinations of a suspect's facial comparison and height determination. Digital surveillance systems have special limitations that must be recognized and considered. Numerous issues confront the digital evidence examiner, including digital versus film resolution, compression, and documenting image enhancement operations. SWGIT Guidelines for acquiring, processing, analyzing, and preserving digital images will be reviewed.

Digital evidence examinations are crucial in today's counterterrorism society. A variety of resources exist for support when conducting digital evidence examinations. These include the Scientific Working Group on Digital Evidence (SWGDE) and the Scientific Working Group on Imaging Technologies (SWGIT), which have issued guidelines for digital evidence examiners.

Digital Evidence, Computer Forensics, Audio/Video Analysis

BS8 Tom Krauss Memorial Bite Mark Breakfast: Forensic Witnesses and Their Vital Role in Special Victims Prosecutions

Yolanda L. Rudich, Esq, Sex Crimes/Special Victims Bureau, Richmond County District Attorney, 130 Stuyvesant Place, Staten Island, NY 10301*

Special victims cases are among the most difficult for a District Attorney's office to prosecute. Sex crimes, child abuse, domestic violence and crimes against seniors often are committed in places that are isolated from any witnesses. The victims are among the most vulnerable, often presenting physical and emotional impediments to gathering the required proof beyond a reasonable doubt.

Increasingly, prosecutions are dependent upon forensic evidence, either as independent proof of criminal culpability or as legally necessary corroboration of witness testimony. Moreover, the popularity of TV shows such as "CSI" has persuaded jurors that such evidence is available and should be presented for their consideration.

Thus, the role of the forensic witness has become critical in successful prosecutions. If the evidence obtained by these witnesses is to be most effectively presented within the criminal justice system, both prosecutors and forensic experts must have a clear picture as to how such evidence should be gathered and reported.

Additionally, as professionals esteemed beyond the laboratory, you can embark on proactive programs in partnership with members of the criminal justice system that will help prevent crime in your own communities.

Forensic Witnesses, Prosecution, Special Victims

BS9 Mmmmmm....MANCHESTER (Murder, Manslaughter, Medicolegal Machinery, Myth, and Mayhem in Manchester, United Kingdom)

John D. Rutherford, BSc, MB ChB, FRCP (Edin), FRCPath, DMJ, Salford Quays Forensic Pathology, PO Box 378, Salford, Greater Manchester M50 3UX, United Kingdom*

This study concerns the ten year period from January 1993 to December 2002. Autopsy reports were examined for all the "suspicious" deaths in Manchester (population approximately 2.75 million), United Kingdom. The outcome of the medicolegal process was established by pursuing these cases through the court records system.

Approximately 1500 fatal cases fulfilled contemporary criteria of "suspicious". Roughly one third of the cases initially deemed to be "suspicious" turned out to be the result of criminal activity and, therefore, classified as "unlawful killing" of one sort or another.

The ratio of "unlawful killings" to the total "suspicious deaths" (year by year), the causes of death, and the ways in which the coroners and criminal courts classified them will be outlined in the presentation. Inconsistencies in the classification system will be highlighted, some cases being difficult to categorize, raising the question of whether new terminology should be introduced.

Although the recorded causes of homicide are proportionally different for the USA and the UK (mainly related to differences in availability of firearms) the criminal justice system in both countries relies upon the adversarial model which has intrinsic advantages and disadvantages. However, the focus is not on a comparative international study but hinges around potential criminal cases being missed by the British system, which derives from a coronial structure dating back to the thirteenth century. A classic example of such missed criminal activity was that of Dr Harold Shipman, Britain's most prolific serial killer, who murdered in excess of 200 of his own patients before detection; there have been other, less high profile, individual cases.

The initial classification of a death as "suspicious" or "non-suspicious" (with consequent detailed investigation or virtually no investigation) is a crucial point at which mistakes can be made and potential criminal cases missed. A different system might stand a better chance of picking up otherwise undiscovered homicides.

Serious questions arise such as "who should decide what is a suspicious death?", "if the right people are not now making such decisions, then who should?", "how do we attain consistency in the definitions of cause and manner of death?" and "has the advent of high technology at the turn of the 21st century made any significant difference to the end result (i.e. the court outcome) of the medicolegal process?".

In keeping with the AAFS 2005 theme, this study straddles the turn of the century and is particularly relevant because at this meeting there is a focus on 21st century technology to combat crime. This presentation underlines the need for 21st century organizational thinking to run parallel with 21st century forensic science in order to revise ways of approaching the "Death Management System" from the first call for help from the bereaved relative right through to the final outcome in court.

Death Investigation, Homicide, Technological Advance

BS10 The Investigation of the Kidnapping of Danielle van Dam: The Physical Evidence Perspective

Jennifer Shen, San Diego Police Department Crime Laboratory, 1401 Broadway, MS 725, San Diego, CA 92101; Tanya DuLaney, BS, San Diego Police Department Crime Laboratory, 1401 Broadway, MS 725, San Diego, CA 92101*

The goal of this presentation is to illustrate using a highly publicized trial, the importance of evidence collection, analysis, and presentation in court. In particular, this presentation highlights the importance of trace evidence in establishing contact timelines between the suspect and victim in this case.

Due to the fact that the entire trial was televised we were able to, after the fact, select important points to emphasize in our presentation and demonstrate the types of direct and cross-examination a trace evidence analyst can expect in a trial of this magnitude. The issues of contamination, fiber and hair transfer, and significance of associations were addressed and are important and relevant topics.

In the morning hours of February 2, 2002, a little girl was discovered missing from her bed. Thus began a massive search and a herculean effort by law enforcement agencies and citizens all over San Diego to find Danielle and bring her home. When her neighbor, David Westerfield, was identified as a suspect and her body was found, a series of events began to unfold, involving the San Diego Police Department and its crime laboratory in an investigation with time constraints and scrutiny unlike anything it had ever experienced. Crime laboratory personnel responded to scenes at the van Dam home, David Westerfield's home, his motor home, his SUV, and the body recovery site. Westerfield was interviewed and polygraphed. Hundreds of pieces of evidence were collected, itemized, and analyzed. Suspicious behaviors, an unreasonable alibi, child pornography, and a failed polygraph, combined with Danielle's blood on Westerfield's jacket and in his motor home, gave the police sufficient cause to arrest him for the kidnapping and murder of Danielle van Dam.

As the preliminary hearing approached, laboratory personnel worked feverishly to find more evidence. Latent prints located in the motor home above the bed were identified as Danielle's. The blood and fingerprint evidence were presented at the preliminary hearing and Westerfield was bound over for trial. As the DA decided to seek the death penalty, the Westerfield defense insisted on a speedy trial, giving the crime lab only a few months to search through mountains of evidence. Danielle's hair, her dog's hair, carpet fibers, and clothing fibers began to emerge from the analyses. It then became necessary to prove that the evidence portrayed a recency of contact between the victim and suspect, and that the evidence was not transferred in an innocent fashion.

In the end, after thousands of man-hours, involvement by nearly every laboratory section, and a grueling time schedule, David Westerfield was convicted of kidnapping and murdering Danielle and was sentenced to death.

Kidnapping, Trace Evidence, Court Testimony

BS11 On The Track of La Pérouse or the Unknown Man of Vanikoro

Yves Schuliar, MD, Institut de Recherche Criminelle de la Gendarmerie Nationale, 1, Boulevard Theophile Sueur, Rosny-Sous-Bois, 93110, France; Jean-Noel Vignal, PhD, Ircgn, 1 Boulevard Theophile Sueur, Rosny-Sous-Bois, 93110, France*

After attending this presentation, attendees will understand the role of the forensic sciences to help to find, to examine and to identify the skeleton of an individual who participated to a famous historical naval expedition in 1784.

This presentation will impact the forensic community and/or humanity by demonstrating the interest of the cooperation between archeologists and a medico-legal team for the identification of historical cases.

In 1784, Louis XVI, King of France, known as the "Sailor King" decided to organise an expedition to seach for the Northwest Passage from the Pacific side and to explore along the coasts of America, China, and Siberia and in the South Seas. He assigned a French navy veteran of the American War for Independence, the Comte Jean-François de Galaup de La Pérouse to undertake the expedition.

Leading two ships, "La Boussole" and "L'astrolabe", Jean-François de Galaup de La Pérouse initially explored the Russian and the Japanese coasts. Then the ships eventually left Australian shores on the 10th of March 1788. At that time, crews did not give any sign of life. Two hundreds sailors, scientists and officers of the King vanished.

After several years of research, both shipwrecks were found on the VANIKORO Island. In November 2003, the Neo-Caledonian association "Salomon" found out, during an expedition in a coral reef, many ship parts among with an almost complete skeleton.

After specifying its discovery conditions (a film will present the recovery expedition), authors describe the work carried out by a multidisciplinary team which studied the skeleton. The following points are discussed :

- anthropological study
- thaphonomical study
- osteopathological study
- post mortem delay assessment
- odontological study
- facial reconstruction
- DNA profile analysis

Hypotheses about the body's identity are expressed, with respect to the expedition historical data.

Submarine Archeology, Forensic Anthropology, Facial Reconstruction

Luncheon Seminars

L1 Frank Davis Cooks Naturally N'Awlins

Frank Davis, WWL-TV Channel 4 Office, 1024 North Rampart Street, New Orleans, LA 70116-2487

From the heart of the historic French Quarter, from deep in the bayou country of southeast Louisiana, AAFS is proud to present Frank Davis, the absolute authority on New Orleans, Cajun and Creole cooking and one of the city's most recognizable television chefs, cookbook authors, and gourmets.

Born and raised in the heart of the Crescent City, Frank Davis began cooking New Orleans food at eight years old and hasn't stopped since. Working with a number of notable chefs, Frank developed a unique culinary style of his own that can only be described as "Strictly N'Awlins."

In 1976, Frank Davis brought the Strictly N'Awlins style to WWL Radio for its first "live" two-hour-call-in cooking show. After five years on the air, he moved from radio to WWL TV and began airing "In The Kitchen with Frank Davis" in the two-hour morning news show. It's still attracting an immeasurable morning audience and pulling unbelievable rating points.

Frank wrote his first cookbook, "The Frank Davis Seafood Notebook," in 1983. His second one, "Frank Davis Cooks Naturally N'Awlins," came along in 1990. They both achieved "best-seller" status rapidly. His latest creation is "Frank Davis Cooks Cajun, Creole, and Crescent City." It, too, is selling like the proverbial hotcakes all over the country! He is presently working on his next book, "Frank Davis Cooks N'Awlins Homestyle." Plans are to have it ready sometime later this year.

Cooking, Frank Davis

L2 What's on the Menu

Jason H. Byrd, PhD, Office of the Medical Examiner, 1360 Indian Lake Road, Daytona Beach, FL 32124*

After attending this presentation, attendees will gain an understanding of the Defect Action Levels allowed for food items.

This presentation will impact the forensic community and/or humanity by providing the realization that insects are a common part of a well-balanced meal.

Many societies have a social stigma against consuming insects as a food source. Our modern society may top the list of cultures having an aversion to "entomophagy", the act of utilizing insects as food. However, our diet is more varied than we may imagine, and most of us unknowingly consume insects on a daily basis, as insects are a routine portion of our diet. Unfortunately, becoming aware of this simple fact may not allow you to avoid the inevitable. The United States Food and Drug Administration Center for Food Safety and Applied Nutrition establishes the maximum levels of natural or unavoidable defects in foods for human use that present no health hazard. Commercially processed egg, meat, and poultry products are regulated by the United States Department of Agriculture's Food Safety and Inspection Service. Contaminants of fruits, vegetables, and other plants are regulated by the USDA's Animal and Plant Health Inspection Service. Such levels are set because it is "economically impractical to grow, harvest, or process raw products that are totally free of non-hazardous, naturally occurring, or unavoidable defects". This presentation focuses on the insect particulate matter present in the food we eat.

Insects, Food, Defects

L3 Justice From Both Sides of the Courtroom: From Homicide Detective to Criminal Defense Attorney

Karen F. Ross, MD, Jefferson Parish Forensic Center, Harvey, LA 70058; Edward J. Rantz, JD, Rantz and Associates, 1515 Poydras Street, New Orleans, LA 70112`; Karen F. Ross, MD*, Jefferson Parish Forensic Center, 2018 8th Street, Harvey, LA 70058; and Eric J. Hessler, JD*, 201 South Galvez Street, New Orleans, LA 70119*

The pursuit of justice is a driving force in the lives of many in the various disciplines of forensic science. After attending this presentation, attendees will be introduced to two former homicide detectives for the New Orleans Police Department now attorneys whose practice includes criminal defense.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of the pursuit of justice from both the prosecution and defense viewpoints.

These men have had the unique opportunity to participate in the criminal justice system on part of both the prosecution and the defense. They will relate their experiences as key fact witnesses for the state including some highly publicized cases such as that of a NOPD officer who was convicted of murdering a fellow officer and was sentenced to die. Both have also been involved in fatal shootings where they were forced to take the life of another person, so they may explain first hand what it is like to endure the scrutiny of criminal justice from that point as well.

As criminal defense attorneys they continue to pursue justice, but from the other side of the courtroom, maintaining the position that all are entitled to an adequate defense and a trial before their peers as the system intends.

Justice, Criminal Defense Attorney, Homicide Detective

Workshops & Workshorts

W1 There is "Gold" in Mold: Forensic Evaluation and Litigation Issues in Mold and Indoor Air Pollutant Claims

Mohan Nair, MD, 5212 Katella, Suite 106, Los Alamitos, CA 90720; Robert Weinstock, MD*, 10966 Rochester Avenue, #4C, Los Angeles, CA 90024; Ajit S. Arora, MD, PhD*, UCLA, 8660 Woodley Avenue, North Hills, CA 91343; Ashok Jain, MD, MPH*, USC Medical School, 237 St. Albans, South Pasadena, CA 91030; and David Gyepes, JD, PhD*, 1990 South Bundy Drive, Suite 320, Los Angeles, CA 90025*

After attending this presentation, participants will learn about the growing "toxic mold industry." They will learn how to evaluate from medical, toxicologic and neuropsychiatric aspects of toxic mold claims. The connection between claims of mold related illness to other forms of abnormal illness behavior, and syndromes such as multiple chemical sensitivity, sick building /new building, fibromyalgia and chronic fatigue will be addressed.

Mold spores are present in all indoor and outdoor environments and cannot be eliminated. Of more than 50,000 species of fungi, only about 150 are known to be human pathogens. While mold mycotoxins can cause mucosal irritation, there is no clear evidence of chronic, nonmucosal pathology in human beings, even in water-damaged buildings. Mold related litigation is described as "the next big thing" after asbestos.

Between 1999 and 2001, there has been a thousand-fold increase in toxic mold-related insurance claims. A query on Google showed 114,000 hits for the term "Toxic Mold Neuropsychiatric." These key words showed zero hits on Psych info and Medline.

A third of the 600 million dollar homeowner claims paid out by Farmers Insurance in the state of Texas over the past two years was mold related. California became the first state in the nation to legislate mold-related regulations, i.e., the Toxic Mold Protection Act, SB732, 2001. The magnitude of payouts have led to major insurance companies excluding coverage for mold related damage

Though sometimes serious, physical illness in toxic mold claims is often of short duration. Attorneys and doctors with high profile toxic mold practices often emphasize n.europsychi.atric claims of disability and suffering from physical problems. This is especially true when there are a few robust findings on laboratory and physical examination. Allegations of brain damage are made on the basis of nonreplicable anecdotal and idiosyncratic interpretation of technologies, such as SPECT, PET and neuropsychological testing that often do not meet *Daubert* Standards. Body fluids are often sent for expensive and obscure tests. Findings of illness and disability may not be substantiated by face-to-face examination, the patient's account of day-to-day functioning, on independent psychological testing, as well as by reviewing prior medical records and depositions. There is often evidence of pre-existing and concurrent factors, unrelated to the mold exposure in these individuals. Dr. Arora will cover key points in the medical examination. Dr Jain will discuss the toxicology of mold mycotoxins and factors *in the* physical and laboratory examination.

Dr. Nair will present the steps in the psychological/psychiatric examination, and review of records Controversies in psychological/-neuropsychological testing and neuroimaging findings will be discussed.

Attorneys, toxicologists, occupational environmental medicine and mental health professionals who conduct Independent Medical and Psychiatric Examinations will benefit from this workshop.

Mold, Indoor Air Pollutants

W2 Forensic Bone Histology

Helen Cho, PhD, Davidson College, PO Box 6934, Davidson, NC 28035-6934; Robert R. Paine, PhD*, Texas Tech University, Department of Sociology, Anthropology, and Social Work, Lubbock, TX 79409; Douglas H. Ubelaker, PhD*, and Dawn M. Mulhern, PhD*, National Museum of Natural History, Smithsonian Institution, Department of Anthropology, Washington, DC 20560; and Samuel D. Stout, PhD*, Ohio State University, Department of Anthropology, 124 West 17th Avenue, 244 Lord Hall, Columbus, OH 43210-1364*

Upon completion of this workshop. the participant should have a better understanding of various applications of quantitative and qualitative histology of human skeletal tissue to aid in the identification of the unknown individuals.

Much can be gleaned from skeletonized human remains, even if they are extremely fragmentary. This presentation will impact the forensic community and/or humanity by demonstrating how standard osteological methodologies coupled with specialized techniques. such as bone histology, can improve the likelihood that unknown skeletal remains will be identified.

Histology, Bone, Microstructure

W3 Educating Forensic Scientists for the 21st Century: Instilling the Forensic Mindset

Suzanne Bell, PhD, West Virginia University, Bennett Department of Chemistry, 217 Clark Hall, Morgantown, WV 26506-6045; Richard E. Tontarski, PhD*, ATF, Fire Research Laboratory, 6000 Ammendal Road, Beltsville, MD 20705; Sherry Brown, MS*, York College of Pennsylvania, Physical Sciences Department, York, PA 17405-7199; Aaron L. Brudenelle, BA, MS*, Tucson Police Department Crime Laboratory, 270 South Stone, Tucson, AZ 85701; Robert E. Gaensslen, PhD*, University of Illinois at Chicago, Forensic Science (M/C/866) College of Pharmacy, 833 South Wood Street, Chicago, IL 60612; Max M. Houck, MA*, Forensic Science Initiative, West Virginia University, 999 Chestnut Ridge Road, Morgantown, WV 26506; Linda A. Lewis, PhD*, Oak Ridge National Laboratory, 113 C Union Valley Road, Oak Ridge, TN 37830; Keith Morris, PhD*, c/o Suzanne Bell, PhD, West Virginia University, Bennett Department of Chemistry, 217 Clark Hall, Morganton, WV 26506-6045; Heather J. Schafstall, MS*, Oklahoma State Bureau of Investigation, 2132 NE 36th Street, Oklahoma City, OK 73111; Susan Scholl, MS*, New Mexico Department of Public Safety, PO Box 1628, Santa Fe, NM 87504-1628; and Kelli Sikorski*, c/o Suzanne Bell, West Virginia University, Chemistry/Forensic Science, 217 West Clark Hall, Morgantown, WV 26506-6045*

The goal of this presentation is to assist attendees to design courses and course activities that serve the needs of students and the profession; understand the need for and foster the development, academic rigor, and acceptance; and define and understand the forensic mindset and use it to guide course and curriculum development.

This presentation will impact the forensic community and/or humanity by assisting forensic educators in designing courses and curricula to meet the unique needs of forensic sciences as a career. It will also foster efforts to increase the academic rigor of forensic science with an emphasis on forensic chemistry. It will also provide a forum for practitioners and educators to discussion joint interest and opportunities.

The Technical Working Group on Education (TWGED) and the Forensic Science Education Programs Accreditation Committee (FEPAC) has done a laudable job of specifying the curricular requirements of a forensic science program. With the framework in place, attention is turning to execution. Educators, many of whom have not worked in the field, need guidance from the profession to flesh out the framework with meaningful courses, lectures, labs, and practicums. This need is particularly pressing in upper division and graduate-level courses where such materials are scarce to non-existent. However, with a need comes many opportunities.

New analysts should leave university with a skill set unique to forensic science. This includes the ability to present meaningful testimony and reaching beyond the borders of their specialities. Instilling these skills, collectively the forensic mindset, is a challenge that forensic educators must rise to. This workshop will assist in this by defining and discussing the elements of the forensic mindset and offering practical ideas and suggestions for developing it in students. The primary goal of this workshop is to assist educators in fleshing out the framework of their programs and courses. Presenters will discuss and define the elements of the forensic mindset and offer practical guidance and suggestions for how to instill it within the context of an academic program.

A second goal of the workshop is to discuss the need for academic acceptance of forensic science. Those who have crossed the great divide from forensic labs into the academic world are under pressure to increase the rigor of forensic science, particularly when it is incorporated into traditional disciplines and departments such as chemistry and biology. Many such departments regard forensic science/forensic chemistry/forensic biology as little more that "blood spatter and crime scenes," a misconception fueled by popular television shows and the flood of students generated. Overcoming this stereotype is vital for the field and can open new opportunities for research, funding, and collaboration. Courses need to be designed with this in mind. Conversely, successful courses and applications can capitalize on student interest and foster appreciation of science regardless of the student's major or career plans.

The morning session will present overviews and ideas from the perspective of students, educators, supervisors, and practitioners. The afternoon will delve into the nuts and bolts of course design, focusing on upper division courses. The discussions and applications have a chemistry flavor but the overriding principles and themes are broadly applicable.

The target audience for this workshop are educators involved in or contemplating the launch of a forensic science program. Forensic supervisors,practitioners, and students with an interest in forensic education will also find much material of interest.

Forensic Education, Professional Training, Continuing Education

W4 Anatomical, Pathological, and Physiological Foundations of Toxicity

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The goal of this presentation is to describe the anatomical systems of the body and how each functions; provide understanding of how toxins adversely affect the body and each of its anatomical systems; and discuss the common mechanisms, sign and symptoms, pathological findings, and actions of a toxin when it enters the body.

This presentation will impact the forensic community and/or humanity by serving to provide a foundation for forensic toxicologists and other interested parties so they may understand how and why agents can be toxic. It will marry the knowledge and observations of forensic pathologists with those of forensic toxicologists to aid in accurate Medical Examiner conclusions for cause and manner of death.

Forensic Scientists evolve from a plethora of educational backgrounds that have not always provided a complete foundation for understanding the mechanism of toxicity by first comprehending how the body functions. This workshop can serve as a review, an introduction, or a continuing educational experience by offering an overview of anatomy, physiology, and pathology and an explanation of how each of these scientific fields are relevant to the basic knowledge of toxicity.

The workshop will begin with a general description of anatomy. The speaker will highlight each of our body's systems at the gross and cellular level. One-by-one anatomical systems such as the nervous, cardiovascular, musculoskeletal, gastrointestinal, respiratory, hepatic, renal, endocrine, and reproductive will be discussed. Once the body's anatomical depiction is complete, the discussion will progress to the next topic of how toxins affect each of these systems.

A forensic pathologist will explain how toxins adversely affect the body on a physiological and pharmacological level. Mechanisms of toxicity for specific anatomical regions will be discussed in detail including signs and symptoms, pathological findings, and pharmacological causes. For example, answers to questions such as: What exactly is pulmonary and cerebral edema and what causes them to occur when a CNS depressant is ingested in excess? What other pathological findings would be expected in cases involving pulmonary and cerebral edema? What other causes of death are consistent with these pathological findings and must be disproved before a pathologist rules the death toxicologically related? will be discussed.

To further illustrate how toxins act on the body, specific agents will be discussed to explain how and why they kill or lead to serious and long-term injury. Considerations such as the route of administration, dosing history (e.g., acute vs. chronic, tolerance vs. non-tolerance) and drug-drug interactions all contribute to how and why a drug kills in one instance or individual but not another. These considerations are easier to explain once the foundations of anatomy, physiology, and pathology have been established.

Finally, the panel of speakers will reconvene to address questions and further discuss topics of interest with the audience. At the conclusion of this workshop, the attendee will have a better understanding of how the body functions anatomically and physiologically, in addition to understanding how toxins act on and adversely effect the body.

Anatomy of Toxicity, Physiology of Toxicity, Pathology of Toxicity

W5 Forensic Digital Evidence: Current and Prospective Scientific and Legal Issues

Anjali R. Swienton, MFS, JD, SciLawForensics, Ltd., 25 Walnutwood Court, Germantown, MD 20874; Gregory L. Hill, JD*, PO Box 451568, Kissimmee, FL 34745-1568; Susan W. Brenner, JD*, University of Dayton School of Law, Juseph E. Keller Hall, Room 421, Dayton, OH 45469-2772; Erin E. Keanneally, JD, MFS*, University of California, San Diego, San Diego Supercomputer Center, 9500 Gilman Drive, LaJolla, CA 92093-0505; Michael J. Menz, BS*, Hewlett Packard & Sacramento High Technology Crimes Task Force, 4510 Orange Grove Avenue, Sacramento, CA 95841; Fred C. Smith, JD*, Assistant United States Attorney, Federal Office Building, PO Box 607, Alburquerque, NM 87102; Michael C. Weil, MBA*, Huron Consulting Group, 550 West Van Buren, Chicago, IL 60607*

After attending this presentation, attendees will have a basic understanding of some digital evidence investigatory strategies and examination procedures as well as evidence admissibility issues related to digital evidence

This presentation will impact the forensic community and/or humanity by opening discourse within the forensic community on timely issues related to accreditation of digital evidence laboratories, validation of examination techniques and trial strategies for trials involving various types of digital evidence.

Currently, forensic digital evidence is anything but a science and is primarily an art, with few accepted techniques, standards of competence and performance and published data as to validity and reliability of results.

Despite the increase in commercially available digital forensic tools and techniques, its introduction and use in the courtroom in criminal cases is largely limited to computer child pornography and Internet stalking cases. Digital forensic evidence is beginning to be introduced into the courtroom in murder, fraud, extortion, securities, and espionage cases. Meanwhile, digital forensics are employed in nearly every major white collar investigation and many aspects of complex civil litigation.

A common theme that will begin to evolve as more and more cases are litigated, regardless of whether the case is criminal or civil, will be the attempt to develop accepted standards of reliability and validity to avoid Daubert challenges to digital evidence as a required routine in nearly every case.

Challenges regarding the technology, ability of technological tools to access and recover such "evidence", limitations or deficiencies in such tools to access and recover "evidence", qualifications of the individual utilizing the tools and the ability of lay and expert witnesses to testify and effectively communicate in court about all of these matters will continue for the foreseeable future.

Various interested sectors, including the network security application industry, have developed their particular niches and parameters for use of forensic tools and techniques. Digital forensics is beginning to be recognized as an area ripe for investigation and research.

The workshop will place the rapidly changing and abstract landscape of litigation involving digital forensic evidence, into a more comprehensible and realistic picture and will be presented in four segments.

The first segment will provide the attendee with an introduction to the field of forensic digital evidence, general terminology, widely used and tested tools, techniques, and their known limitations for the production and analysis of admissible forensic evidence.

The second segment will be presented in the format of a criminal trial which will deal with several frequently encountered aspects of the problem of presenting admissible forensic digital evidence in the courtroom. Case facts derived from an actual case will be customized, with checklists and actual decision summaries to bring to life the concrete past examples and also provide guidance for handling future problems.

A third segment will include a panelist discussion to assess the current status and prospective issues in forensic digital evidence. The panel includes: a prosecutor, a defense attorney, an academic legal scholar, a technical expert, an investigator, and an examiner. Each panelist will address certain issues relative to their area of expertise.

Finally, a group discussion, with the attendees participating and presenting their own problems in advance to the panel for discussion and feedback will close out the session.

At the conclusion of the workshop the participants should possess a basic understanding of the current status of forensic digital evidence and the scientific and legal issues that have been litigated to date. Through the panel presentations and group discussion, the forensic science community should be able to further explore the development of digital evidence to enhance its usage and reliability in the courtroom.

Digital Evidence, Technical Expert Testimony, Criminal Trial

W6 Serial Homicide, Myths, Legends and Facts

Robert J. Morton, MS, FBI NCAVC, FBI Academy, Quantico, VA 22135; James J. McNamara, MS*, FBI NCAVC, FBI Academy, Quantico, VA 22135; Mary Collins-Morton, BS*, FBI Washington Field Office, 601 4th Street, Northwest, Washington, DC 20535; and Gerard F. Downes, BS*, SSA - FBI NCAVC, FBI Academy, Quantico, VA 22135*

The purpose of this workshop is provide investigators and medico-legal professionals with an understanding of serial murderers, their motives, methods of operation, victim selection, and body disposal scenarios highlighted through case examples. The focus of the workshop is on the practical issues involved in investigating and analyzing the actions of a serial murderer, the benefits of input from different disciplines and the need for cooperation between professionals.

This presentation will impact the forensic community and/or humanity by providing participants a greater understanding of the "truth" about serial homicide, to include, the scope of serial murder, serial offenders and motivation, methods of operation, victim selection, body disposal, forensic techniques and collection strategies pertinent to serial homicide, and cooperative investigative strategies useful to successful case resolution.

This workshop is targeted at providing investigators and medico-legal practitioners with a broad base of knowledge concerning serial murder, as well as a thorough understanding of the nature of serial offenders. Workshop will include a discussion of serial murder and it's parameters, motivations of serial offenders, forensic issues and investigative issues. Workshop discussions will be augmented by numerous case examples, including several "high profile" cases.

Serial homicide has long been an issue that generates much attention, from law enforcement, mental health practitioners, medico-legal professionals, and the media. There are a plethora of opinions. Law enforcement regard serial homicide as a painful anomaly, mental health practitioners look for causes, medico-legal professionals struggle with the results and the media inflates serial homicide into an epidemic. It's no surprise that many myths and legends abound concerning serial killers.

The FBI's National Center for the Analysis of Violent Crime (NCAVC) is routinely consulted by federal, state and local authorities in a variety of cases of violent crimes, especially bizarre or serial homicides. The NCAVC has had extensive experience in assisting federal, state, and local law enforcement agencies in the investigation of serial homicides, and has reviewed hundreds of serial homicide cases for research purposes. Currently, the NCAVC is engaged in several research projects on serial offenders, including interviews of incarcerated serial offenders. The material presented in this workshop is based upon actual case experience, ongoing research, and current interviews with serial offenders.

Serial Homicide, Serial Murderer, Victimology

W7 Tutorial and Panel on Engineering Evidence and Lay Testimony

Richard W. McLay, PhD, PE, University of Iowa, 1231 Hamilton Court, Iowa City, IA 52245; Robert N. Anderson, PhD, PE*, RNA Consulting, Inc., 27820 Saddle Court, Los Altos Hills, CA 94022; Donald J. Anderson, BS*, Anderson Engineers, 13176 Pierce Street, Blain, MN 55434; Joe S. Cecil, PhD, JD*, Division of Research, Federal Judicial Center, One Columbus Circle, NE, Washington, DC 20002-8002; Laura L. Liptai, PhD*, Biomedical Forensics, 1660 School Street, Suite 103, Moraga, CA 94556; Joseph J. Maltese, JD, MJS*, New York Supreme Court, Home Port Court House, 355 Front Street, Staten Island, NY 10304; Andre A. Moenssens, JD, LLM*, The University of Missouri, 1760 East Poplar Road, Columbia City, IN 46725; Donn N. Peterson, MSME, PE*, Peterson Engineering, PO Box 47565, Plymouth, MN 55447-0565; David V. Scott, JD*, Scott, Forrest, and Bourne, PO Box 785, New Albany, IN 47151-0785; Thomas J. Vesper, JD*, Westmoreland, Vesper, Schwartz, and Quattrone, Bayport One, Suite 500, 8025 Black Horse Pike, West Atlantic City, NJ 08232; and Timothy W. Waldeck, JD*, Waldeck & Lind Law Firm, 1400 TCF Tower, 121 South 8th Street, Minneapolis, MN 55402*

After attending this presentation, attendees will understand the three forms of engineering evidence and be able to evaluate lay engineering testimony and opinions.

This presentation will impact the forensic community and/or humanity by demonstrating how a major problem with engineering testimony has been that laymen without proper training, using improper scientific methods, have been allowed to give engineering opinions in both criminal and civil cases. With the 1993 U.S. Supreme Court Decision on *Daubert* and the companion decision on *Kumho Tire vs. Carmichael*, methods have become available to challenge laymen giving questionable engineering testimony. The impact on our society and on humanity in general for this workshop will be to propose methods of fairness in evidence.

This program, in two parts, presents: tutorials on engineering methods for use in accident reconstruction and a panel on lay engineering testimony. The tutorials are on technical content and precedents in the law:

- Engineering fundamentals are presented for momentum and energy.
- Biomechanics principles for accident reconstruction are illustrated.
- Mapping in engineering analysis is shown to be crucial for records.
- Simulation in vehicle impact and non-contact motion is presented.
- Failure analysis of vehicle components is shown to be a factor in analysis.
- Deposition methods for inquiring of lay engineering testimony are shown.
- *Daubert* challenges are presented for engineering evidence.
- Precedents in engineering evidence are presented.

The panel discussion will focus on lay engineering testimony and the methods to be used to ensure that the evidence is good science and engineering. The speakers will be joined by the author of the amicus curiae brief for engineers, submitted to the U.S. Supreme Court in *Kumho Tire vs. Carmichael*; a Justice of the New York Supreme Court; and the Director of The Evidence Project at the Federal Judicial Center.

A CD-ROM handout will include abstracts of the presentations.

Engineering Evidence, Engineering Methods, Lay Testimony

W8 Practical Homicide Investigation: Tactics, Procedures and Forensic Techniques

Vernon J. Geberth, MS, MPS, P.H.I. Investigative Consultants, Inc., PO Box 197, Garnerville, NY 10923; and Robert D. Keppel, PhD*, Sam Houston State University, Box 2296, Huntsville, TX 77341-2296*

Upon completion of this workshop, the participants will have an understanding of the practice and theory of professional homicide investigation; they should better understand pertinent legal decisions, multiple crime scenes, components of a murder investigation, how time and distance as solvability factors affect murder cases, the management of the homicide investigations and the processing of the homicide crime scene.

The instructors for this workshop have many years of homicide investigation experience. Currently, they both teach law enforcement officers from around the country about practical homicide investigation. At the Academy of Forensic Sciences, that same information can be passed on the forensic scientists from all disciplines. This presentation will impact the forensic community and/or humanity by providing forensic scientists with an understanding of the most modern techniques and procedures homicide investigators utilize to solve murder cases.

Specifically, Commander Geberth will cover the practice and theories of professional homicide investigation involving equivocal death investigation, the homicide crime scene, the general and specific duties of the first officer, and duties at the crime scene for detectives.

Dr. Keppel will focus on the empirical research on solvability factors in murder investigations. His presentation will show that the more information on the times and distances separating where the victim was last seen, the locations of the original contact between the victim and the killer, where the initial assault occurred, the murder site and the body site the more likely a murder case will be solved.

The workshop also informs participants about managing the homicide case and the homicide crime scene process. This will include the use of blood enhancement reagents, the recognition and management of wound structures in shootings, stabbings, blunt force injuries and deaths by asphyxiation.

The workshop concludes with a "who-done-it" and "who-is-it" rape-murder case presentation in which the victim was found in a wooded area with no identification and no immediate evidence leading to the killer. The participant will be taken through the entire investigative process from the finding of the body to the arrest of the suspect, using information about the site locations and the evidence at each site to identify the suspect and connect the suspect to the victim and, ultimately, resolve the case.

Homicide, Murder, Solvability

W9 Analysis of Samples From Clandestine Methamphetamine Laboratories

Sanford A. Angelos, MSc, MEd, and Camala L. Dubach, BSc*, U.S. Drug Enforcement Administration, 536 South Clark Street, Room 800, Chicago, IL 60605; David W. Love, BS*, U.S. Drug Enforcement Administration, South Central Laboratory, 10150 East Technology Boulevard, Dallas, TX 75220-4377; Nelson Santos, BA, MPA*, U.S. Drug Enforcement Administration, North Central Laboratory, 536 South Clark Street, Chicago, IL 60605, and Harry F. Skinner, MS*, U.S. Drug Enforcement Administration, Southwest Laboratory, 2815 Scott Street, Vista, CA 92081*

The goal of this presentation is to present an overview of the predominant concerns surrounding the analysis of samples from clandestine methamphetamine laboratories. The attendees will receive information on the legal background and current status of methamphetamine as well as court testimony and production capacities of clandestine laboratories. This workshop will provide general information on current clandestine laboratory synthesis methods and specific protocols for the sampling and

analysis of clandestine laboratory exhibits. Various reaction by-products and commonly identified adulterants found in samples and their significance will also be discussed.

This presentation will impact the forensic community and/or humanity by demonstrating the ease of clandestinely manufacturing methamphetamine and the similarities in the varieties of chemical syntheses procedures, recognition and positive identification of the manufacturing process can present challenges.

Currently, there are three major synthetic methods commonly used to convert ephedrine or pseudoephedrine to methamphetamine. The first is the hydriodic acid (HI) and red phosphorus (red P) method; the second is the iodine (I_2) and red phosphorus method commonly referred to as the 'Cold Cook'; and the third is the anhydrous ammonia (NH_3) and either sodium (Na) or lithium (Li) metal method, known as the 'Birch Reduction' method. These methods have a regional character and can vary dramatically in production scale. All of these procedures require either ephedrine or pseudoephedrine as the precursor. Additionally, each of the procedures can have several variations. Given the ease of clandestinely manufacturing methamphetamine, and the similarities in the varieties of chemical synthesis procedures, recognition and positive identification of the manufacturing process can present challenges to forensic chemists and law enforcement personnel.

The forensic chemist has two areas of concern in the analysis of clandestine methamphetamine laboratory samples. The first is the determination that there is a clandestine laboratory and that the material manufactured is in fact a controlled substance. The forensic chemist must be able to identify the synthesis procedure and the variations made by the operators. This requires a more systematic analytical approach. The second consideration is that the prosecution will usually require the forensic chemist to provide information that the site was a clandestine laboratory, and the clandestine laboratory's production capability, especially if a substantial amount of a listed precursor is involved. Coupling the various complex and confusing legal aspects with the analytical difficulties, clandestine laboratory samples present the forensic chemist with significant challenges.

The workshop will provide information to address the challenges stated above. An overview of the three current syntheses used to convert ephedrine or pseudoephedrine to methamphetamine encountered in clandestine laboratories will be provided. Various reaction by-products and commonly identified adulterants found in samples and their significance will also be discussed. In addition, the workshop will show how samples are identified to be submitted as exhibits and the procedures for taking samples at clandestine laboratories. Analysis protocols for liquids, both aqueous and organic, as well as solid samples, will be presented. Actual data will be provided.

Clandestine Laboratories, Sample Analysis, Methamphetamine Synthesis

W10 NITECRIME: Workshop on Trace Elements and Isotopes in Forensic Science

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After attending this presentation, attendees will understand the basic principles of trace elemental and isotopic analysis, become aware of how these methods can be applied to forensic science and learn how to access these methods for their own work.

This presentation will impact the forensic community and/or humanity by providing a better understanding of the application of these sophisticated methods to evidence analyses. Workshop participants will be exposed to a number of techniques and methods that can be immediately applied to improve the value of scientific evidence.

The requirement to characterize and compare physical evidence from crime scenes, fraud and environmental casework is a major task in forensic science. Trace element and natural isotope profiles can assist in this process. New developments in instrumentation have created exciting possibilities for the routine "non-destructive" isotope and trace-element analysis of small and valuable specimens. Specialists from the NITECRIME Network (www.nitecrime.eu.com) will give an introduction on how to use trace elements and natural isotopic profiles to verify the authenticity and/or origin of raw materials, industrial products and materials, illegal drugs, foodstuffs, and human remains. Special attention will be given to the origin of trace element and isotopic variations in nature, the pro and cons of analytical systems and data presentation and interpretation.

NITECRIME is an acronym for "Natural Isotopes and Trace Elements in CRIMinalistics and Environmental forensics". It is an EU funded global network for developing and validating state of the art analytical methods and for disseminating these methods and practices to relevant users. Member organisations consist of forensic laboratories (FSS, FBI, BKA, NFI, US Customs and others) and academic institutions (Inst. of Food Research, Florida International University, ETHZ, Curtin Univ., Utah Univ., Otago Univ. and others) from around the world. (See also www.nitecrime.eu.com).

The methods developed in the network are used to identify characteristic inorganic fingerprints not only from classical forensic materials like glass and bullets but also from food products, precious metals and human remains. Additionally the network is developing guidelines on how to interpret the multivariate data and how to present the results to a legal audience.

Elemental Analysis, Isotope Ratio Analysis, Multi-Variante Data Analysis

W11 Forensic Image and Video Processing

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After attending this presentation, attendees will undertand the possibilities are with digital images and video streams, and which techniques can be used in forensic science. Learn how quality assurance principles are applied to AV.

During this workshop information will be provided on new developments of forensic investigation of (digital) images and video streams and the use of 3-dimensional computer modelling in forensic investigations.

Traditional sources of images as evidence concern crime scene photography, and more specifically, photographs of fingerprints, tool marks, shoe prints and other impressions. A short overview of image processing techniques is given. Special attention is given to the introduction of artefacts by image processing (e.g. FFT on fingerprints).

During the last 25 years the use of CCTV-camera systems has become widespread. Typical questions concern the quality and the selection of images from a specific camera in a multi-camera-recording. Digital processing of video streams for presentation and storage purposes, and the compression techniques that are applied in digital CCTV-systems, lead to questions about the integrity and authenticity of recordings. Also questions about image interpretation like facial recognition, body length, or car speed, often in low resolution, time lapse, or compressed images have increased.

New sources of video streams and images are video recordings from handy cams, digital photo camera's, internet and cellular phones. Typical questions about these recordings concern the integrity and authenticity of the recordings, the data compression techniques used, the synchronicity of sound and images, compensation for camera movement, and the conversion of a video stream to a higher resolution image.

We will focus on methods for digital capture and analysis of analogue and digital multiplex surveillance recordings, state-of-the-art image enhancement techniques as contrast stretching and de-blurring, as well as new methods as super resolution, stabilising and automatic tracking.

Since more images are being processed for forensic investigation, new methods have been developed for answering questions about the interpretation of images. Examples given: Is it possible to read a license plate number? Is our suspect, or his car, the one depicted in the image? What is the body length of the robber or the speed of a car? Is it possible to do a reconstruction of an accident or a shooting incident from the information in these images? Methods for image comparison, facial comparison with non standardized images, image reconstruction, and Photogrammetry are presented and discussed. Special attention is given to accuracy of the results and the impact on the conclusions from these investigations. Furthermore, there will be a hands on training during this workshop.

Finally, some extra attention is given to the use of 3-dimensional computer modelling in forensic investigations, since we believe that these techniques will have an impact on traditional crime scene photography.

Computer models and animations have been recently used for analysing video by superimposition of computer generated views of the model on the video images, for the visualisation of complex scenario's in animations and for testing scenario's against video footage and evidence in crime scene photographs. Examples: the reconstruction of car accidents from photographs, analysis of blood spatter patterns from photographs using a computer model of the crime scene, the visualisation of wound channels in computer models of human bodies, the reconstruction of bullet trajectories, the reconstruction of a burglary using the limited information in dark images from a multi camera video recording, and the analysis of firework explosions from video recordings, photographs and geographical data. Special attention is given to modelling techniques, the accuracy of the models, methods for visualizing uncertainties and possibly erroneous suggestions coming from these visualizations.

The use of image processing in the analysis of patterned injury of the skin, with emphasis on child abuse and as an aid in image analysis in forensic pathology will be discussed. The interpretation and recognition of image processing artifacts and image quality issues in forensic pathologic evaluation will be demonstrated.

Image Processing, Video, 3D Reconstruction

W12 The Pathological Examination of Deaths in the Elderly

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After attending this presentation, attendees will interpret clinical and pathological findings in the elderly; define clinical and pathological features of dementia and delirium; will be familiar with the incidence of abuse in the long term care setting; be able to interpret postmortem findings in residents of long term care settings, both anatomical and toxicological, in light of geriatric practice; and be able to distinguish nursing homes, assisted living facilities, home health, and hospice, including the regulation and expectations of these entities.

As our society ages, questions concerning quality of care given to and received by elderly residents of long term care facilities, such as nursing homes or assisted living facilities, will grow more and more common. Often these questions will be directed to forensic pathologists, who are already familiar with injuries and death investigation. Nevertheless, elderly individuals, much like children, have their own special considerations when one is evaluating the state of their health. Geriatricians are familiar with these considerations, but forensic pathologists are less familiar. Moreover, forensic pathologists are less familiar with the long term care setting and the implications of various forms of care than are geriatricians. This presentation will impact the forensic community and/or humanity by presenting the forensic pathology of the elderly from a geriatrician's point of view, thus enhancing the practice of forensic pathologists in serving the elderly.

This workshop is designed for the pathologist who wishes to learn about the clinical manifestations and expected findings of advanced age in order to enhance the pathologist's practice of forensic pathology. Because the setting in which death occurs is important in understanding how death occurs, the workshop will also cover the structure and governance of the various sorts of long term care facilities where many elderly individuals die. The workshop will consist largely of didactic presentations. In particular, the presentations on the clinical expectations of advanced aging and dementia and on long term care facilities will be given by a geriatric psychiatrist and neuropathologist who has served for years as the director of training for state nursing home accreditation inspectors. Handouts covering the topics will be provided, and there will be time for participant discussion and interaction.

One of the changes that may come with advanced age is dementia, the impairment of cognitive function that affects 47% of individuals who are 85 years of age or greater. As dementia progresses, the individual affected regresses so that, like a child, he is unable to care for himself. Significant behavioral abnormalities occur in up to 75% of demented persons. The stress that this condition places on the caregiver can lead to abuse which, like child abuse, is difficult to detect and difficult to prove with an amnestic, aphasic subject. At the same time, aging brings degenerative changes, such as osteoporosis or the friability of the skin and its superficial vessels, that can lead to findings that mimic abusive injuries. Careful correlation of the circumstances surrounding death with the findings at autopsy can establish or refute a claim of abuse, but this evaluation is made more accurately with knowledge of the structural and physiological changes that can be expected with advancing age. The circumstances surrounding death also depend on the environment in which death occurs. Knowledge of what constitutes reasonable and unreasonable care will help in the evaluation of a given death. Data collected by regulatory agencies can also provide valuable insights into past deficiencies in care identified during the survey process.

Participants in this workshop will be taught clinical features of aging and dementia and the workings of various long term care facility organizations, such as nursing homes, assisted living facilities, and home health. Participants will have a better understanding of the special environment and medical considerations involved in deaths of elderly individuals from long term care facilities.

Nursing Home, Assisted Living Facility, Elder

W13 Human Factors, Performance, and Transportation Safety - The Rest of the Story: Beyond Alcohol and Other Drug Impairment

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The objectives of the workshop are to raise the awareness of toxicologists and other scientists who assess human factors contributions to crashes and highway safety to look beyond alcohol and drug related impairment; to be aware that cell phone and other distractions, fatigue, aging and medical conditions are important factors to consider in accident causation; and to gain an understanding of the models, methods and practical application of the data from behavioral performance studies.

This workshop will have decided impact on the forensic community. Those associated with highway and other accident investigations will be introduced to a series of factors, outside of the usual investigative issues of alcohol and drug involvement, that play crucial roles in human performance. Historically, these factors have been largely overlooked by toxicologists, accident investigators and the general forensic community.

Historically, toxicologists and other accident investigators have focused on the role of alcohol and other drugs as possible contributing factors to impaired performance. This focus has been guided in part by epidemiological studies suggesting that alcohol and other drugs (marijuana, CNS stimulants and depressants) are over-represented in impaired, injured and fatally injured drivers. It has also been guided by controlled closed-course and driving simulator studies demonstrating the impairing potential of many centrally acting drugs. However, highway and other accident investigations are far more complex than simply identifying a potentially impairing substance and assuming causation or even contribution.

This workshop is designed to raise the awareness of toxicologists and other forensic investigators about a number of human factors (often over looked) that can affect performance in driving and other complex behavioral tasks. Data will be presented from an international panel of experts on human factors and performance in the areas of cell phone and other distractions, fatigue, aging, and medical conditions as well as models and methods for assessing impaired performance. As cell phone use increases, there have been growing concerns about the effects on highway safety and the constructs of effective legislation. Data will be presented comparing impairment from cell phone use to that of alcohol consumption. Fatigue has been shown to be a contributing factor in highway safety, yet it is often overlooked in accident investigations. The National Transportation Safety Board plays a leading role in this area of research and will discuss fatigue involvement in highway safety. Medical factors such as those affecting visual acuity, color discrimination, cardiac sufficiency, asthma, diabetes and psychiatric disorders and their potential contribution to driving will be discussed. Closely allied with the medical factors that may contribute to driver impairment are the complications and health issues associated with aging. Physicians already help their older patients preserve their driving abilities by providing health maintenance, but they also can play a more active role by assessing their patients for medical fitness to drive. Lastly, to fully understand the literature and research in the areas just discussed, one must have an understanding of driver distraction models, assessment methods, experimental measures and the applicability of the results. By understanding some of the research being done at the National Advanced Driving Simulator we will gain knowledge in all of these areas.

From this workshop participants will gain an awareness of the potential contributions to accidents, crashes and highway safety of numerous human factors such as cell phone and other distraction distractions, fatigue, aging and medical conditions. Also, they will gain an understanding of the models, methods and practical applicability of the data from behavioral performance studies.

Impairment, Human Factors, Safety

W14 State of the Art Infrared and Ultraviolet Examinations of Documents by the Video Spectral Comparator

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The goals of this workshop are to help the attendees understand the theory light relative to VSC Examinations; understand the theory and application of visible/infrared transmitted, incident, coaxial and oblique light examinations; understand the theory of longwave and shortwave ultraviolet incident and transmitted light examination; and understand and apply the appropriate filtration; and to provide understanding of basic microspectrometry applications (e.g., measure absorption, reflectance, transmission, and fluorescence spectra).

This presentation will impact the forensic community and/or humanity by preparing the document examiner to better understand the theory behind the analysis and better explain his / her findings.

Infrared (IR), Ultraviolet (UV) and visible radiation has been used for many years in the examination of questioned documents revealing differences in inks, obliterations, erasures, alterations, deletions and insertions to documents. This workshop is going to explore the theory of light which makes these examinations possible. Jerry Richards will discuss the theory of these radiations. Kristina Kovarik of Foster and Freeman will explain the practical application of these theories and the latest technologies using a High Resolution Video Spectra Comparator. The workshop will cover incident visible, IR reflected, transmitted, and Luminescence examinations as well as short and long wave ultraviolet UV examination. Coaxial illumination and oblique visible and IR light techniques will be explored and demonstrated. Measurement of absorption, reflectance, transmission and fluorescence by the Microspectrometry will also be explained. The workshop will conclude with a group discussion lead by John Sang on the protocols for theses types of examinations.

Infrared, Ultraviolet, Alterations

W15 Practical Chromatographic Mechanisms Applied to Solid Phase Extraction

Max B. Erwine, BS, BGS Varian, 1634 Otte Avenue, Cincinnati, OH 45223; Adam Negrusz, PhD, DSc*, Department of Biopharmaceutical Sciences, College of Pharmacy, UIC, 833 South Wood Street, Chicago, IL 60612*

After attending this presentation, attendees will have a working knowledge of Solid Phase Extraction, where it can be applied, a working knowledge of the fundamentals and a reference to trouble shooting and other resources.

This presentation will impact the forensic community and/or humanity by improving bench knowledge of chromatography and the use of solid phase extraction.

This half-day workshop will include a comprehensive discussion on all aspects of solid phase extraction techniques with some application examples. The discussion will be divided into Fundamentals, which will include reasons for using SPE, the steps of SPE, a chromatographic comparison of digital SPE vs. HPLC, silica and as a substrate for SPE, polar, non polar and ion exchange chemistries will be discussed in detail.

Advanced and alternative approaches will detail improvements in the retention of polar compounds, trouble shooting, reduction of ion suppression in MS detectors, the use of polymers in SPE, packed bed and disk technologies and the use of solid supported liquid/liquid extraction techniques.

Solid Phase Extraction, Chromatography, Sample Preparation

W16 FBI Bank Security Device Workshop

Marc A. LeBeau, MS, and Ronald L. Kelly, BS*, FBI Laboratory, 2501 Investigation Parkway, Quantico, VA 22135; Joel Bartholf, BS*, 3SI Security Systems, Ashley Park, Suite 5A, 3902 Northside Drive, Macon, GA 31210; Phillip H. Grimm, BS*, U.S. Currency Protection Corporation, PO Box 6021, Scottsdale, AZ 85261; Robert F. Mothershead II, MA*, Pamela C. Reynolds, BS*, and Michael P. Rickenbach, PhD*, FBI Laboratory, 2501 Investigation Parkway, Quantico, VA 22135; and Ronald Scott*, 3SI Security Systems, 5891 Harmony Ranch, Aubrey, TX 76227*

After attending this presentation, attendees will be able to further their knowledge in the area of bank security device products: past, present, and future. A validated procedure for the analysis of bank dye-pack chemicals will be introduced and available for scientists to implement. Various analytical techniques will be discussed so that current forensic examiners can tailor the procedure to what is applicable to their laboratory's capabilities.

In order to adequately analyze bank security device evidence, a forensic scientist should possess much information about the dye-pack products and the procedure used to identify chemicals of interest. This presentation will impact the forensic community and/or humanity by attempting to provide examiners the knowledge and skills to not only analyze evidence related to bank security device dye-packs, but to adequately testify as an expert in this area.

For many years the Federal Bureau of Investigation (FBI) has been the lead agency in the analysis of evidence from bank robberies. Bank security dye-packs expend chemicals when activated during a robbery and contaminate money and other pieces of evidence with specific chemicals. A forensic scientist should be kept up to date on products related to dye-packs as well as to analytical techniques and procedures used to detect the expended chemicals. There is a history in the evolution of dye-pack products, their manufacturers, and the analytical methods used to identify specific chemicals on evidentiary items. Active forensic scientists who are either currently working with bank dye-pack evidence or who are foreseeing a future in analyzing these types of cases will be offered pertinent information, a validated procedure, and opportunities to discuss issues with both company representatives and other qualified scientists. Case examples, evidence packaging, method development issues, and future products in the area of bank security devices will also be discussed.

Bank Security Devices, Dye-Pack, Procedure

W17 SWGIT Presents: Guidelines for Acquiring, Processing, Analyzing and Archiving Video and Image Data

Richard W. Vorder Bruegge, PhD, FBI, Forensic Audio, Video and Image Analysis Unit, Building 27958A, Quantico, VA 22135; Carl R. Kriigel, BS*, U.S. Army Criminal Investigation Laboratory, 4553 North 2nd Street, Forest Park, GA 30297; William R. Oliver, MD*, Georgia Bureau of Investigation, Northwest Regional Crime Laboratory, 533 Underwood Drive, Trion, GA 30753; and Mark Shuman, MD*, Miami-Dade County Medical Examiner Department, Number 1 Bob Hope Road, Miami, FL 33136*

Upon completion of this workshop, the participant will have a better understanding of how to incorporate proper procedures for handling image evidence into their law enforcement activities. They will know what sort of equipment and software they should utilize, how best to document their procedures, and will also know something about the legal; basis for the presentation of digital evidence in court.

Images and video are intrinsic to law enforcement activities today. Crime scenes, suspects and evidence are photographed to document steps in an investigation. Surveillance images are seized and processed in order to reconstruct events and help criminals. Some images, such as latent print photographs, are processed and then analyzed to identify suspects. Many of these images ultimately find their way into the courtroom for use in prosecution. Analyses conducted on these images are frequently crucial to the successful completion of an investigation.

The increased use of digital imaging technology in law enforcement has led many defense attorneys to raise multiple criticisms of it and law enforcement's procedures, in an attempt to exclude such evidence. In this environment, it is more critical than ever that law enforcement take active measures to ensure that its images and imaging procedures can be defended in the court room. Recognizing this challenge, the FBI formed the Scientific Working Group on Imaging Technology (SWGIT) in 1997 to address the myriad of issues that can arise related to the science and technology of imaging. As of June 2004, SWGIT had formally published nine documents (with more in press) that address issues ranging from general guidance on chain of custody and the proper media for the preservation of image evidence, to procedures for image processing, the handling of video evidence, and advice on training in imaging. The purpose of this workshop is to acquaint law enforcement personnel with these documents and the

guidance contained therein, so that the attendees can incorporate these guidelines into the procedures within their own agencies and laboratories.

Attendees will learn about chain of custody issues as they relate to crime scene photographs and surveillance video recordings from both analog and digital systems. They will also receive guidance regarding proper procedures for preserving such data and will learn where they can go to find out more about it.

After a general overview, attendees will then be given some guidance regarding how to best utilize digital and traditional film systems for the acquisition of evidentiary photographs at crime scenes and in the laboratory. The selection of cameras and the steps necessary to acquire images sufficient for the purpose needed will be discussed. This will include a detailed explanation of image resolution and other factors that should be considered to determine which camera (and imaging system) is best suited for the purpose at hand. (It may surprise some to learn that digital imaging is not the answer to all of law enforcement's imaging needs!)

Next, attendees will learn about the variety of video surveillance systems in use throughout the country and SWGIT's efforts to work with manufacturers to develop industry standards that meet the evidentiary needs of law enforcement. This section of the workshop will also address proper procedures for the capture and processing of video evidence by properly training personnel.

Once images have been acquired in an investigation, they must be processed and analyzed to produce results meaningful to an investigation. SWGIT has developed guidelines regarding what sort of processing steps are most useful in a forensic setting and has also provided guidance on how to document those steps. Likewise, SWGIT is developing guidelines to provide imaging scientists with a set of "Best Practices", to ensure that the testimony offered by imaging experts is supported by practices as rigorous as those applied in other forensic disciplines.

Next, attendees will learn of the recent recognition of "Digital Evidence" as a discipline subject to accreditation by ASCLD/LAB. Included within this discipline is the subdiscipline of "Video and Image Analysis". SWGIT recognizes that some confusion remains over what parts of a laboratory might be subject to accreditation under this discipline, and can provide guidance on this issue.

Finally, many in law enforcement remain concerned regarding the admissibility of digital images within the courtroom. This workshop will provide attendees with a reference list of case law, as well as common sense approaches to this issue, that should help them ensure that their images, no matter their source, are admitted in court.

Imaging, Image Processing, Digital Evidence

W18 Shooting Reconstruction

Timothy M. Palmbach, JD, MS, University of New Haven, 300 Orange Avenue, New Haven, CT 06516; Robert K. O'Brien, MS*, State of Connecticut, Forensic Science Laboratory, 278 Colony Street, Meriden, CT 06451; Edward Jachimowicz, BS*, State of Connecticut, Forensic Science Laboratory, 278 Colony Street, Meriden, CT 06451; and Paul E. Kish, MS*, PO Box 814, Corning, NY 14830*

The goal of this presentation is to discuss scene investigation and scientific principals involved in the investigation of a shooting incident.

This presentation will impact the forensic community and/or humanity by demonstrating thorough investigation through scientific principals.

This workshop will focus on the investigation and reconstruction of shooting incidents. Physical evidence and pattern interpretation at the shooting scene will provide valuable information in conducting a proper shooting reconstruction. In addition, laboratory analysis and interpretation of the physical evidence is critical to the reconstruction. Topics such as determination of bullet trajectory, glass interpretation, bloodstain pattern interpretation, GSR/Distance Determination and the national firearm database will be discussed. Numerous case scenarios will be presented for review.

Shooting Reconstruction, Trajectory, Bloodspatter

W19 Understanding the Psychopath: The Theoretical and Conceptual Issues Related to Psychopathy and Their Practical Application to Understanding Violent Criminals and Their Behavior

Mary Ellen O'Toole, PhD, Federal Bureau of Investigation, Behavioral Analysis Unit, FBI Academy, Quantico, VA 22135; and Robert D. Hare, PhD*, University of British Columbia, #26 15020 27A Avenue, Surry, British Columbia V4P 2Z9, Canada*

Upon completion of this workshop, the participant should be able to better understand the theoretical, conceptual and operational issues associated with psychopathy and its implications for criminal justice and mental health. Particular attention will be paid to the application of the theory and research on psychopathy to law enforcement, crime scene analysis, and criminal investigation and interrogation.

Participants will learn about clinical and non-clinical methods for the assessment of psychopathy and its association with recidivism and violence. They also will learn how knowledge about psychopathy can be applied to crime scene analyses, criminal investigations, hostage negotiations, and interviews and interrogations.

Psychopathy has emerged as one of the most important clinical constructs in the mental health and criminal justice systems. Although psychopaths make up only about 15-20% of the criminal population, they may be responsible for more than half of the serious, violent, and repetitive crimes. This presentation will impact the forensic community and/or humanity by assisting in the ability to distinguish between psychopathic and other offenders, and to understand the implications of this distinction, is critical for everyone involved in criminal justice.

Dr. Robert Hare has researched psychopaths for more than a 35 years and is recognized as the world's foremost expert on the topic.

Psychopathy has emerged as one of the most important clinical constructs in the mental health and criminal justice systems. The psychopath is defined by a unique constellation of affective, interpersonal, lifestyle and antisocial characteristics. These include egocentricity, manipulativeness, callousness, impulsivity, shallow emotions, grandiosity and lack of remorse for one's actions. Not every psychopath will have contact with the criminal justice system. However, the traits associated with this personality disorder place psychopaths at risk for committing crime and for acting out violently. Psychopathy is not limited to a remote murder scene in the middle of a desert. Psychopaths can also be found in board rooms, and government and political offices throughout the world where they wreak havoc on co-workers, investors, clients, and others with whom they come into contact.

Psychopaths and their crimes are different from those of other offenders: more violent, cold-blooded, and persistent. Their lack of conscience, remorse and empathy readily allows them to become human predators, and to engage in instrumental aggression without concern for the victims or others around them. It is critical for those working in the criminal justice system to understand and appreciate the significance of this distinction between psychopathic and other offenders. An assessment of psychopathy is predictive of response to therapy, recidivism, violence, and sexual offending. The combination of psychopathy and deviant sexual arousal is particularly dangerous to society.

This workshop will be two faceted: Information will be presented regarding both the theoretical and conceptual issues related to psychopathy, including current research on psychopathy as a risk factor for recidivism, violence and sexual offending. The assessment instruments for Psychopathy will be discussed including the Hare Psychopathy Checklist (PCL-R), the Screening Version (PCL-SV) and Youth Version (PCL-YV).

In Part II, information will be presented which "operationalizes" the psychopathy construct in terms of a crime scene behavior classification system. This perspective on psychopathy will identify some key behaviors observed at a violent crime scene which can be indicative of a psychopathic offender. Utilization of this type of behavior classification system can assist law enforcement in developing strategies for investigations, interviews and prosecution of cases involving psychopathic offenders

Psychopathy, Violence, Crime Scene Behavior

W20 The Uses and Abuses of Statistics and Fordisc in Forensic Anthropology

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Upon completion of this workshop, the participant should be able to choose among several alternatives of statistical analysis based on the strengths and weaknesses of each method. The participant will have been instructed in measurement techniques and will be better able to address the reliability of a statistical analysis, both his or her own as well as others' analyses.

Forensic anthropologists increasingly use FORDISC and other statistical techniques to analyze remains and make probablistic statements concerning ancestry, sex, stature, and other individuating characteristics. This presentation will impact the forensic community and/or humanity by making the attendees aware of the theory and assumptions underlying each method in order to choose the best method, to make better estimates, and to address reliability concerns.

Various statistical procedures, especially discriminant function analysis (DFA), are being used more and more in Forensic Anthropology. Several computer programs can be used for statistical analysis, including SAS, SYSTAT, and FORDISC. The power of DFA lies in the fact that DFA maximizes the differences in bone size and shape among groups.

FORDISC 2.0 has been used extensively to aid in ascertaining the biological profile of skeletal remains, especially for ancestry. The impetus to develop FORDISC came from increasingly frequent requests from forensic anthropologists to calculate "made-to-order" discriminant functions (DFs) using data from the Forensic Data Base (FDB). Such custom DFs are necessary when measurements required by published DFs, for example Giles and Elliot (1962; 1963) or Jantz and Moore?Jansen (1988), are impossible to obtain. DFs are also desirable when one wishes to compare the unknown to different reference groups. FORDISC allows anthropologists to construct DFs using two to eleven modern groups, some including males and females, using up to 34 craniometrics, or two to four groups using up to 39 postcranial measurements. Fordisc uses Linear Discriminant Functions (LDFs) to calculate probabilities of group membership and is easy to use. Perhaps it is too easy to use. In our experience, many users merely type in measurements and record the classification. However, there are a number of statistical assumptions and caveats that need to be addressed in DFA to avoid certain problems, the most consequential being an incorrect classification of remains. The appropriateness of certain samples should also be considered. For example, LDFs require approximate multivariate normality and about the same level of variation among groups in order to produce reliable results. If group levels of variation differ greatly, Quadratic Discriminant Functions or non-parametric DFA are solutions. Additionally, much research has been devoted to ascertaining the "best" variables to use in DFA. Noise variables do not aid in discrimination and can decrease the accuracy and reliability of DFA. Stepwise selection of variables is valuable with some cautions. These methods are available in several statistical software packages and will gradually be incorporated in the next version of FORDISC.

Additionally, FORDISC 2 enabled the easy estimation of stature from long bone lengths. There are also several cautions worthy of note in estimating stature.

Attendees will hear lectures on theory, see empirical results that have practical implications, including case studies, receive instruction in craniometric measurement techniques, learn about emerging powerful new methods, and analyze example cases

FORDISC, Statistical Analysis, Physical Anthropology

W21 Preparing a Forensics Science Laboratory for Accreditation Under ISO 17025

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Upon completion of this workshop, the participant should understand how to prepare a laboratory or laboratory system for accreditation under ISO 17025 Standards. The preparation of a laboratory system is more demanding than the preparation of an individual laboratory because of the coordination required among the Quality Managers in all laboratories. Different approaches to problem solving must be harmonized to meet the requirements for the highest quality forensic work product.

This presentation will impact the forensic community and/or humanity by examining the experiences of one large laboratory system in preparing for an accreditation under ISO 17025 standards, forensic laboratory managers contemplating a similar accreditation status will be exposed to the successes and potential hurdles in the process.

The objective of this workshop is to present a synopsis of the procedures which were developed to prepare the nine (9) Drug Enforcement Administration (DEA) Office of Forensic Sciences laboratories for accreditation under ISO/IEC 17025 General Requirements for the competence of testing and calibration laboratories.

Accreditation is becoming a de facto requirement for the recognition of a laboratory's operation under documented policies and procedures. Three states have mandated laboratory accreditation for testifying in courts.

The Drug Enforcement Administration (DEA) laboratory system was first accredited in 1994, and reaccredited in 1999. These accreditations were conducted under the standards and criteria of the American Society of Crime Laboratory Directors/Laboratory Accreditation Board. In 2002 management within the DEA Office of Forensic Sciences made the decision to pursue the 2004 accreditation of the laboratory system under a program which would use as a base the International Standard ISO/IEC 17025 General Requirement for the competence of testing and calibration laboratories. Preparation for the 2004 accreditation of the DEA laboratory system would involve the Quality Assurance Managers from the seven regional laboratories, the Special Testing and Research Laboratory, and the Digital Evidence Laboratory. The accreditation also involved assessment visits to two (2) subregional laboratories, and one mobile laboratory. These three facilities are under the operational control of a regional laboratory director. The Office of Forensic Sciences Quality Assurance Manager had the

overall responsibility for coordinating the preparation of these twelve facilities for the accreditation process. The assessments included the following forensic disciplines: drugs, fingerprint comparisons and identifications, toolmarks examinations on solid dosage units, and digital evidence.

Accreditation of a laboratory system with a significant number of laboratories spread across the United States required planning and coordination. Since the 2004 accreditation would be conducted under a set of standards different from the two previous accreditations, significant training of personnel from each laboratory was required to familiarize individual laboratory management with the requirements of ISO and the accrediting body.

The following is a synopsis of the steps which brought the accreditation process to a successful completion:

- The appointment of a Quality Assurance Manager within the Office of Forensic Sciences to coordinate the accreditation process.
- The familiarization of Quality Assurance Managers within each laboratory with the standards for an ISO accreditation program.
- Internal pre-accreditation inspections of all laboratories.
- Periodic meetings of key individuals within the laboratory system to discuss and develop responses to each of the requirements for accreditation. This involved enhancing the laboratory system's policies and procedures to meet the requirements.
- The compilation of a conformance file to address each individual requirement for accreditation under an ISO program.

In June 2004, the Federal contract for accreditation of the DEA laboratory system was awarded to the American Society of Crime Laboratory Directors/Laboratory Accreditation Board. (ASCLD/LAB). The ASCLD/LAB International Program provides accreditation of forensic sciences laboratories under ISO/IEC 17025 requirements, enhanced by ASCLD/LAB-International Supplemental Requirements. The latter are based on the elements of the ASCLD/LAB Legacy Accreditation Program and ILAC Guide 19. After award of the contract to ASCLD/LAB, the preparation of the DEA laboratory system continued with a focus on meeting the specific requirements of the accrediting body.

An important part of this workshop will involve detailed discussions of those accreditation requirements which caused a significant degree of concern and fell outside of the "comfort zone" of familiarity with previous accreditation inspections. The discussions in this workshop will be candid. The goal of the organizers is to present suggestions for developing viable, practical suggestions for achieving accreditation under an ISO accreditation program for a forensic science laboratory.

Laboratory Accreditation, ISO/IEC 17025, Drug Enforcement Administration

W22 Evidence-Based Forensic Science: Interpreting Postmortem Toxicology in the Light of Pathologic Findings

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After attending this presentation, this joint Toxicology/Pathology/Biology workshop will provide both toxicologists and pathologists with guidelines in interpreting toxicology in the light of pathological findings in assessing the cause of death.

Evidence-based medicine has become one of the major driving forces in clinical practice, with an impact on education, policy making and research. Evidence-based medicine is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research (1). Can this new paradigm be applied to forensic sciences, in particular to forensic toxicology and pathology ? As far as the determination of the cause and manner of a death is concerned, the presence of a substance in a body raises the question of its possible role in the death. Attempts at directly relating postmortem blood drug concentrations to outcomes only seem reasonable to those unaware of just how many variables need to be considered. In addition to a thorough account of what was observed at the scene and an inquiry into the decedents past medial history, the medical examiner should integrate both toxicological and pathological findings. It is the purpose of this joint toxicology/pathology workshop to provide the forensic physician with the most advanced and objective knowledge in both toxicology and pathology, in accordance with principles of forensic-based medicine.

The following presentations will examine toxicological and pathological issues of practical relevance to the assessment of the cause of death.

1. Introduction. The principles of evidenced-based medicine.
2. Sampling guidelines for toxicology.
3. Hair Testing : Why Postmortem Toxicology is Incomplete Without it.
4. Back Calculation, is the Process Ever Legitimate in the Dead ?
5. Postmortem Redistribution
6. Influence of pharmacogenetics and impaired metabolism in chronic accumulation of medications
7. Interpreting Toxicology in the Light of Pathologic Findings
   a) Cardiac Pathology
   b) Other Pathologic Findings
8. Alternative Explanations for Sudden Cardiac Death, an Introduction to the Molecular Biology of Ion Channel Disease.
9. Interpreting Postmortem Opiate Measurements ; Methadone, Oxycodone, Bupranorphine, and Other Substitutes Drugs.
10. Interpreting Postmortem Stimulant Measurements: Cocaine, Methamphetamine, and MDMA
11. Determining the Role of Doping in Sport-Related Deaths.
12. Special Situations
    a) Murder by Succinylcholine
    b) Murder by Epinephrine
    c) Euthanasia - Does Toxicology Testing Help?
    d) Is Murder by Breast Feeding Possible ?
13. Illustrative(s) Case(s)
14. Discussion

(1) Sackett DL, Rosenberg WMC, Gray JAM, Haynes RB, Richardson WS. Evidence-based medicine: what it is and what it isn't. BMJ 1996; 312: 71-2.

Toxicology, Pathology, Cause of Death

W23 Quality Assurance in Forensic Anthropology

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After attending this presentation, attendees will understand the basic quality assurance principles and measures applicable to forensic anthropologists. Participants will learn the unique challenges faced by forensic anthropologists when striving to have their facilities, procedures, and casework meet the standards demanded by the criminal justice system. Attendees should be able to utilize the material presented to formulate a quality assurance program for their organization.

Quality assurance in forensic laboratories and programs has become a growing trend over the past decade. This presentation will impact the forensic community and/or humanity by demonstrating how formal quality assurance programs can lead to objective and measurable standards and performance that ultimately strengthen and elevate the forensic science profession as a whole.

Quality assurance programs in forensic laboratories and activities have been a growing trend over the past decade. Since 1999 the Joint POW/MIA Accounting Command, Central Identification Laboratory (JPAC-CIL) has implemented a stringent quality assurance program to ensure the scientific integrity of its casework. The CIL's quality assurance program ultimately led to the Laboratory's accreditation by the American Society of Crime Laboratory Directors Laboratory Accreditation Board (ASCLD-LAB) in 2003--the first forensic skeletal identification laboratory to be so credentialed.

The goal of this workshop is to introduce the attendee to the CIL's Quality Assurance Program and to convey the lessons learned resulting from its implementation and growth. A video overview of the JPAC CIL is presented followed by an overview of its quality assurance program. In the latter, the concept of the scientific integrity of the laboratory is discussed followed by a summary of the "Surety" model of quality assurance.

The participants will become familiar with each measure that comprises the surety model of quality assurance. The importance of integrating and synchronizing all of the surety measures discussed during the workshop will be continually stressed. In Part I, infrastructure and support considerations necessary for a successful quality assurance program are also presented. Surety measures addressed include:

- Desired qualities of a laboratory manual and other vital documentation
- Adequacy and safety of facilities
- Policies and procedures conducive to a positive work environment
- Evidence management and security
- Training and professional development

Gathering and interpreting evidence is the focus of Part II where quality assurance in field operations and trace evidence analysis is discussed. The surety measures directly related to casework--the peer review process, validation of technical procedures, case file management, analytical notes and documentation--are presented for consideration.

Quality assurance procedures and programs are ineffective in the absence of monitoring, enforcement, and corrective action. These are accomplished through a myriad of surety measures including proficiency testing, review of court testimony, audits, annual reports, and corrective action policies, which are presented in Part III.

In closing, the attendees will become acquainted with the problems that hindered, and the processes that led to, the accreditation of the JPAC CIL. In closing, surety assistance programs offered by the CIL will be discussed in the event an attendee's organization desires assistance with their surety programs or accreditation efforts.

A question and discussion period follows the conclusion of the presentation portion of the workshop.

Quality Assurance, Forensic Anthropology, Accreditation

W24 The Forensic Nurse Death Investigator as a Member of the Multidisciplinary Forensic Investigative Unit

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Upon completion of this workshop the participant will be able to identify and discuss the correlation of scientific nursing education to the field of forensic science, specifically to that of death investigation.

This presentation will impact the forensic community and/or humanity by increasing the availability of knowledgeable, competent individuals to assist the healthcare and legal system in relevant assessment and documentation in the field of death investigation.

Death investigation is a complex process, one that involves accurate data collection, communication and documentation. As a science dealing in an objective assessment of death, the investigative process requires a degree of knowledge in human anatomy and physiology, psychology, basic chemistry and physics. A variety of disciplines are essential in order to accurately assess, interpret and correlate the various elements involved in decedent identification, cause and manner of death, support and encouragement to survivors, and to maintain channels of communication with additional investigative personnel.

Members of the multidisciplinary death investigative team have routinely included law enforcement agencies, crime laboratory personnel, and medical examiner and/or coroner (ME/C) investigators. Additional team members, include those specializing in forensic engineering, odontology, anthropology and the behavioral sciences. Forensic Nurse Death Investigators (FNDI) have recently become valued members of death investigative systems and are increasing in many ME/C jurisdictions.
The educational requisites of the FNDI include specific aspects of each of these various forensic disciplines with which they regularly interface.

Forensic nurse examiners (FNE) in the United States are recognized for their clinical education and experience in the biomedical sciences. The FNE is accomplished in the application of scientific process to objective data collection, evaluation and interpretation of that data, including the implementation of methods essential to the investigation of suspicious deaths. Forensic nursing science requisite skills involve observation, documentation and assessment of objective data, human anatomy and physiology, basic chemistry and biochemistry, microbiology, physics and pharmacology. Familiarity with human psychology in response to both internal and external stressors helps to prepare the FNE for the task of death notification. In addition, an understanding of cultural family systems and available community resources is essential in order to provide direction and support to the bereaved. Thus the FNE is uniquely qualified to fill the role of the forensic death investigator.

ME/Cs who employ FNDIs appreciate the educational requirements for an individual to become a licensed professional. Scientific based education and critical thinking skills allow the forensic nurse examiner to recognize and recover physical and biological evidence with laboratory specification. The ability to identify specific human elements basic to normal physiological and psychological functions across the life span as well as assist the forensic nurse examiner in the identification of trauma in human remains.

Considering that the majority of all reported ME/C cases are comprised of natural deaths, the biomedical expertise of the FNDI provides for differentiation between disease process and suspicious deaths with

reasonable certainty. One emerging application of the FNE in death investigation is providing postmortem sexual assault examination prior to autopsy. Forensic pathologist and the FBI criminal laboratory find the FNE exceptionally qualified as experts in the evaluation of sexual assault trauma and collection of biological evidence.

A question frequently asked is: What qualifies the Registered Nurse to participate in death scene investigations, postmortem procedures and provide expert witness testimony? To examine the evolution of a forensic specialist in nursing, one must first consider the initial education, which begins as a nurse matriculates through an accredited nursing program. Basic nursing curricula focus on a strong physical and psychological science base, including human anatomy and physiology, chemistry, biology, basic and advanced mathematics, physics, behavioral sciences, and general courses in the fine arts.

The scientific process is applied throughout all aspects of general nursing curricula; the basic sciences are correlated to various body systems and related natural disease. Legal and ethical issues are a major component of each course. Graduates are eligible to apply for licensure examination developed by the National Council of State Boards of Nursing. The successful candidate is awarded the designation of Registered Nurse and licensed to practice, independent of physician licensure. At this juncture, nurses with an interest in the forensic sciences seek out accredited forensic nursing science programs.

In recent years, undergraduate, graduate, and postgraduate programs in forensic nursing science have been developed and are continuing to develop across the U.S. and abroad. These programs offer specific forensic curricula in the scientific investigation of injury and death, human abuse, forensic chemistry, crime scene/crime laboratory, forensic photography, toxicology, victimology, traumatology, sexual violence, human rights, psychosocial and legal aspects of forensic science, among others. Advanced forensic nursing curricula pursues pathophysiology, research, epidemiology, consulting, curriculum design and informatics. As generally happens, the greater desire for knowledge promotes higher academic goals. To date, four accredited United States (U.S.) universities offer doctorate level forensic nursing degrees. As principle research investigators and associates to forensic pathologists, it is believed that future advance practice forensic nurse examiners will assist in alleviating a global shortage in competent forensic services pertaining to the scientific investigation of death.

In tribute to the AAFS, forensic nursing was first recognized as a scientific discipline at the 43`d annual meeting in 1991 (Anaheim, California). The International Association of Forensic Nurses (IAFN), patterned after the AAFS, was founded in 1992. In 1995 the American Nurses Association (ANA) Congress of Nursing Practice bestowed formal recognition to forensic nursing as an official nursing specialty, and in 1997, the IAFN published the Standards and Scope of Forensic Nursing Practice in conjunction with the ANA. IAFN board certification for the forensic nurse examiner in both adult and pediatric sexual assault examination and evaluation was implemented in 2001. Development of specific standards and national certification in biomedical investigation for the Forensic Nurse Death Investigator is currently in progress through the IAFN. This certification will include professional standards in postmortem sexual assault examination for those who practice in this field.

The utilization of the FNDI provides competent individuals skilled in the biomedical investigation of death. Where perpetrator prosecution may be indicated, successful resolution to questioned death related issues instills confidence in the health and justice systems and contributes to community mental health through social justice.

This workshop will address the development of forensic nursing education programs, certification examination, role clarification, investigative case management, and multidisciplinary team relationships. Case examples are presented in which the FNDI's biomedical skills benefit the forensic pathologist in the analysis of fatal injuries and medical deaths. The foremost FNDI investigative program in the U.S. will present an overview of the Medical Examiners Investigative Unit comprised exclusively of Forensic Nurse Death Investigators. Discussion of the unlimited potential for FNDIs in developed and developing countries is previewed with data related to existing programs and those currently developing.

Death Investigation, Forensic Nurse Death Investigator, Forensic Nurse Examiner (FNE)

W25 Identifying Printmaking Techniques Through the Artistic Process

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The goal of this workshop is to provide for a better understanding of scientific techniques, applications and future implications on the printmaking industry. Ideally, the scientific community will gain a more accurate and detailed understanding of the processes used in printmaking so that detection and analysis will be better accomplished.

This presentation will impact the forensic community and/or humanity by providing the forensic document examiner a greater understanding of printmaking through fine arts processes and gain knowledge of the cross over between industrial printing and fine art printing.

The attendees of this workshop will be introduced to the artist techniques and the ongoing use/development of Printmaking. Printing techniques, inks and paper are continuously being updated over time by artists as well as the printing industry. A discussion of the history of printmaking will be presented along with ideas of future techniques in the printing industry. This program will consider the traditional methods of printing (lithography, intaglio, wood cut relief, silk screen, pad printing, photo polymer plates, letter press) as well as future implications of computer applications, digital, and holography printing.

Printmaking, Artist Techniques, Traditional Printing

WS1 Filicide: Risk Factors and Psychological Aspects

Karen F. Ross, MD, Jefferson Parish Forensic Center, 2018 8th Street, Harvey, LA 70058; and John W. Thompson, Jr., MD*, Tulane University School of Medicine, Department of Psychology and Neurology, TB53 1440 Canal Street, 10th Floor, New Orleans, LA 70112*

The goal of this presentation is to define filicide and related forms of child abuse; list the 3 general categories of fatal child abuse; list previous classifications of filicide; list maternal, paternal and infant risk factors for filicide; discuss psychological aspects of filicide including motivating factors in the absence of insanity; note the differences between filicide perpetrators and other perpetrators of child abuse.

This presentation will impact the forensic community and/or humanity by discussing filicide in a way that will strive to enlighten those that investigate these tragic cases about the risk factors in the parents and the child, and motivating factors in the absence of insanity as well as approach to evaluation of psychological make-up of the perpetrator in hope of providing preventive measures and improve the adjudication of such cases.

Filicide is the killing of a child by a parent at any age. While all child abuse cases are tragic, none provoke more questions and emotional response than the case of a child (or sometimes multiple children) who is killed by a parent. This may result at least in part because of the incongruity between societal expectations that parents should love, nurture and protect their offspring and the reality in such cases that they brutally abuse and murder them.

This workshort begins with an overview of the broad categories of child abuse (gentle homicide, battered child Syndrome, and Impulse Homicide), then offers a review of previous classifications of filicide, discusses risk factors for filicide including motivating factors and psychological aspects and addresses ways in which filicide perpetrators differ from other perpetrators of child abuse including increased likelihood of mental illness. Differences in motivating factors and psychological features of the perpetrators will be discussed in context of the 3 broad categories as listed above also.

Filicide, Child Abuse, Psychological Evaluation

WS2 Latest Advances in Hair Testing and Cardiac Electrophysiology Applied to the Determination of the Cause of Death of Napoleon Bonaparte

Paul Fornes, MD, PhD, Department of Pathology, Hospital E.G. Pompidou, 20, rue LeBlanc, Paris, 75015, France; and Steven B. Karch, MD*, PO Box 5139, Berkeley, CA 94705-0139*

After attending this presentation, attendees will be able to examine comparatively the results obtained by different technologies : Instrumental Neutron Activation Analysis, Graphite Furnace Atomic Absorption Spectroscopy, Inductively Coupled Plasma Mass Spectrometry, Electrothermal Atomic Absorption Spectrometry, Synchrotron and X-Ray fluorescence, and Nano-Secondary Ion Mass Spectrography. Analytical procedures and decontamination methods will be examined. Limitations of these methods will be discussed; and will be able to examine the possible roles of arsenic, mercury chloride (calomel), and tartar emetic (antimony potassium tartrate), in the light of most recent cardiac electrophysiological studies. These findings will be discussed in the light of autopsy findings and historical background.

The present forensic works will impact the forensic community and/or humanity by contributing to improve our knowledge of history.

On May 5, 1821, Napoleon Bonaparte died at the age of 51, on Saint Helena island, where he was detained in exile since October 1815. An autopsy was performed by Francesco Antommarchi, Napoleon's personal physician, witnessed by seven British medical officers. Antommarchi's report described among other findings, a perforated gastric ulcer contained by adhesions to the liver. The gastric lesions were considered cancerous, but there was no peritonitis, nor peritoneal carcinosis, nor visceral metastases. Yet, most history books state that Napoleon died of cancer of the stomach. In accordance with his wishes, Napoleon's hair was then cut off and strands were distributed as keepsakes to the various members of his establishment. In 1840, Napoleon was exhumed on the order of the French government, and the remains were then brought to Paris, where they now rest in the Hotel des Invalides.

After studying various reports, a Swedish dentist named Sten Forshufvud concluded in the early 60s that acute and chronic arsenic poisoning explained the course of Napoleon's entire illness, with the exception of the last several weeks, when he believes the emperor also suffered from antimony poisoning as a result of too much tartar emetic and from mercury poisoning as a result of too much calomel. Forshufvud explained his hypothesis in a 1961 book titled Who Killed Napoleon? He later obtained one of the hair strands that had been cut from Napoleon's head the day after his death. This piece of hair was analyzed for arsenic by neutron activation analysis, at the British Atomic Energy Establishment in Harwell. The results, which were published in 1962 in the journal Nature, showed that the hair contained more than 10 parts per million of arsenic, well over 10 times the normal value. Other specimens of Napoleon's hair have also been proven to contain arsenic.

However, the cause of Napoleon's death is still being debated by historians.

Finally, the following issues will be discussed: Was arsenic a contaminant, or was it inhaled or ingested, and was it actually the cause of death? If Napoleon did have gastric carcinoma, did he die of it or with it? Was Napoleon murdered? By whom? How would have the murderer used arsenic? What could have been the motive?

Napoleon, Hair Testing, Arsenic

WS3 Chemistry of Voodoo: Murder in the French Quarter

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Upon completion of this presentation, attendees will understand the fundamentals of crime scene investigation; understand the need for team cooperation in death investigation; appreciate the procedures followed in a Coroner's court; and understand the practice of "voodoo" and it's chemistry.

Welcome to New Orleans, a fabulous city for fun, frolic and mystery. It's a city with wonderful restaurants and tantalizing food; great jazz and Cajun music; moonlight nights on the Mississippi; carriage rides; marvelous coffee and beignets; Bourbon Street; hurricanes; and **Voodoo**.

New Orleans also has a seamy/steamy side; muggings, scams; corruption; and **MURDER**! An opportunity will be afforded to the amateur detective to analyze and solve a series of murders. The participants to analyze and collect evidence will use on-scene investigative techniques. The participants; powers of observation and knowledge of pathology will be challenged to determine the cause of death and to find the killer. A police detective and medical examiner will be there to assist you, but you must be careful of the representatives of the media. The objectives in these cases are to develop skills in analyzing and reconstructing a crime(s) as well as to determine motivation in cases where there is conspiracy and complicity.

Investigation, Chemistry and Toxicological, Coroner's Court Procedures

B1 Evaluation of Y-STR Multiplexes for Analysis of Casework Samples

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After attending this presentation, attendees will learn the relative abilities of various Y-STR multiplexes for forensic use.

This presentation will impact the forensic community and/or humanity by assisting in the ability to determine relative performance of Y-STR multiplexes.

Fluorescence-based DNA detection systems are being widely in forensic DNA analysis. These methods have greatly assisted the sensitivity and ease of measurement of PCR amplified short tandem repeat (STR) alleles. In multiplexed STR genotyping kits, fluorescent dyes are covalently coupled to one primer for each locus. These STR multiplexes amplify 13 autosomal STRs with a power of discrimination of over one in a billion and have proven invaluable in identification of perpetrators of violent crimes. However, sexual assault cases often contain a mixture of DNA from the male perpetrator and the female victim that are difficult to interpret using autosomal STR kits, due to the presence of excess female DNA in these samples as compared to the male DNA. By using male polymorphisms on the Y chromosome, male DNA can be identified specifically in male-female mixed samples.

The present study was conducted to evaluate two recently introduced commercial Y-STR multiplexes (Promega's PowerPlex® Y and Reliagene's YPlex 12). The robustness of the multiplexes was determined by sensitivity studies. The sensitivity data indicated that both kits were sensitive, although the YPlex 12 displayed consistently higher peak heights. Additional stutter-like peaks were noticed in pristine male samples at DYS392, DYS389II, DYS437 and DYS385 loci, though no artifacts were noticed when amplification was performed with female DNA. Further analysis of these artifacts need to be performed to determine the origin of these additional peaks. Mixture studies indicated that the limit of detection of the minor component in a male:male mixture was 1:5 (for YPlex 12) and 1:2 (for PowerPlex® Y). Researchers also performed CEPH family studies to demonstrate Mendelian inheritance of the Y-STR loci. To assess the ability of the multiplexes to analyze forensic samples, testing on blood, oral swabs and male-female mixtures as well as previously adjudicated sexual assault samples were performed. Based on these studies, the relative ability of the two multiplexes to successfully analyze a variety of forensic was determined.

Y-STRs, Multiplexes, Casework

B2 Optimization of the Extraction of Total Ribonucleic Acid (RNA) From Semen

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The goal of this presentation is to optimize the extraction of total ribonucleic acid (RNA) from body fluids for reverse transcription polymerase chain reaction (RT-PCR) and subsequent determination of source attribution.

This presentation will impact the forensic community and/or humanity by demonstrating how messenger RNA expression patterns can provide cell and tissue specific information that can be used to positively identify a tissue or body fluid source. Subsequent amplification of mRNA via RT-PCR using tissue specific genes can be to identify the tissue/body of origin.

Although DNA technology can be used to identify (i.e., type) a suspect, the source of DNA itself (blood, semen, *etc*.) cannot always be definitively identified. Therefore there is a need for the development of tissue or body-fluid specific protocols to identify forensically relevant body fluid or tissue samples. The development and use of RNA technology may complement existing DNA technology where the source of the stain (i.e., body fluid or tissue type) can be identified by examining the expression profile of body fluid or tissue-specific genes. Each cell type has a distinctive pattern of messenger RNA (mRNA) expression. Messenger RNA expression patterns provide cell and tissue specific information that can be used to positively identify a tissue or body fluid source. Subsequent amplification of mRNA via RT-PCR using tissue specific genes can be to identify the tissue/body of origin.

The RNA extraction protocol was streamlined for ease of use in the forensic laboratory. The traditional RNA extraction protocol is lengthy, produces toxic bi-products (i.e., phenol), and requires a skilled user. To be validated and used in casework, stringent quality control measures must be performed on each batch of new reagents, decreasing sample throughput. The use of a RNA extraction kit has several benefits: (i) increased sample throughput, (ii) lack of toxic/hazardous chemical bi-products, (iii) ease of training, and (iv) "built in" quality control measures.

The extraction of RNA from liquid body fluids was optimized using cryopreserved human semen. RNA was extracted from 0.5-500ul of semen using the RNAeasy Micro kit (Qiagen, Valencia, CA). The Agilent 2100 Bioanalyzer was used to determine RNA quantity and quality, including RNA Integrity Number (RIN) analysis. RNA samples (0.5pg to 50ng) were reversed transcribed using the Sensiscript Reverse Transcription kit (Qiagen, Valencia, CA). PCR products were amplified with semen-specific Protamine-1 primers. The subsequent PCR products were analyzed using the Agilent 2100 Bioanalyzer.

The amount of total RNA extracted from semen samples ranged from 9pg/ul to 20ng/ul. RNA quality was variable, with RINs ranging from 1-8.6 (scale 1-10). RNA samples having a RIN of 1 lacked 18S and 28S ribosomal peaks, but still contained quantifiable RNA. Samples with a RIN of 8.6 contained intact 18S and 28S ribosomal RNA bands. RNA samples (degraded and non-degraded) were efficiently reverse transcribed and amplified to produce a semen specific RNA product. A semen-specific Protamine-1 RT-PCR product was obtained from as little as 5pg (RIN=7.4) or 15-25 pg (RIN=1).

The amplification of a semen specific product was possible with degraded RNA, suggesting that RNA can be used for cellular source attribution even when there is a question regarding the overall integrity of the sample. The potential benefits of an RNA based approach for body fluid stain or tissue characterization include: (i) the ability to perform parallel tests for numerous markers of a single body fluid in a single assay format, (ii) the ability to perform parallel tests for different body fluids in a single assay format, (iii) a definitive identification of body fluids for which presently no specific test exists, and (iv) the ability to automate the process. The use of RNA technology could supersede current protocols for forensic body fluid identification.

Serology, Semen, RNA Analysis

B3 Verification of STR Alleles by Alternative Primer Pairs Through a Singleplex PCR System

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The Singapore National DNA Database Laboratory uses the ABI IdentifilerTM kit for DNA profiling of the 13 CODIS loci. Routinely, researchers encounter allele ambiguities such as off-ladder range alleles, microvariant alleles, allele peak imbalances and tri-alleles among the different DNA loci typed. In order to determine whether these are true alleles or PCR artifacts, alternative primers of the questioned DNA locus are used to confirm the alleles typed. An allele is automatically assigned by its DNA locus specific Genotyper™ macro. Using the FGA locus as an example, the singleplex PCR of the questioned DNA locus approach is described here.

This presentation will impact the forensic community and/or humanity by demonstrating how the systematic singleplex PCR approach with automated allele assignment method will allow routine confirmation and resolution of STR allele ambiguities encountered during routine DNA profiling in the laboratory.

PCR artifacts such as stutter products and non-template nucleotide additions and other factors such as microvariants, allele dropout, allele imbalance and mutations can arise that may interfere with the clear interpretation and genotyping of the alleles present in the DNA template.

In the National DNA Database Laboratory, the Identifiler™ DNA typing kit is used in routine DNA profiling. The DNA is extracted and amplified from blood stained FTA™ collection cards of convicted offenders. Duplicate DNA typing is performed for each sample and results are compared for consistency and quality before uploading into the CODIS system. On some occasions, heterozygote allele peak imbalances, three banded allele patterns, off-ladder range alleles, microvariant alleles and spurious PCR artifacts are encountered. In order to resolve interpretation difficulties and allow genotyping of the correct STR alleles present in the DNA template, alternative fluorescent (6-FAM) labelled primer pairs using Promega® Powerplex™ 16 or mini STR primer (Butler *et al.* 2003) sequences of each DNA locus are obtained. For each DNA locus, amplifying the alleles obtained from either the diluted Identifiler™ or Powerplex™ 16 allelic ladders as template creates the allelic ladder. A Genotyper™ macro is then written for automated allele assignment based on the amplified ladders for each DNA locus. The questioned DNA samples are then amplified using the DNA locus-specific singleplex PCR primers. Alleles are assigned on the PCR products using its DNA locus-specific Genotyper™ macro. The identity of the PCR products is verified as either as PCR artifacts or as true allele amplified from the DNA templates.

An example of this approach using the FGA locus is discussed here. The Powerplex™ 16 primers for the FGA locus are used. Out of the 70 blood samples with allele peak ambiguities observed using the Identifiler™ DNA typing kit, 29 samples were confirmed to be off-ladder range alleles, 30 samples with peak imbalances were corrected and 10 tri-alleles were verified. The corrected imbalanced peak indicated point mutations at the primer binding position of the Identifiler™ FGA primers. Off-ladder range alleles were confirmed to be alleles of the FGA locus. The remaining sample with an imbalance peak typed using the Identifiler™ DNA typing kit is likely to be a tri-allele pattern as the imbalance peak was consistent with the singleplex PCR result. The tri-allele should consist of a homozygote allele peak with an imbalanced third allele.

In conclusion, this singleplex PCR approach with automated allele assignment allows routine confirmation and resolution of STR allele ambiguities encountered during routine DNA profiling in the laboratory.

STR, Peak Imbalance, PCR

B4 The Effects of Different Environmental Factors on Quantity of DNA Extracted From Skeletal Remains Recovered From Gravesites in Former Yugoslavia and Quality of DNA Typing Results

Arijana Selmanovic, BS, Ana Milos, BS, Jon M. Davoren, MS, Tony Donlon, BS, Lejla Smajlovic, BS, Edina Omerovic, Rijad Konjhodzic, BS, and Jon Sterenberg, MS, International Commission on Missing Persons, Alipasina 45a, Sarajevo, 71000, Bosnia and Herzegovina*

The goal of this presentation is to present data which will reflect upon the quality of the obtained STR profiles and the quantity of DNA extracted from bone samples taken from skeletal remains that were exposed different environmental influences, and the observed differences between them.

This presentation will impact the forensic community and/or humanity by providing information to persons performing DNA STR testing of skeletal remains from mass graves.

The International Commission on Missing Persons has been tasked with the challenge of identifying mortal remains from the armed conflicts in the former Yugoslavia that occurred in the 1990s. This process is complicated due to several factors: at least nine years have passed since the conflicts ended, there are up to 30,000 missing persons in graves scattered throughout the former Yugoslavia, the conditions of the mortal remains being recovered, and because DNA testing has become the only reliable means of identification in the majority of these cases.

In the ICMP's identification efforts, bodies have been found buried in mass graves of up to hundreds of bodies. Within the same grave remains are often exposed to a number of different conditions as some were buried in body bags, others were wrapped in plastic and some were in direct contact with either soil or with other bodies. Many sets of mortal remains have also been burned prior to being placed in the mass graves.

DNA testing of skeletal remains is a rather challenging task because the DNA in such bone samples is generally highly degraded. In addition, it is normal that a substantial microbial population infests the bone samples. The process is further complicated because of the diverse storage conditions in which bodies were placed at time of death. The ICMP has developed a DNA-led identification process that is successful in obtaining STR profiles in over 85% of the skeletal cases from the former Yugoslavia. In order to further optimize this testing process the authors are investigating the effects of the environmental conditions of the mass graves to see if there is any link between those conditions and the recovery of DNA from bones.

To determine the effects of environmental factors on the degradation of DNA, multiple bone samples from two different disposal sites were examined. The pH values of soil samples from those two gravesites were measured. Survey data of gravesites was collected with information on depth and position of bodies within the grave. Factors pertaining to conditions of bodies such as: whether bodies were burnt, whether plastic sheeting was used to wrap bodies and whether bodies were buried in body bags were also noted and considered.

The relative DNA content of bone samples from those specific locations was determined by quantification of DNA extracted using The Quantifiler™ Human DNA Quantification Kit and ABI Prism® 7000 Sequence Detection System.

STR Typing was performed using the commercially available Promega PowerPlex® 16 System.

The data presented will reflect upon the quality of the obtained STR profiles and the quantity of DNA extracted from bone samples taken from skeletal remains that were exposed different environmental influences, and the observed differences between them.

DNA, STR, Degradation

B5 Developing a Simple Method to Process Compromised Bone Fragment for Forensic DNA Isolation

Richard Li, PhD, Sandra Chapman, MS, and Mary Thompson, BS, Sam Houston State University, Box 2296, Huntsville, TX 77341; and Michal Schwartz, BS, Sam Houston State University, Box 2296, Huntsville, TX 77341*

The goal of this presentation is to introduce a new method for processing compromised bone fragments prior to DNA isolation. The advantage of this method over conventional methods is in applying the proteinase solution that will omit the step of a physical cleaning procedure, such as sanding.

This presentation will impact the forensic community and/or humanity by demonstrating data which suggests that this method could be used for 1) initial sample preparation for cleaning the outer surface of compromised human skeletal fragments, and 2) could be adapted for automated DNA isolation for bone fragment in the near future.

Skeletal remains have been challenging biological samples for DNA isolation. Bones are more difficult for preparing and sampling prior to DNA extraction. One of the labor-intensive and time-consuming steps in DNA isolation from bone fragments is the initial cleaning and sampling of the bone. Due to the potential of having co-mingled remains, adhering inhibitors and bacterial contamination, the outer surface of the bone fragment has to be cleaned by a current method like sanding. However, to avoid cross-contamination between samples, the bone dust that is generated during the sanding of the bone must be removed. Additionally, safety protection equipment and procedures are necessary to protect lab workers and technicians from exposure to blood-borne pathogens.

To address this issue, a simple processing method has been developed using proteinase solution prior to DNA isolation. In this study, the use of proteinase solution requires much less labor than a physical method such as sanding. By incubating with the proteainse solution, the soft tissue and outer surface of the bone fragment sample is removed. The processed bone fragment or a portion of the fragment can then be used for DNA isolation. The characterization of the effect of the proteinases on the cleaning of bone fragments was performed. Proteinases were screened and the best candidates were selected. Additionally, the optimum incubation condition (concentration of proteinase, incubation temperature and pH) for the proteinase was determined. DNA from processed bone sample was isolated. The results demonstrated that this method is effective for removing those soft tissues attached to bone samples and the outer surface of bone fragment samples. The data suggest that this method could be used for 1) initial sample preparation for cleaning the outer surface of compromised human skeletal fragments, and 2) could be adapted for automated DNA isolation for bone fragment in the near future.

Bone, Challenging Samples, DNA Isolation

B6 Investigation of the Performance of the Promega PowerPlex® 16 System for Testing of Low Copy Number (LCN) STR DNA Samples

Lejla Smajlovic, BS, Edina Omerovic, Ana Milos, BS, Arijana Selmanovic, BS, Jon M. Davoren, MS, Tony Donlon, BS, and Rijad Konjhodzic, BS, International Commission on Missing Persons, Alipasina 45a, Sarajevo, 71000, Bosnia and Herzegovina

After attending this presentation, attendees will be shown a number of DNA – STR profiles from the Promega PowerPlex® 16 system during validation of the system for Low Copy Number analysis.

This presentation will impact the forensic community and/or humanity by discussing some of the findings associated with low copy number analysis with the Promega PowerPlex® 16 system.

The International Commission on Missing Persons has setup a DNA-led identification system in the former Yugoslavia. The initial phase of the identification effort utilized short tandem repeat (STR) analysis to match bone samples with family reference samples. The Promega PowerPlex® 16 System (PP16) has been highly successful for testing of bone samples even 10 – 12 years postmortem. However, for some bone samples the PP16 system was not able to amplify many loci using the standard 32 cycle PCR protocol. In most of the samples that failed testing using the PP16 system it has been shown that they contained less than 100 pg of DNA, as analyzed by the Applied Biosystems® Quantifiler™ system, as well as significant levels of PCR inhibitors.

A number of studies have shown that increasing the number of PCR cycles can yield more DNA STR data. With this increase in sensitivity it has also been shown that there is an increased risk of producing artifactual peaks, peak imbalances, and there is an increased risk of contamination. As a first step to try and obtain more STR data from the DNA extracts, with low levels of DNA recovered, the PP16 system was tested at increased cycles and optimized for low copy analysis on these extracts.

To study the effects of LCN analysis on the PP16 system various DNA samples, containing between 20 pg and 500 pg of DNA, were amplified between 32 and 36 cycles. The effects of the various levels of DNA were compared for the occurrence of stutters, artifacts, heterozygote balance and allelic drop out. The results from this study are compared to previously published data for the PP16 system as well as that of the Applied Biosystems® AmpF*l*STR® SGM Plus™ kit.

LCN, STR, DNA

B7 Optimization of the Promega PowerPlex® 16 System for Testing of Bone Samples With Low Levels of DNA

Stojko Vidovic, PhD, Daniel Vanek, PhD, Zoran Obradovic, MD, Bozana Filipovic, Danijela Music, Jon M. Davoren, MS, and Tony Donlon, BS, International Commission on Missing Persons, Alipasina 45a, Sarajevo, 71000, Bosnia and Herzegovina*

After attending this presentation, attendees will be shown the results of the optimization of the Promega PowerPlex® 16 system for use on skeletal samples.

This presentation will impact the forensic community and/or humanity by demonstrating the significant benefit for anyone performing DNA-STR analysis of bone samples.

The International Commission on Missing Persons has been given the task of identification of missing persons from throughout the former Yugoslavia. This identification process is challenging primarily because of the large number of missing persons, the relatively long length of time that has passed since persons have gone missing, the lack of medical records, and the large number of sets of co-mingled remains.

The process of reassembling bodies by DNA STR testing is often difficult because many of the less dense bones contain much lower levels of DNA. The low levels of DNA in many bones such as ribs, vertebrae, and pieces of skull bones makes the STR testing very difficult.

In order to optimize DNA STR testing procedure for bone samples with relatively little DNA researchers have investigated the effects of altering a number of parameters in the Promega PowerPlex® 16 system (PP16). The PP16 system has been optimized by altering the amount of primers added to the PCR reaction, increased amounts of *taq*, increasing the length of the extension cycle and concentration of the final amplified products.

As the DNA isolated from small amounts of bones is well below the recommended amount of DNA for the PP16 system all optimizations were

validated to ensure that quality of the results. The optimizations of the PP16 system have been shown to increase the success rate of the testing from 0% using the PCR protocol in the PP16 manual to 30 – 40% with the modified protocol.

DNA, STR, PP16

B8 The Relationship Between DNA Quantity and the Quality of the DNA STR Profile for DNA Extracted From 10- 13-Year-Old Bone Samples

Rijad Konjhodzic, BS, Jon Davoren, MS, Ana Milos, BS, Arijana Selmanovic, BS, Lejla Smajlovic, BS, Edina Omerovic, Ljiljana Jukic, BS, and Adnan Rizvic, International Commission on Missing Persons, Alipasina 45a, Sarajevo, 71000, Bosnia and Herzegovina*

After attending this presentation, attendees will be shown results obtained while working with 10 - 13-year-old bone samples.

This presentation will impact the forensic community and/or humanity by assisting people working on DNA STR analysis of degraded samples.

The International Organization of Missing Persons (ICMP) has been tasked with the identification of approximately 30,000 missing persons. The ICMP identification system has been implemented using deoxyribonucleic acid simple tandem repeat (DNA STR) testing of family reference samples and bone samples. To ensure the accuracy of the identification process the minimum acceptable posterior odds for matching of reference and bone samples has been set at 99.95%. Unfortunately for many cases there are few family members alive to use as reference samples and therefore achieving a posterior odds of 99.95% requires a large number of STRs.

The ICMP uses the Promega PowerPlex® 16 system (PP16) as the primary kit for STR analysis. With the ICMP's extraction procedure the success rate for reporting of 12 or more loci from the first run is approximately 88%. Unsuccessfully tested samples, however, represent a large number of missing, due to the fact that the overall number of victims is so high.

Samples that fail the initial testing are quantified using the Applied Biosystems Quantifiler™ system. The Quantifiler™ kit uses Real-time PCR technology to obtain both the amount of DNA present in a sample as well as to assess the level of inhibition that occurs during the PCR amplification.

Quantification was performed on 200 DNA extracts that had already been tested with the PP16 system. For these 200 samples a range of results were obtained during the PP16 testing. Samples were selected that amplified no alleles while others were chosen that amplified between 1 and 16 loci. A correlation was made between DNA content of an extract and the success rate of the STR testing. Samples with fewer than 16 loci amplified were then retested using adjusted amounts of DNA.

This presentation will discuss the range of DNA quantities calculated by the Quantifiler™ system and how this information can serve as a means of improving the success rate of the PP16 testing. It will also show how the relatively inexpensive Quantifiler™ testing can both reduce the cost and improve the results of the more expensive STR testing. Ultimately improving the success rate of the STR testing will increase the number of cases of which the posterior odds are over 99.95% and therefore can be identified.

DNA, Real-Time PCR, STR

B9 Biological Stains Collected From Crime Scenes Using FTA® Paper

Luis J. Martinez-Gonzalez, MS, F. Fernandez-Rosado, MS, Esther Martinez-Espin, MS, J. Carlos Alvarez, PhD, and Carmen Entrala, PhD, Laboratory of Genetic Identification, Department of Legal Medicine, University of Granada, Granada, 18012, Spain; José A. Lorente, MD, PhD, University of Granada, Department of Legal Medicine, Faculty of Medicine, Granada, 18002, Spain; and Bruce Budowle, PhD, FBI Laboratory, FBI Academy, Quantico, VA 22135*

After attending this presentation, attendees will learn about the utility of FTA® paper to recover and store semen and blood stains (from 1 to 10 microliters) from different surfaces (absorbent, non absorbent), as long as the quantitation and amplification protocols that yield better results with these stains.

This presentation will impact the forensic community and/or humanity by showing forensics scientists a new approach to recover biological evidences from crime scenes.

Proper collection and preservation of biological evidence recovered from the scene of crime is crucial to facilitate the analysis and interpretation of all analytical results, including DNA typing. FTA® paper is a well-known and widely use medium to collect and store biological materials before completing DNA or RNA analysis. Its typical applications are basically focused on the generation of databases (clinical and forensic ones), although it has also been used for preservation of other biological materials, as those related to agriculture and forestry.

Among the main advantages of FTA® is its ability to preserve biological materials. When specimens are spotted or applied to the FTA® matrix cards, cell membranes and organelles are lysed, and the nucleic acids are released, causing both RNA and DNA to become entrapped in the fibers of the matrix. Therefore, biological samples such as blood or saliva can be preserved at room temperature (without further need to cool or freeze), and to rapidly inactivate organisms including blood borne pathogens, preventing the growth of bacteria and other microorganisms. Finally, it is also important to mention that archived samples are ready for analysis in less than 30 minutes, since the genomic DNA remains bound to the FTA® paper; this purification process is easily amenable for automation.

Blood and semen stains ranging between 1 and 10 microliters were spotted and collected from 5 different surfaces (wood, cotton/clothes, tiles, glass, and carpet), after 3 different periods of time: one day, one week, and one month. Two different ways of recovery are being used. The first one is accomplished by moistening the FTA® paper with sterile distilled water and then pressing it against the stain. For the second alternative the stain is moistened with sterile distilled water and then the FTA® paper is applied.

Results show that FTA® paper is an ideal medium to collect dry specimens from hard, non-absorbent surfaces, such as wood, tile and glass. It is also good medium to collect cells from absorbent surfaces (carpet, cotton), although the performance depends on the size of the stain (amount in microliters of biological specimen spotted). The best approach is to first moisten the sample, and then apply and press with FTA® paper.

From non-absorbent surfaces, positive PCR amplification for autosomal STRs, Y-chromosome and correct allelic assignation have been obtained in all cases using as little as 1 microliter of blood or semen. It should be considered that the volume of 1 microliter used to test FTA®'s abilities is clearly smaller than most of the samples found at the scene of crime, where bigger biological stains will be more easily recovered with FTA®.

Among the advantages -already presented for bloodstains at the last AAFS meeting- the first one to mention is that this is an easy procedure to recover samples from the scene, since it is only necessary to add sterile distilled water into the sample and apply the FTA® paper; second, it is possible to store samples at room temperature for a long time; third, the preservation of the original support (the place where the biological fluid

was deposited), since there is only a transfer of the cells from, i.e., the carpet or the wood, into the FTA®. Finally, a fourth advantage worth mentioning is the relative homogeneity in collecting and storing different kind of samples that could be achieved by using FTA® in a number of cases.

FTA®, Scene of Crime, DNA Analysis

B10 Species Identification of *Kachuga tecta* Using the Cytochrome *b* Gene

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After attending this presentation, attendees will learn species identification of *Kachuga tecta* by DNA tchnique using the cytochrome b gene.

This presentation will impact the forensic community and/or humanity by demonstrating how the Cytochrome b gene is a valuable genetic marker in the species identification.

A DNA technique has been established for the identification to species level of tortoises. The test works on the shell of the animal, which is frequently used in the illegal production of ornaments and preparation, were used to identify samples from the species *Kachuga tecta.* A total of 100 tortoise shell specimens collected from the National Council of Agriculture, Taiwan, were used in this study. Primer pairs were designed to amplify partial DNA fragments coding for cytochrome b within the mitochondrial genome. The DNA data showed that among the 100 samples there were four distinct haplotype DNA sequences, within which there were a total of 90 variable sites. Between haplotypes 1 and 2, there is only 1 nucleotide difference at the nucleotide position 228. Between haplotypes 1 and 3, 64 nucleotide differences were observed; haplotypes 1 and 4, 62 nucleotide differences; and haplotypes 3 and 4, 52 nucleotide differences were observed. All four haplotypes were compared to the DNA sequences held at the GenBank and EMBL databases, the most similar species were *Kachuga tecta* (haplotype 1 and 2), *Morenia ocellata* (haplotype 3) and *Geoclemys hamiltonii* (haplotype 4), and the highest similarity were 99.5%, 99.3%, 89.9% and 99.5% respectively. However as this was only 89.9% homologous of haplotype 3 with *Morenia ocellata,* it would seem that this haplotype shows only limited homology to a similar species registered currently in these databases. The method established by this study is a further method for the identification of samples protected under CITES and will improve the work for the preservation of the endangered species.

***Kachuga Tecta*, Cytochrome b Gene, DNA Forensics**

B11 Evaluation of Commercial DNA Extraction Kits Using Bacterial Spores Associated With Problematic Matrices

Matthew J. Ducote, PhD, and James M. Robertson, PhD, FBI-CTFSRU, FBI Academy, Building 12, Quantico, VA 22135; and Douglas L. Anders, PhD, FBI-HMRU, FBI Academy, Laboratory Building, Quantico, VA 22135*

After attending this presentation, attendees will retain that commercially available kits can provide high quality DNA from problematic matrices, including soils, foods, drinks, and plants.

Although the kits tested are intended for microbial samples, this presentation will impact the forensic community and/or humanity by demonstrating how they can also be applied to situations in which the extraction of human DNA is required from problematic matrices.

Sensitive and specific PCR-based assays are available for detecting a variety of pathogenic microorganisms which may be used as bioterror agents; however, difficulties with these techniques may be encountered if the organisms are associated with materials such as soils, food and drink items, and plants. Because of inefficient separation of biological material from the surrounding matrix, suboptimal cell lysis, and co-purification of PCR-inhibitory substances along with nucleic acids, traditional laboratory methods for isolating DNA may prove ineffective for such samples. In cases where the release of a biological threat agent results in amounts of potentially hazardous microorganisms higher than those found in the environment, it is essential that high quality DNA can be extracted and used for PCR-based detection and identification.

Commercially available DNA extraction kits are designed to efficiently release nucleic acids from bacteria and other cell types typically found in the soil, as well as to remove or neutralize substances which may inhibit downstream applications such as PCR. In this study, several kits have been evaluated with respect to reproducibility and quality of the end product as obtained from a variety of problematic environmental matrices. Loam, clay, and sand samples were spiked with *Bacillus cereus* spores (a surrogate for *B. anthracis*), allowed to incubate for various times, and then subjected to DNA extraction using the kits. The various soil types provided differing starting amounts of PCR-inhibitory humic and fulvic acids, as well as different levels of physical attachment of the surrogate cells to the matrix, and therefore different types of challenges to the materials and reagents included in each kit. A variety of food and drink items as well as leaf surfaces were also tested as materials from which to extract bacterial DNA, and represent examples of other problematic matrices that may be encountered in forensic scenarios. Real-time PCR amplification of a 145 base pair region from the *B. cereus* genome was used to determine the quantity of *B. cereus* DNA obtained from the spiked samples, as well as the effectiveness of the various kits at procuring high quality DNA free of PCR inhibitors.

To optimize the kits for use in the forensic laboratory, the manufacturers' protocols were modified as necessary, including the addition of an exogenous reagent that has been shown to effectively remove PCR inhibitors. The results of this study will be made available to the forensics community so that researchers and investigators may choose appropriate methods for isolating nucleic acids from different types of biological material incorporated into problematic matrices.

DNA Extraction Kits, Bacterial Spores, Problematic Matrices

B12 DNA Detergent: A Novel Technique to Remove PCR Inhibitors From Soil-Derived DNA

R. Lazarin, BS, R. Wingo, PhD, T. W. Robison, PhD, J. M. Dunbar, PhD, and P.C. Stark, PhD, Chemistry Division, Applied Chemical Technology Group, Los Alamos National Laboratory, MS J964, Los Alamos, NM 87544; James M. Robertson, PhD, FBI-CTFSRU, FBI Academy, Building 12, Quantico, VA 22135; and Douglas L. Anders, PhD, and Rebecca L. Walker, PhD, FBI-HMRU, FBI Academy, Laboratory Building, Quantico, VA 22135*

After attending this presentation, attendees will know that it is possible to remove PCR inhibitors from environmental samples in a one-step procedure.

This presentation will impact the forensic community and/or humanity by demonstrating a simple procedure was developed for removal of humic and fulvic acids from forensic samples. Forensic scientists will be given a protocol that can be used to remove humic acids from environmental samples.

Procedures for purification of DNA extracted from bacteria in environmental samples are time-consuming and require expertise by the analyst. The extraction procedures must be complex, because environmental samples are contaminated with humic and fulvic acid substances, which often co-purify with the DNA. If the humic and fulvic acids are not removed from the DNA, they will prevent analysis by the PCR because the dissociation and enzymatic steps are inhibited. In addition, the compounds can influence the results of down stream procedures that utilize fluorescence detection, such as real-time PCR. Commercial kits are available for extraction of DNA from soil samples, but the yield and quality of the DNA is often poor.

An alternative to the commercial kits has been developed that has the potential to allow a high number of samples to be processed in a day. The new procedure uses a compound (hereafter referred to as PCR inhibitor remover, PIR) that is added to the crude extracts to initiate an immediate, selective reaction with humic acids and other PCR inhibitory materials. After mixing with the PIR compound, the DNA was precipitated, dissolved in buffer, and a portion tested in the PCR. To identify effective PIR compounds, the approach taken was to examine compounds known to be reactive with carbonyl groups because these moieties are highly present in humic acids and could act to sequester Mg2+ and form covalent bonds with primary amines of the polymerase. The PIR compounds were tested on known humic acid samples for their humic acid-removal capabilities by both fluorescence spectroscopy and PCR compatibility. A popular commercial kit was tested with the humic acid-containing samples in parallel experiments, and the results were compared with those obtained with the PIR compounds.

Thiamine, pyridoxamine (PDA), and phenylthiazolium bromide have been identified as promising PIR compounds. These compounds out perform the commercial kit by 10 to 100 fold, improving the PCR amplification 10-10,000 fold over untreated samples. PDA can alleviate PCR inhibition at concentrations exceeding natural levels of humic acids and was selected as the best PIR compound. To utilize PDA in a one-step reaction, it can be tethered to glass beads. An alternative approach is to use serial passage through 5mm and 0.2mm pore size filters to remove the large particles and aggregates of humic acids. A simple protocol will be presented for PCR-ready DNA from soil extracts using the PIR compound and filtration. Exploiting the fact that dilution of extracts often mitigates inhibition effects, it was found that the DNA extract without the PIR compound required up to a 1:10,000 dilution to obtain strong PCR products. In contrast, with the PIR compound, the DNA extract required only a 1:10 dilution to support the PCR. The purification procedure could be completed in less than 3 minutes.

Soil, Nucleic Acid Purification, Humic Acids

B13 Comparison of DNA Storage Methods

Keri L. Smith, San Jose State University, One Washington Square, San Jose, CA 95192; Steven Lee, PhD, San Jose State University, One Washington Square, San Jose, CA 95192*

After attending this presentation, attendees will understand the best methods of DNA storage.

This presentation will impact the forensic community and/or humanity by enabling the forensic laboratories to store their samples in such a manner that they are assured that there will be no DNA retention to the plastic.

DNA storage is a critical issue in forensic, epidemiological, clinical and genetic database laboratories. [1]In forensic DNA laboratories, there is always the possibility that cases may be re-opened and samples may need to be re-tested. This is especially important when the amount of DNA is limited. In addition to sample quantity, intrinsic differences in sample types resulting in differences in quality, and extrinsic differences in the storage buffers (e.g., ionic strength), tube surface type, exposure to UV and temperature of storage may lead to differences in the ability to recover and re-test the sample.

Laboratories utilize different methods to extract DNA depending on the sample type. The composition of the final solvent in the different methods and the inherent properties of the casework samples may impart differences in ionic strength. Casework DNA samples are usually dissolved in TE-4 and kept in plastic tubes. The commercial tubes that are utilized to store the DNA come from different sources and are composed of different types of plastics.

It has been observed that DNA can bind to polypropylene tube surfaces and these surfaces cause the DNA to denature.[2] Alternate polymers (polyallomer vs polypropylene) appear to reduce the retention of DNA.[2] Non ionic detergents have been found to be effective in preventing DNA adhesion at concentrations that do not inhibit PCR.[3] In addition some of the tubes may contain nucleases and chemical contaminants that may digest and/or denature the DNA.[2]

In this study, a comparison of storage of DNA samples at varying concentrations, in different buffers over varying amounts of time, at different temperatures in different tube types, will be performed. Utilization of the most efficient storage method (buffer, tube, and temperature) may prove critical in the ability re-test samples.

Inter- and intra-lot tube variation will first be evaluated using control DNA. Glass tubes will be used as a control. Any variation in storage temperatures and humidity will be evaluated and monitored using NIST certified digital thermometers. Tubes containing replicate samples at 0.5, 1.0 and 10ng of DNA in 30ul volume for each time point and each temperature and each tube type will be stored in the dark and covered in aluminum foil to avoid exposure to UV.

Samples will be stored at –20°C, 4°C, and room temperature. Aliquots will be analyzed at the start, 1 day, 1 week, 1 month, 3 months, 6 months and 1 year (a 3 year and 10 year time point set will also be made). Samples will be in TE storage buffer and Chelex storage buffer.

Quantification will be performed by UV spectrophotometry and a subset will be analyzed using agarose gel electrophoresis. These values will be compared to the original sample values to determine if there has been any loss/retention of the DNA sample based on storage method or length of time. Data in triplicate for each sample type, storage tube and temperature will be analyzed for standard deviation and coefficient of variance. In addition, amplification of STRs from a subset of the samples will be performed.

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3. Rensen G. Buoncristiani M. and Orrego C. "Assessment of DNA retention on plastic surfaces of commercially available microcentrifuge tubes." (2002): available from http://www.promega.com/geneticidproc/ussymp13proc/abstracts/73_buoncristiani.pdf

DNA, Storage, Polypropylene

B14 Mitochondrial DNA-Based Identification of Forensically Important Sarcophagidae and Calliphoridae (Diptera) in Hawaii

Bethany G. Fox, 373 Awakea Road, Kailua, HI 96734; and Ellen Shimakawa, PhD, Chaminade University of Honolulu, 3140 Waialae Avenue, Honolulu, HI 96816*

After attending this presentation, attendees will learn about how to identify different species with mitochondrial DNA sequencing, and how important this is to forensic entomologist in order to determining the post-mortem interval correctly.

This presentation will impact the forensic community and/or humanity by giving them samples of Sarcophagidae and Calliphoridae

species from Hawaii. The mitochondrial DNA sequences will help law enforcement in determining postmortem interval.

The poster will present partial mitochondrial DNA sequence analysis from DNA isolated from larvae and adult flies of the Sarcophagidae and Calliphoridae families in Hawaii. The mitochondrial DNA sequences from Hawaii are similar but not identical to flies from other locations around the world.

Organic extraction such as CTAB, Pure Gene, and other methods were used to isolate amplifiable mitochondrial DNA, Centricon YM-100 filters were used to further purify the template. The *Sarcophaga ruficornis* DNA extraction sample contained a concentration of .515□g/□l times 50□l= 25.75□g and the *Chrysomya megacephala* DNA extraction sample contained a concentration of 1.31□g/□l times 100□l= 131□g. The samples were diluted down to a concentration of 10ng/□l, and between 30 and 70 ng templates were used in each PCR reaction. The pair of primers used were TY-J-1460 and CI-N-1840. The Annealing temperature used in the thermocycler was at a set temperature of 41ºC for 30 complete cycles. Amplification product was verified by a 1% agarose gel electrophoresis containing Ethidiumbromide stain, and yields estimated for subsequent sequencing with the DNA molecular weight marker XIV (100-1500bp). Amplification was successful in all of the larvae and adult fly samples. The samples were sent to the Biotechnology Core Facility at the University of Hawaii in Manoa for sequencing in an Applied Biosystems 377XL DNA Sequencer. The sequences analysis was based on a region between 400 base pairs of the gene for cytochrome oxidase subunit one (CO1). The sequences for the *Sarcophaga ruficornis* and the *Chrysomya megacephala* were then compared in an online BLAST search engine of the National Center for Biotechnology Information's Genbank. The results from the sequence comparison for the *Chrysomya megacephala* in Hawai'i were similar but not identical to the *Chrysomya megacephala* from between Lae and Bulolo, Papua New Guinea (Wells and Sperling, 2000) (Calliphoridae, GenBank accession AF295551). The results from the sequence comparison for the *Sarcophaga ruficornis* in Hawaii did not result in a close sequence similarity with the *Sarcophaga ruficornis* Genbank entry (AF259511) but instead it closely resembled a *Sarcophaga africa* sequence from Berkeley, California, a related species (Wells, Pape, and Sperling, 2000) (Sarcophagidae, GenBank accession AF259508). The *Sarcophaga ruficornis* sequence was also found to be similar to *Sarcophaga crassipalpis* from Berkeley, California (Wells, Pape, and Sperling 2000) (Sarcophagidae, GenBank accession AF259510).

The conclusions of this research resulted in isolation of amplifiable DNA for larvae and adult flies in Hawaii. Mitochondrial DNA sequences from these species in Hawai'i are similar but not identical to the fly species from other regions around the world. This research also shows evolutionary difference between the two specific species in different regions. Being able to identify the Calliphoridae and Sarcophagidae families more easily will help the forensic community in determining the postmortem interval in Hawaii. This work was supported by USDE grant number P217A030070.

Mitochondrial DNA, Sarcophagidae or Calliphoridae, Species Identification

B15 A Method for Determining the Age of a Bloodstain

Kristin N. Nestor, BS, Stacey Anderson, BS, Brandi Howard, BS, Regina Trott, Gerry Hobbs, and Clifton Bishop, PhD, West Virginia University, Department of Statistics, PO Box 6057, Morgantown, WV 26506-6057*

The goal of this presentation is to show how RNA can also be used in the forensic community as an indicator for the age of a bloodstain. As a result, the age of a bloodstain could act as information in relevance to the time a crime occured. In addition, this information could also be useful for the exclusion or inclusion of a suspect.

This presentation will impact the forensic community and/or humanity by informing the forensic science community about new research and technology that can be useful in investigations. In addition, this presentation may bring further interest to this area of study.

DNA allows for the unambiguous identification of the person from whom a biological sample was derived but provides little information about when the sample was deposited. This information only indicates that the biological sample was deposited at the crime scene prior to the collection of evidence. The ability to determine the age of a biological sample would greatly benefit the forensic science community, providing a temporal linkage of biological evidence to the time a crime was committed. Conversely, if the sample were deposited at a different time, then value resources might not be wasted pursuing an innocent person. The authors have used real-time reverse transcriptase PCR (RT-PCR) to show that the ratio between different types of RNA (mRNA versus rRNA) changes over time in a linear fashion when dried human blood was examined over the course of 180 days. One study focused on the comparison of individuals from three ethnic groupings: European-American, Asian-American, and African-American. Additional studies demonstrated how environmental conditions, specifically temperature as well as humidity, changes the rate of RNA decay. Although other approaches have been used in the past to estimate the age of a biological sample, this approach offers the following advantages: enhanced detectability of small samples, simultaneous isolation of DNA and RNA from the same sample, species-specific probes, and an increased window of usefulness.

Forensics, Real-Time PCR, RNA Decay

B16 Analysis of DNA Mixture Samples: Integration of the Quantifiler™ Real-Time PCR Kits and the AmpF*l*STR®Yfiler™ Kit

Chien-Wei Chang, PhD, Julio J. Mulero, PhD, Robert L. Green, BA, and Lori Hennessy, PhD, Applied Biosystems Inc., 850 Lincoln Centre Drive, Foster City, CA 94404*

After attending this presentation, attendees will that sensitive, reproducible and reliable methods are available to quantify and genotype mixture DNA samples containing relatively low proportions of male DNA.

This presentation will impact the forensic community and/or humanity by demonstrating advances in mixture DNA sample analysis for quantitation and STR analysis.

This presentation will discuss the incorporation and utility of the Quantifiler™ Real-Time PCR Kits and the AmpFlSTR®Yfiler™ Kit into the analysis of mixture samples typically encountered in forensic casework.

Forensic samples from sexual assault cases frequently contain a mixture of genotypes in which the DNA of the male contributor, present only in a very small amount, needs to be discerned from a high background of female DNA. Physical separation of the two genotypes using the differential extraction method may sometimes be possible. However, the technique is laborious, time-consuming and is limited to certain sample sources. With current autosomal short tandem repeat (STR) typing systems, male DNA in mixture samples can be correctly interpreted only when it comprises 5% or more of the DNA in the mixture. Although the degree of male contribution can be estimated by the analysis of the amelogenin locus or by estimating the quantity of male DNA from the number of spermatozoa detected, genotyping results of mixture samples may require a significant degree of interpretive skill from the analyst. With the aim to improve the ability to obtain useful genotypic information from mixture samples containing relatively low proportions of male DNA, recent advances in DNA analysis of forensic samples have focused on developing sensitive, reproducible and reliable methods to quantify and genotype mixture DNA samples.

The AmpF*l*STR®Yfiler™ PCR Amplification kit is a STR multiplex assay that co-amplifies 17 Y chromosome STR loci in a single PCR reaction. The authors have evaluated the efficacy of the

AmpF*l*STR®Yfiler™ typing system combined with the Quantifiler Real-Time PCR Kits to determine the range of ratios of mixture DNA within which positive detection and accurate genotyping of a minor male contributor DNA could be obtained. First, mixtures of purified male and female DNAs were prepared and analyzed with the Quantifiler™ Y and Quantifiler™ Human assays to determine the relative contributions of male and total human genomic DNA in samples, respectively. Mixtures with ratios ranging from 1:1 to 1:8000 (male:female) were then processed with the AmpF*l*STR®Yfiler™ kit. The characteristics of Yfiler profiles produced from DNA sample mixtures were studied on the basis of specificity, signal quality and intensity. These experiments indicated that full profiles of minor male contributors were obtained from male-female mixture samples with ratios up to 1:4000. In contrast, the male components were not detectable by standard autosomal STR typing methods. The resulting signal intensity of the Yfiler assays directly correlated with the concentrations of male DNA determined by the Quantifiler™ Y assays. In addition, it was shown that the AmpF*l*STR®Yfiler™ typing system allows alleles from multiple male individuals in mixtures sample to be easily determined in the presence of excess female DNA. Results clearly illustrate that the use of the Quantifiler™ Y Human Male DNA Quantification Kit in conjunction with the AmpF*l*STR®Yfiler™ Kit allows the detection, quantification and genotype determination of the male DNA component specifically without interference from female DNA.

Mixture DNA Sample, STR, Y Chromosome

B17 Pitfalls in Crime Scene Investigation: Report of Four Cases

Francesco Introna, PhD, Antonio De Donno, MD, Simona Corrado, MD, and Domenico Urso, MD, Section of Legal Medicine DI.M.I.M.P, University of Bari, P.zza Giulio Cesare, 11, Bari, 11-70124, Italy*

After attending this presentation, attendees will learn about 4 cases of murder in which avoidable errors committed by the Police scene of crime officers compromised the final result of the investigations

This presentation will impact the forensic community and/or humanity by showing the importance of the presence of a team of medical experts in crime scene investigations.

This presentation will describe four cases of murder in which avoidable errors committed by the Police scene of crime officers compromised the final result of the investigations.

Inspection of the crime scene has a primary role in correct operational set-up and must be meticulously performed by qualified, specifically trained staff. Attention must be paid not only to macroscopically evident signs but also to all elements, however apparently insignificant, present on the scene.

In the first case (Court of Bari) a child disappeared from the yard of the apartment block where she lived. Searches were immediately made by the Police Force and continued, unsuccessfully. The only element neglected during the analyses was later to prove decisive: the sudden emergence of flies from a hole in the cellar wall. This had been ignored and the hole filled. A year later the skeletal remains of a child were found under a thin layer of gravel in the apartment block cellar. The Pathologist established a correspondence between the times of disappearance of the child and of death and deposit in the cellar. However, the advanced stage of decomposition made it impossible to establish by autopsy and laboratory investigations whether prior rape had been committed. The fundamental error in this case was the incomplete search for the body in the vicinity of the child's habitation.

In the second case (Court of Lecce), a Mafia murder and summary burial of the body (a "lupara bianca" case), the skeletal remains were committed to the Section of Legal Medicine DI.M.I.M.P for investigation after superficial excavation by the police force of the hole in the ground where the body had been found. Examination revealed a firearm entrance wound in the skull. No exit wound was apparent, but the bullet had not been retained in the skull. The authors felt obliged to make a second, meticulous excavation of the crime scene using metal detectors. This yielded not only the bullet but also other bone remains that the police officers had failed to recover. Examination of the bullet resulted in identification of the weapon from which it had been fired and hence of the murderer. The error lay in the incomplete excavation of the hole and recovery of the skeletal remains performed by inexpert staff.

The third case (Court of Lecce) also regarded a Mafia murder and burial of the body (lupara Bianca), where the confession of a "pentito" (an erstwhile accomplice) had indicated ritual lapidation as the murder method. During the excavation operations, carried out by the undertakers, a vast accidental fracture was caused in the occipital region by a stroke with a spade. This postmortem lesion allowed the defence to claim that all the lesions were postmortem and thus to confute the accusation of murder by lapidation. Close anthropological examination of the injuries then enabled differentiation between the vital lapidation injuries and the postmortem lesion caused during recovery. This confirmed the pentito's confession and the State Attorney secured a murder sentence. Again the error was in allowing inexpert staff to excavate the hole and recover the skeletal remains.

In the last case (Court of Bari), a 7-year-old gypsy disappeared. Searches by the Police Force, with search dogs (later reported to have anti-drugs training), were unsuccessful. The girl was assumed to have been kidnapped by a rival clan, but not murdered. After about 4 months, a cadaver in a pre-skeletrization state was found 400 metres from the site of disappearance, at the edge of a rural road. Investigations confirmed a correspondence between the times of disappearance and of death. No objective signs could establish the cause of death or any prior rape, and the case is still unsolved. The error was in allowing unqualified staff to search for the body.

In the light of the above cases, the authors emphasize that in crime scene investigations involving cadavers or biological materials, the presence of a team of medical experts in criminology, pathology or forensic anthropology is essential to avoid missing vital clues. Both pathologists and police officers should therefore be selected from among highly qualified staff, and should undergo periodic updating courses.

Crime Scene, Investigations, Pitfalls

B18 Education of the Forensic DNA Analyst in the 21st Century

Joseph E. Warren, BS, MS, PhD, John V. Planz, BS, MS, PhD, and Arthur J. Eisenberg, BS, MS, PhD, University of North Texas Health Science Center, Department of Pathology and Anatomy, 3500 Camp Bowie Boulevard, Fort Worth, TX 76107*

After attending this presentation, attendees will gain knowledge of a graduate program specilaizing in training forensic DNA analyst and technical leaders.

This presentation will impact the forensic community and/or humanity by informing the forensic community the existence of this program and its potential to assist the forensic community in the challenges of 21st. Century DNA testing. It is hoped that a dialouge will be started with Laboratory Directors and DNA Technical Leaders as to how the faculty can further design this program to keep it as relevant as possible in order to meet the current and future needs in the field.

Accreditation of Forensic DNA testing laboratories has now become standard in the field. An important aspect of the accreditation process is the qualifications and training of the DNA analyst. The National Standards has explicit requirements for coursework and training of DNA analysts and Technical Leaders. Furthermore, with the advent of new technologies such as SNP panels, Real-Time PCR, robotic systems, non-human DNA testing, mitochondrial DNA testing, Y chromosome analysis and Whole Genome

Amplification individuals who are trained to understand the science, research, development and validation of these systems will soon be required by crime laboratories to implement these technologies. Other disciplines that are now developing including microbial forensics, bioterrorism, genomics and bioinformatics in forensic science, will require individuals with at least some familiarity with these areas.

In 2001, the University of North Texas Health Science Center started what was at that time, the first graduate program to offer a Master of Science degree specializing in Forensic Genetics. This program was developed to provide the forensic community with trained personnel, all of who meet and exceed the requirements to be DNA Technical Leaders except for the actual three-year work experience as a DNA analyst in a forensic laboratory. While that is still the primary focus of the program, it is also recognized by the faculty that it must keep abreast of new discoveries and technologies available in genetics and identity testing so as to produce the finest students capable of working in 21st century forensic laboratories.

The program itself is two years in length. The first year consists of coursework in molecular biology, biochemistry, ethics, biostatistics, a journal club entitled "Topics in Forensic and Molecular Genetics," population genetics, immunology and microbiology. During the summer of year one the students take two courses, Molecular Methods in Forensic Genetics and QA/QC for Forensic DNA Laboratories. Second year coursework includes courses in Biological Evidence Evaluation, Genetic Data Analysis, Topics in Forensic and Molecular Genetics, Forensic Anthropology and Expert Testimony in Forensic Science. Four electives are also offered, Bloodstain Pattern Analysis, Forensic Hair Comparison, mtDNA Sequencing and Forensic Biology: The History and Science of Human Identity Testing. The last project the students need to complete is a 6-8 weeklong internship at a forensic laboratory. They then are required to present that and publicly defend it as an internship practicum.

This presentation will provide more information as to the coursework, research projects, job placements and future projects of this unique program.

DNA, Education, Training

B19 An Evaluation of the Efficacy of a Large Metropolitan Detective Training Program in Forensic Biology/DNA Concepts and Procedures Utilizing a Hierarchical Formative Evaluation

Garry J. Bombard, MS, Forensic Institute for Research, Science, and Training, 3400 West 111th Street, Suite 116, Chicago, IL 60655*

The goal of this presentation is to present to the forensic science community an educational hierarchical formative evaluation model for use in evaluating forensic biology/DNA training to police detectives/ investigators.

This presentation will impact the forensic community and/or humanity by providing an example of a public policy analysis conducted by a forensic scientist. The analysis introduces an evaluation model measuring the effectiveness of a forensic biology/DNA training program to police detectives. The model can be further utilized to develop and evaluate the effectiveness of any future forensic science training within the criminal justice community. The presentation is timely and applicable based upon several national agendas.

The presentation provides an overview of a public policy analysis. The public policy analysis is a research study examining the efficacy of a collaborative forensic biology/DNA training program to the Chicago Police Department Detective Division. The study establishes a unique model of evaluation derived from the educational field. The study is timely in developing forensic science training programs to criminal justice agencies and mirrors the national agenda for the development and monitoring of training programs.

The specific focus is to determine the efficacy of training, evaluating knowledge and understanding of forensic biology/DNA concepts and procedures, of a forensic biology/DNA training program previously presented by the Illinois State Police Forensic Science Center at Chicago to the Chicago Police Department Detectives. The study evaluates the retention of information by the training attendees, the ability to utilize the information, and identifies future training needs of the Chicago Police Department Detective personnel.

The study develops a model to measure the efficacy of the collaborative training program. The researcher utilizes an educational model, a hierarchical formative evaluation, proposed in 1993. The hierarchical formative evaluation is further developed and operationalized by incorporating a widely accepted educational taxonomy on cognitive thinking skill levels. The resulting evaluation model is a unique approach to measure the efficacy of training at several different levels. The final evaluation model is unique. No published literature documents the incorporation of this taxonomy into the formative evaluation model.

A self-administered survey instrument is the primary data source. The survey instrument (questionnaire) was developed from material presented in the collaborative training program. The questionnaire measures the cognitive thinking skill levels for achievement of the material delivered during training.

From a local perspective, the benefits of the study determine the current understanding of forensic biology/DNA within the Chicago Police Department Detective Division. The study also determines if the training received from the Illinois State Police was effective and identifies additional specific topic related training. In addition, suggestions for changes/modifications to the current program for new detective classes are recommended.

From a national perspective, the research is applicable to other entities within the criminal justice system and other complex systems/organizations. To date, very little emphasis has been placed on the development of training in forensic sciences for police detectives. This lack of training and emphasis in forensic science has been identified through national surveys and studies on police detective training. Currently, there is the start of a national effort, the "Improving Justice Through DNA Initiative," to develop formal forensic science training programs for all elements of the criminal justice community.

Additionally, the research will validate the collaborative training model. The collaborative approach to the development of the training is new to the law enforcement community. The collaborative model demonstrates a successful method to accomplish forensic science education in detective training in the future. This research on the development of the hierarchical formative evaluation model and confirmation of the collaborative training model will significantly contribute to the national agenda.

Lastly, the National Institute of Justice (NIJ) is developing a model to measure the effectiveness of training. The evaluation of training will be mandatory for any training project utilizing grant money. The model presented accomplishes this future requirement.

Forensic Biology/DNA Training for Detectives/Investigators, Public Policy Analysis, Hierarchical Formative Evaluation

B20 Microspectral Analysis of Gemstones and the Applications to Forensic Science

Paul Martin, PhD, CRAIC Technologies, 2400 North Lincoln Avenue, Altadena, CA 91001*

After attending this presentation, attendees will learn the techniques used to prepare and analyze gemstones and to understand and interpret the spectral data.

Since gemstones are often stolen, this presentation will impact the forensic community and/or humanity by giving the forensic community the

skills to identify and characterize gemstones as criminalists comes across them in their work.

The theft of gemstones has occurred since time immemorial and has become quite romanticized. The topic has been the subject of literature and film from "Le Count du Monte Cristo" to "The Pink Panther." Yet the theft of gemstones is quite a real issue and there are real problem in identifying gems. In addition, because of their value, gems are often counterfeited with less precious materials. It is important for the forensic scientist to be able to confirm the identity of precious stones and their less precious substitutes.

The purpose of this paper is to show the techniques used for the forensic analysis of gemstones by UV-visible-NIR microspectroscopy and microfluorometry. These techniques include sample preparation, methods of spectral data acquisition and, of course, spectral analysis and interpretation. The talk will also review the data from several types of gemstones in order to aid the examiner in identifying them in casework.

Microspectrophotometer, Gemstones, UV-Visible-NIR

B21 The Outdoor Crime Scene: Influence of Weather and Soil Types on the Detection of Diluted Blood With Luminol

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The goal of this presentation is to demonstrate to the forensic community the usefulness of luminol application at outdoor crime scenes, months and even years after blood was spilled.

This presentation will impact the forensic community and/or humanity by showing the usefulness of applying luminol at outdoor crime scenes to detect diluted blood, will discuss the different results on different types of soil and discuss how it may aid the crime scene investigator in his/her homicide investigation.

Traditionally luminol has been used as a presumptive reagent to detect blood, both fresh and old. Luminol is capable of detecting blood in dilution up to 1:5.000.000 and it´s usefulness at indoor crime scenes is well known and well documented.

Due to the effect of rain or snow, visible blood may quickly disappear at an outdoor crime scene. Little has been documented on the use of luminol to detect diluted blood in outdoor conditions although homicides committed outdoors are not uncommon.

This presentation will describe a study performed to investigate the time period that luminol can detect diluted blood outdoors, in exposed areas and to investigate if the type of soil that blood is spilled on, affects the length of time that luminol can detect spilled blood outside. The study was also designed to investigate the possible difference in detection of diluted blood with luminol, between blood spilled in the summer, when the ground is dry, and blood spilled in the winther, when the ground is wet or snow covered. Possible difference in the behavior of human versus pig blood and human blood with and without an added anticoagulant was also investigated for research purposes.

A remote rural area with restricted access was chosen for the site of study. The area contained a green area, with both grass and moss, gravel, mixed with sand, and rocks. On the green area as well as the gravel and rock, selected volumes of human blood (obtained from live volunteers) was spilled. The volume ranged from 5ml-1000ml, to simulate anything from insignificant bleeding to a life threatening blood loss. Blood was spilled according to a protocol in the month of August, under sunny and dry conditions, and in February, on top of snow, while raining. As human blood in large volumes is difficult to obtain, a parallell study was run using pig blood for comparison to see if pig blood might be substituted for human blood in further such outdoor studies. Both the human and pig blood was without anticoagulant. For further comparison, a large volume of human blood mixed with anticoagulant was also spilled. Automatic hourly recordings of temperature, windspeed and precipitation were obtained for the area during the entire study period. The areas of spilled blood were monitored daily while blood was visible with the naked eye. Thereafter selected areas within the areas where the blood was spilled, were sprayed weekly with luminol and the luminesence documented. Planned study period is 18 months. For an extended time frame, a homicide scene where blood was known to have been spilled in a lava field 18 months previously was revisited with luminol at the onset of the study.

Results of this study will show the usefulness of applying luminol at outdoor crime scenes to detect diluted blood, will discuss the different results on different types of soil and discuss how it may aid the crime scene investigator in his/her homicide investigation.

Luminol, Outdoor Crime Scene, Criminalistics

B22 Fulfilling the Role of the Forensic Scientist: The New Orleans Police Department as a Case Study and Argument for Greater Emphasis on Actualized Science

Anna S. Duggar, MS, and Rose R. Duryea, MA, New Orleans Police Department Crime Laboratory, 2932 Tulane Avenue, New Orleans, LA 70119*

After attending this presentation, attendees will learn the emphasis of active casework and interagency communication over the strict re-validation of accepted techniques. Practical examples from the working New Orleans Police Department structure will be provided as a starting point for efforts in the attendee's lab or law enforcement agency.

Most public sector forensic scientists have to face the choice of research and validation versus casework and communication. Using the NOPD as a model, this presentation will demonstrate the need for scientifically trained personnel to move from the academic emphasis on completeness to the more flexible "triage" emphasis on responsiveness and inter/intra-agency communication. This presentation will impact the forensic community and/or humanity by serving to provide examples of creative solutions to the conflict, and to contining the current discussion of the role of the forensic scientist in criminal investigations.

Forensic science is defined as the application of science to questions of law and is, by nature, an applied science, implemented without the benefit of the controlled conditions present in more traditional sciences. Recent accreditation, validation, and quality assurance/quality control efforts aim to regulate science to prevent the acquisition of false data and to make results more reproducible. But this inherently desirable process can go too far if insistence on formal validation protocols in applied forensic labs creates an impediment to a laboratory's expansion of its capabilities or its ability to meet the needs of the law enforcement community. With the challenges of understaffing and underfunding facing many applied forensic labs, most forensic scientists have to face the choice of research and validation or casework and communication.

At the 2004 meeting of the American Academy of Forensic Sciences, a series of presentations in the Criminalistics section addressed the involvement of the forensic scientist at the crime scene and in criminal investigations. Widespread agreement exists that scientists in forensic science must be involved, as non-scientists cannot be expected to produce skillful applications of the scientific method to applied casework. As with any science, experimentation leading to expansion of capabilities and new technologies is vital. Forensic science has an impressive cadre of researchers whose full-time mission is the dissemination of improved technology to the practitioners in the field. But the practitioners have their own challenges to meet: timely casework results—in not only an adjudicative role, but in the underutilized investigative mode—and inter-agency communication must be paramount for the applied forensic scientist to fulfill

his or her function. Cumbersome validation studies that prevent or delay the usage of generally accepted techniques can be a significant hindrance to job performance.

The New Orleans Police Department is a working model demonstrating the vital need for scientifically trained personnel to move from the academic emphasis on completeness to the more flexible "triage" emphasis on responsiveness and communication. Criminalists at the NOPD Crime Lab have faced the considerable caseload of any forensic scientist in a large city, compounded with drastically low wages and a malnourished laboratory budget. In a situation where responsive casework management, investigative involvement of forensic professionals, and better interagency communication are balanced against the forensic community's demand for in-house validation and classic structure, it rapidly becomes clear that more creative approaches are necessary.

For example, in response to the identification of a lack of communication between branches of law enforcement in New Orleans as one of the primary obstacles facing crimefighting efforts in the city, district attorneys have been invited to COMSTAT meetings, while homicide detectives sit in on the DA's weekly strategy sessions. Additionally, the constant need for low turnaround times on priority cases has prompted the metamorphosis of the Forensic Light Unit (FLU), a two-man on-call unit, from a reactive latent print unit into a proactive investigative response unit. New techniques are responsibly and effectively put into practice by FLU with appropriate QA/QC protocols, but the predominant emphasis in this new model is the direct application of scientific expertise to questions of law provided by investigators and attorneys, and the conscious commitment of time and energy to maintaining open lines of communication. The success of this new emphasis is evident in both anecdotal and quantifiable levels of satisfaction among investigators.

In applying creative problem solving to overwhelming demands on time and resources, the department has definitively demonstrated, as prominent members of the field have suggested, that "doing the job right cannot supplant doing the right job."

Forensic Science, Validation, Communication

B23 The Value of Trace Evidence as an Investigative Tool

G.M. Yezzo, BS, Ohio BCI&I, 1560 State Route 56, PO Box 365, London, OH 43140*

The goal of this presentation is to provide some case examples of unexpected circumstances or forms of trace evidence that have provided assistance in an investigation.

This presentation will impact the forensic community and/or humanity by serving as a reminder of some of the uses of trace evidence as an additional investigative tool that may solidify the findings in case.

DNA analyses alone may not resolve all cases that include biological evidence such as semen or blood. Even in cases where these materials are present, depending upon the case facts, trace evidence may assist substantially in the investigation.

Most forms of Trace evidence provide only class or comparative information. However, the microscope may be used to identify particles that provide important investigative information. Many of the types of materials discussed in this presentation are documented in available references on trace evidence such as Volumes of *The Particle Atlas (McCrone and Delly (1973) and McCrone, Delly and Palenik (1979)), Color Atlas and Manual of Microscopy for Criminalists, Chemists and Conservators* (Petraco and Kubic, 2004), *Mute Witnesses –Trace Evidence Analysis (Houck, 2001) and Trace Evidence Analysis* (Houck, 2003). Taking advantage of the trace evidence may provide crucial investigative information or establish a link between individuals or an individual and a location. The goal of this presentation is to provide some case examples of unexpected circumstances or forms of Trace evidence that have provided assistance in an investigation.

The presentation will highlight variations of the typically encountered types of trace evidence that may have greater value given special circumstances and assist in an investigation of an unknown perpetrator or illustrate association with the incident due to the presence of material or form or condition of the samples. Examples to be presented include evidence deposited in bloodstains, beaded spray paint microscopically identified on a roll of duct tape left at the scene which led to a subject, bloodstain patterns of the impression of the weapon (a table steak knife that had been cleaned and returned to a drawer in the kitchen) that demonstrated a garment worn by one of the victims, microscopic examination of a human hair wig used to disguise a perpetrator that led to finding that some imported are made from cadaver hair, the tire and partial license plate impression in snow at the scene of a multiple homicide and variations of fabric damage including an example that helped to substantiate statements of the victim in an acquaintance sexual assault.

This presentation will also include some unusual types of trace evidence. Examples include botanical samples such as thorns in a subject's clothing that were found to be consistent with thorns from a rose bush damaged by the perpetrator who jumped from a second floor window to escape from the scene, sequential layers of material deposited in hollow point projectiles, welding spheres microscopically identified from the debris on the clothing of an 8-year-old kidnapping victim, and air bag evidence such as makeup, fiber samples and starch granules that may assist in determining the driver of a vehicle involved in a fatal accident. If you do, you could say that provided information linking the items to the airbag.

The author gratefully acknowledges the permission of Glenn Schubert and the Illinois State Police for permitting the inclusion of photos related to air bag evidence in this presentation.

In summary, it should be emphasized that the use of trace evidence as an additional investigative tool may solidify the findings in any given case.

Trace Evidence, Investigative Information, Criminalistics

B24 Forensic Intelligence - Forensic Science Beyond the Courtroom

Rebecca Bucht, BSc, 309 West 76th Street, #4A, New York, NY 10023; and Oliver Ribaux, PhD, Université de Lausanne, Ecole des Sciences Criminelles, Lausanne-Dorigny, BCH, 1015, Switzerland*

The goal of this presentation is to introduce a framework for integrating forensic evidence into the criminal investigation and intelligence analysis processes, complete with examples of real life applications and results.

This presentation will impact the forensic community and/or humanity by demonstrating how the development of forensic intelligence can improve knowledge of criminal mechanisms through the exploitation of a solid set of real-time data at a tactical, operational and strategic level.

Despite evidence of the benefits of applications of forensic case data to the investigative and intelligence world, research and implementation of forensic science continues to focus primarily on its function as proof in courts of law. This not only deprives said investigative and intelligence applications from an added information source, it also renders a huge wealth of forensic information unexploited.

Forensic intelligence is in essence the product of logically processing forensic case data. Although the concept of collecting and processing forensic data is by no means novel, modern technology provides databases capable of storing, handling and sorting large amounts of increasingly complex data, allowing these old concepts to be realized more effectively and on a larger scale.

The basic inferences made from forensic data include identifying recidivists, individualizing a source based on a trace, individualizing a trace based on a source, linking cases by trace-trace comparisons, profiling of the source of a trace, classifying the source of a trace, listing possible sources of a trace and listing possible relatives of the source of a trace. These inferences are made based on physical and chemical characteristics of samples and standards.

Fingerprint and DNA databases are two examples of where forensic information is used in a wider context, whether it is to identify recidivists, individualize a source based on a trace, individualize a trace based on a source, or link cases. Other forms of traces such as shoeprints, tool marks, and glove prints are less systematically exploited. These traces are abundant on crime scenes, less expensive to process, and can provide significant information. Even though a particular trace cannot necessarily provide a conclusive enough inference to be used as evidence in a court of law, the information it can provide can be indispensable in an intelligence setting.

The forensic science community should be more aware of the importance of extending the impact of forensic science beyond the courtroom. Similarly the intelligence community needs to be aware of the kind of information forensic science can provide. Effort also needs to be made to ensure functional channels of communication exist between forensic scientists and investigators, intelligence analysts and other professionals in order to ensure that the forensic case data is properly understood and contextualized.

For example, in the case of illicit drug profiling, the chemical data is first interpreted by forensic scientists in order to evaluate links between seizures. This linkage information is then passed on to investigators, and further to criminologists and geo-politicians, who all may be able to combine the forensic data with the data they already base their investigations on.

There are many potential benefits in expanding the use of forensic science data in investigative and intelligence scenarios. The input and cooperation of the forensic science community is needed in order to assure a successful integration.

Forensic Intelligence, Intelligence Aanalysis, Linkage Blindness

B25 1,2-Indanedione: Is it a Useful Fingerprint Reagent?

Chris Lennard, PhD, Australian Federal Police, Forensic Services, GPO Box 401, Canberra, ACT 2601, Australia; Christie Wallace-Kunkel, BSc, and Claude Roux, PhD, University of Technology, Sydney, Centre for Forensic Science, PO Box 123, Broadway, NSW 2007, Australia; and Milutin Stoilovic, MSc, Australian Federal Police, Forensic Services, GPO Box 401, Canberra, ACT 2601, Australia*

After attending this presentation, attendees will gain an understanding of the fingerprint reagent 1,2-indanedione: its strengths, weaknesses and the inconsistencies reported over the last 8 years in terms of its value as a fingerprint reagent. Recommendations will be made based on the results of the research performed.

This presentation will impact the forensic community and/or humanity by the presentation of the results of this research which will contribute to the body of information already available on the value of 1,2-indanedione as a fingerprint reagent. Conflicting results have been reported to date. This study, under Australian conditions, indicates that 1,2-indanedione is a viable alternative to ninhydrin and DFO for latent fingermark detection on porous surfaces.

Ninhydrin is the accepted, routine reagent for the chemical detection of latent fingermarks on porous surfaces such as paper. Ninhydrin reacts with the amino acid component of the latent fingerprint deposit to produce a dark purple product known as Ruhemann's purple. Secondary treatment of a ninhydrin-developed mark with a zinc or cadmium metal salt produces a coordination complex that is luminescent under certain conditions. Significant enhancement is possible in the luminescence mode. Numerous research projects have been undertaken since the early 1980s to find ninhydrin analogues that offer advantages over ninhydrin itself.

In 1995, whilst researching ninhydrin analogues, Jouillé and co-workers, in conjunction with the U.S. Secret Service, synthesised a new type of latent fingerprint visualising agent, 1,2-indanedione (Ramatowski, 1997). Since then, researchers around the world have conducted research into the capabilities of 1,2-indanedione as a fingerprint reagent. The results have been varied, with conflicting results and different recommendations made.

A critical review of the literature regarding 1,2-indanedione was performed. A number of discrepancies exist in the literature as to which formulation and which development procedure produces optimal results. As a result, this project set out to determine the best formulation and development procedure under Australian conditions, encompassing all published recommendations as well as some novel approaches. 1,2-Indanedione formulations were compared with respect to initial color, luminescence, concentration of reagent, acid concentration, and the effect of different carrier solvents.

Numerous development conditions were investigated, including a conventional oven, a heat press, humidity, metal salt treatment and liquid nitrogen. A heat press set at 165º C for 10 seconds proved to give the best initial color and the highest luminescence. Secondary metal salt treatment improved initial color and luminescence. The Polilight (Rofin), the VSC-2000 (Foster & Freeman), and the Condor Chemical Imaging Macroscope (ChemImage Corp) were used to detect the fingerprints developed with 1,2-indanedione on a variety of high- and low-quality porous surfaces. Overall, very good results were obtained.

The optimum formulation for 1,2-indanedione was found to be a 1% (w/v) solution using HFE 7100 as the carrier solvent. 1,2-Indanedione treated fingermarks were best developed using a heat press set at 165º C for 10 seconds, after which they display a bright pink initial color and a high degree of luminescence at room temperature.

Field tests were also conducted to compare 1,2-indanedione with DFO and ninhydrin, showing that 1,2-indanedione develops more fingerprints than the conventional reagents and thus should be considered as a viable alternative for the development of fingerprints on porous surfaces. It is obvious that 1,2-indanedione, as a fingerprint technique, is very much dependant on environmental conditions, reagent formulation, and development conditions for optimum results to be obtained. It is for this reason that different research groups around the world have had varying results with respect to the application of this reagent.

It has been well established that ninhydrin reacts with amino acids to form Ruhemann's purple. Very little information on the chemistry of 1,2-indanedione exists in the literature and the product formed upon reaction with amino acids has not been confirmed to date. The current research aims to characterize the reaction product using fluorescence spectroscopy, infrared spectroscopy, UV-visible spectroscopy, mass spectroscopy, and nuclear magnetic resonance spectroscopy.

Latent Fingermarks, Porous Surfaces, 1,2-Indanedione

B26 The Billiard Ball Ricochet Effect and the Garment as an Intermediate Target

H. Bulent Uner, PhD, Istanbul University, The Institute of Forensic Sciences, I.U. Adli Tip Enstitusu Cerrahpasa, Istanbul, 34303, Turkey; and Ismail Cakir, PhD, Council of Forensic Medicine, Minisrty of Turkey, Adli Tip Kurumu Esekapi Cerrahpasa, Istanbul, 34246, Turkey*

After attending this presentation, attendees will learn the importance of billiard ball effect while determining firing distance.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of billiard ball effect while determining firing distance.

From the area of dispersed pellets on the target, a rough estimation of range of fire can be made. There are many factors that affect the dispersion of the pellets like length and diameter of the barrel, size of the pellets, degree of the choke, etc.

If a shotgun is fired in contact with a body or at close range, pellets hit the body en masse and are scattered a wide area within the body. This

ricochet phenomenon has been termed 'the billiard ball ricochet effect'. Also, this phenomenon can occur when pellets hit the clothing en masse. This intermediate target will cause an increase in dispersion of the shot. The thickness of the clothing, the nature of the fabric and the number of layers of the garment can alter this dispersion of the shot.

In determining the range of fire in decomposed and burned bodies where the skin pattern cannot be seen, x-rays revealing shot patterns may be of considerable assistance. However caution is necessary. In these cases, the billiard ball ricochet effect may lead to erroneous conclusions about the range of fire because of the opinion is formed on basis of the pattern of the pellets on x-rays. Wide dispersion of the shots seen on the x-rays may lead to conclusion of a great range of fire than actually occurred

The cases presented are good examples of the billiard ball ricochet effect with intermediate targets. In the first case a woman had a contact shotgun wound of the abdomen. On the x-rays, widespread scatter of pellets were seen within the body. In the second case, although the pellets hit the clothing en masse, the size of shot pattern on the body was over a large area.

Shotgun, Pellet Distribution, Billiard Ball Ricochet Effect, Range of Fire

B27 Who Shot Muhamed Jamal Al-Dura? Is the Boy Still Alive?

Maurice Rogev, MB ChB, 11 Zamenhof Street, Tel-Aviv, 64373, Israel; and Nahum Shahaf, Msc, Natop, Habiluim st 3, Ramat-Gan, 52297, Israel*

After attending this presentation, attendees will understand the need to be cautious with media reports unless it's based on accepted forensic science criteria.

This presentation will impact the forensic community and/or humanity by demonstrating the inaccurate impression created by the media in their description of the A-Dura episode on the second day of the Palestinian Intifada, emphasises the need for caution in interpreting critical Death news reports published by the media unless its based on accepted forensic science criteria.

Details of the Incident: On September 30, 2000, the second day of the Intifada a crowd of Palestinian policemen and civilians, some armed, attacked repeatedly an isolated Israel Defence Force (IDF) outpost situated at a road junction near Netzarim, an Israeli village in Gaza.

French and other television groups televised the incident. The event developed initially as a demonstration and turned violent when Palestinian policemen began to shoot at IDF soldiers in the outpost. French television showed a father and his son Muhammed al-Dura hiding behind a concrete barrel. The 12-year-old boy seemed to be killed and his father seemed to be wounded. The French television alleged that A-Dura was killed by IDF fire. The IDF soldiers claimed that they did not see the pair crouched behind the barrel and they didn't shoot at them.

The pictures of the event were shown all over the world and Muhammad a-Dura became the symbol of the Palestinian intifada.

Methodology: No autopsy examination of the body was made by the Palestinians, there are no accurate details of any wounds that may have been caused by the gunfire. The body was not identified according to accepted standards and recognized practices. The identity of the body cannot therefore be accepted as that of Mohammed a-Dura the boy A-Dura was clearly not killed by IDF fire.

Aerial photographs were taken of the scene that showed the crossroad and the position of the Israeli Defence Force (IDF) outpost. Television footage of scenes of the riot, the boy cowering with his father and of the funeral procession were examined as well as medical notes and still photographs of the boy lying on a mortuary slab.

The aerial photographs showed the crossroad, the wall and concrete barrel behind which the boy and his father had hidden, the IDF outpost and the Palestinian outpost called the "Pita" across the road opposite the wall.

As the original wall had been destroyed for security reasons, a reconstruction of the immediate area of the wall and the barrel of concrete was made. The barrel had the same diameter of the barrel involved in the incident. Geometric and ballistic criteria were used in the reconstruction

The same type of rifles used by the IDF soldiers and the Palestinians were fired directed towards the barrel and the wall at an angle of the alleged fire from the IDF outpost, the "Pita" and from other angles. The television footage and still photographs of the incident and the still photographs of the body were also studied. Medical reports by a Palestinian doctor describing the injuries found on the body were studied in the absence of a complete autopsy protocol. No spent bullets or cartridge cases were available for Ballistic examination.

Results and Conclusions:

1. The geometrical and ballistic findings show that the boy was protected from the direction of the Israeli outpost.
2. The spread of the particles of stone caused by the impact of the two bullets next to the boy's head proves that the fire came from a less oblique direction, consistent with the Palestinian position (named "Pita").
3. The position of the Palestinians relative to the Israeli outpost raises the possibility that the shooting was deliberate.
4. Part of the bullet holes in the wall were made later artificially.
5. Long cut on the body of the boy described by one of the doctors fit a knife rather than a bullet.
6. The evidence of the doctors shown in the television and in telephone conversations is not consistent with the signs of injury in the photographs of the boy alleged to be that of Mohammed A-Dura in the hospital. This raises the suspicion that this is not the boy A-Dura.
7. According to the evidence of the doctors at the hospital the body of the boy a-Dura reached the hospital some hours before the time of the incident started. Therefore the dead boy presented in the hospital as Muhammad a-Dura cannot be the boy from the Netzarim junction.
8. The signs of injury on the boy's body at Netzarim were not con sistent with fresh blood.
9. Many manufactured incidents were revealed in the television pictures. These included gunfights in front of the cameras in areas that were hidden from the IDF outpost.

The all event around Mohammed al-Dura including many other events seems to be created, including the death of the boy named Muhammad al-Dura.

Media Reports, Al-Dura, Forensic Criteria

B28 Uncertainty in the Estimated Angles of Impact of Freely Falling Blood Drops

Jon A. McGuire, MFS, and Walter F. Rowe, PhD, Department of Forensic Sciences, The George Washington University, Washington, DC 20052*

After attending this presentation, attendees will learn how to determine the confidence limits for the calculated angle of impact of a falling blood drop with a target surface. This preseantation will outline the relevant experimental data for a particular target surface and the statistical treatment of this data.

This presentation will impact the forensic community and/or humanity by demonstrating that the uncertainties in the calculated angles of impact of blood drops with target surfaces are considerably smaller than standard texts on bloodstain pattern analysis claim.

The goal of this presentation is to provide crime reconstructionists with a validation of the Balthazard formula for the calculation of the angle of impact of a blood drop with a target surface. This presentation also will also provide estimates for the uncertainty in a calculated angle of impact for ranges of impact ranging from 10 to 90 degrees.

Crime scene reconstructionists and bloodstain pattern analysts frequently use the Balthazard formula for calculating the angle of impact of a freely falling blood drop with a target surface from the dimensions of the resulting blood spot. Blood drops impacting a flat surface at an angle θ produce an elongated blood spot having length L and width W. The angle θ is then given by the equation:

$$\theta = \arcsin (W/L)$$

In 1993 the U.S. Supreme Court set out a number of criteria for the admission of scientific evidence; among them is the known or potential error of a scientific technique. Books on bloodstain pattern analysis rarely discuss the uncertainties in the calculated angle of impact. Bevel and Gardner's widely used text *Bloodstain Pattern Analysis* suggests that the calculated angles are accurate to within five to seven degrees.

This research was undertaken to determine the 95 and 99% confidence limits for the estimated angles of impact of blood drops. Fifteen microliter drops of human blood were allowed to fall ten and thirty-six inches onto the uncoated surface of white poster board with impact angles of approximately 10, 20, 30, 40, 50, 60, 70, 80 and 90 degrees. Fifteen drops of blood were dropped at each angle of impact and each distance of fall. Fifteen microliters was found to be the smallest volume of blood that would fall freely from the disposable tip of a Pipetman pipetter. Two different distances of fall were used to determine if the estimated angles of impact showed any dependence on the distance of fall. Theoretically there should be no such dependence. The untreated surface of the white poster board was chosen as the target surface to reduce the flow of the blood drops after impact. The target surface was held in a homemade device made from Plexiglas and wooden dowel rods. Slots were cut in the Plexiglas at angles ranging from 10 degrees to 90 degrees; the angles of the slots were measured after they were cut. The lengths and widths of the blood spots were measured with a Cen-Tech 4 inch digital caliper. Three of the blood spots produced at an angle of impact of 80 degrees and a thirty-six inch distance of fall were discarded because their widths were greater than their lengths. The measured lengths and widths of the blood spots were used to calculate the angle of impact using the Balthazard formula. The means and standard deviations of the calculated angles of impact were determined for each angle of impact and each distance of fall.

Analysis of variance (ANOVA) was performed on the calculated angles of impact. For a ten inch distance of fall an F value of 1187 was obtained, while for a thirty-six inch distance of fall an F value of 1288 was obtained. These results show that the Balthazard formula is statistically significant at the 99.5% level. More importantly, because these two F values exceed the critical F values for the 99.5% confidence level by more than a factor of four, the Balthazard formula is shown to be a satisfactory predictive tool.

The standard deviation of the calculated angle of impact was found to increase with the angle of impact, in agreement with previously published work. The confidence range (the difference between the upper and lower confidence limits) for the calculated angles of impact were determined at the 99% confidence level using:

$$2t_{0.005,n-1}\frac{s}{\sqrt{n}}$$

where t is Student's t, s is the standard deviation and n is the number of data points used to calculate s. The table below shows the confidence ranges for the angles of impact from 10 to 90 degrees for both distances of fall.

Approximate Angle of Impact	Distance of Fall = 10 Inches	Distance of Fall = 36 Inches
90	6.410283	8.255688
80	11.2365	7.701132
70	3.365768	4.722746
60	2.463193	2.667552
50	2.148248	1.754003
40	1.686314	2.435882
30	1.136359	1.993076
20	0.795556	1.59836
10	1.46632	0.710401

Up to an angle of impact of 60 degrees the uncertainty in the calculated angle of impact is less than 3 degrees, substantially better than the uncertainty claimed by Bevel and Gardner.

Bloodstain Pattern Analysis, Crime Scene Reconstruction, Criminalistics

B29 The Detection and Enhancement of Latent Fingermarks Using Infrared Chemical Imaging

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After attending this presentation, attendees will gain knowledge of the capabilities of a novel technique (infrared chemical imaging) for imaging latent fingermarks on difficult surfaces.

With technology continuously evolving, this presentation will impact the forensic community and/or humanity by exploring new developments that may prove to be superior to techniques currently in use in forensic laboratories. Infrared Chemical Imaging has been demonstrated to be effective for detecting fingermarks on difficult substrates.

This poster will present the results of a study that began in 2003 and continues to date. During this study the use of a new technique, Fourier transform infrared (FTIR) chemical imaging, has been demonstrated for the enhancement of latent fingermarks on a number of surfaces.

All fingerprint detection techniques aim to create contrast between the ridge details of a latent fingermark and the background on which it is located. The majority of current methods rely on this contrast to be in the visible part of the electromagnetic spectrum, and thus encounter problems when background interferences such as printed images or patterns are present. Some of these problems may be overcome using traditional visible or fluorescence imaging techniques (e.g., alternate forensic light sources with appropriate barrier filters) or visible and fluorescence chemical (hyperspectral) imaging techniques. However, due to the very broad, overlapping bands that make up all visible absorbance and fluorescence spectra, it is not always possible to obtain acceptable fingerprint images even using chemical imaging techniques in this region of the electromagnetic spectrum.

The vibrational spectra (infrared or Raman) of most carbon compounds consist of large numbers (often more than ten) narrow, well-resolved bands that represent vibrational modes of discrete functional groups in these molecules. As a means of identifying and discriminating between different molecules, vibrational spectra are thus far more powerful than UV-visible methods, which consist of very broad, overlapping bands. To date, this inherent feature of infrared (and Raman) spectra has not been utilized in the forensic visualization of fingermarks. This is because that,

until recently, infrared and Raman techniques provided no spatial information on a sample. Spatially resolved chemical information, however, is now accessible with the development of infrared chemical imaging.

FTIR chemical imaging employs a focal plane array (FPA) detector that can be thought of as a large number (thousands) of discrete detectors (or pixels) laid out in a grid pattern (Digilab, Nicolet, Bruker instruments). The instrument collects images that may consist of thousands of pixels, with a spectrum at each pixel. In this way thousands of mid-infrared spectra are simultaneously collected from a sample while maintaining spatial information.

By far the most common type of FPA detector used for mid-infrared chemical imaging is a 64 × 64 pixel mercury cadmium telluride (MCT) focal-plane array detector. The detector used in this study was a Digilab Lancer 64 x 64 MCT detector. This detector collects 4096 infrared spectra simultaneously into a file that can be thought of as a datacube. This three dimensional datacube (x x y x wavenumber) can be visualized as a collection of images of the sample, with one image for each wavenumber resolution unit.

This poster describes the application of infrared chemical imaging to the visualization of fingermarks, with and without cyanoacrylate fuming, and explores the future possibilities of this technique. Images of untreated fingermarks on glass substrates with excellent ridge detail were acquired using infrared chemical imaging. High quality fingermarks on glass substrates were also developed using ethyl cyanoacrylate (super glue) fuming and subsequent infrared chemical imaging. This new method allows the collection of images from backgrounds that traditionally pose problems for current fingerprint detection methods. The background may, for example, be highly colored, have a complex pattern, or possess other pattern or image characteristics that make it difficult to separate fingerprint ridges using traditional optical or luminescent visualization. One background that has proven to be a challenging surface for the development of latent fingermarks is the Australian polymer banknote. To demonstrate the power and applicability of infrared chemical imaging, latent fingermarks fumed with ethyl cyanoacrylate were successfully imaged from Australian polymer banknotes.

This imaging technique has shown enormous potential for the detection and enhancement of latent fingermarks on a range of surfaces. This work is currently being extended so that the true capabilities of infrared chemical imaging may be realized. It is important to stress that this new method does not aim to replace any of the currently used fingerprint enhancement techniques, but rather aims to provide the forensic scientist with a tool that may prove useful on surfaces where conventional techniques fall short.

Infrared Chemical Imaging, Latent Fingermarks, Hyperspectral Imaging

B30 Development of a Rubber Stamp for Fingerprint Research

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After attending this presentation, attendees should consider the use of a rubber stamp and an amino acid solution as a method for producing standard latent fingermarks for the evaluation of amino acid specific fingerprint reagents.

This presentation will impact the forensic community and/or humanity by demonstrating the use of the rubber stamp for fingerprint detection research will allow fingerprint reagents to be directly and accurately compared not only within one fingerprint research project but across different research projects. Significant applications for quality assurance purposes are also envisaged.

Latent fingermarks produced for research purposes are generally deposited by the same donor(s) at various times throughout the course of the project. The problem with this approach is that each fingermark deposited will differ in chemical composition and pressure applied due to environmental and physiological factors. Thus the results cannot be compared directly, as the composition of each latent mark on the support surfaces will vary to some extent.

The purpose of this research was to develop a rubber stamping process for the production of 'standard' latent fingermarks for the evaluation of fingerprint reagents, ensuring that the same quality print would be deposited with each application, thus allowing direct comparison not only within one research project but across various research projects.

The development of the rubber stamp involved three processes:

1) The development and manufacture of a rubber stamp. Inked thumbprints were obtained, scanned onto a computer, and sent to a rubber stamp making company. The stamps were ready within 48 hours.
2) The formulation of a 'standard' amino acid solution and the determination of a method of application. The formulation of the solution was determined by investigating the concentration of amino acids in eccrine secretions (human sweat). Inkless stamp pads were obtained to which the amino acid solution was added.
3) Method validation as well as transfer and persistence studies. This involved an investigation of the variations in amino acid concentration between stamp applications. A high performance liquid chromatography (HPLC) method was developed and validated for the detection of amino acids in a water-based solution and in deposited marks.

Using high performance liquid chromatography, it was found that the amino acids did not persist on the rubber stamp, nor did the concentration of the amino acids vary over time to any significant extent. This means that each impression laid by the stamp was qualitatively and quantitatively constant — this was the desired outcome for the use of the procedure as a comparative research tool.

The whole process enabled a rubber stamp to be developed and used for the application of 'standard' latent fingerprint samples to be used for research purposes. Through this process, fingerprint reagents can be directly compared against a uniform 'standard'. Application of this method in the study of amino acid based fingerprint reagents removes a large number of variables associated with the use of latent fingermarks deposited by a range of randomly-selected donors. A similar strategy could also be used for the development of proficiency tests and quality control checks for the evaluation of latent fingermark detection protocols. To date, no such tests are available.

The use of a rubber stamp and an amino acid solution of known concentration cannot replace natural fingermarks, but should be considered as an option for the objective evaluation of an amino acid based fingerprint detection technique. While this option may appear simplistic, it goes some way towards reducing the variables that typically impact on fingerprint detection studies.

Latent Fingermarks, Rubber Stamp, Quality Control

B31 Chemical Processes Related to the Development of Latent Blood Fingerprints

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There are many different chemical methods of developing latent blood fingerprints. The goal of this presentation is to address what is the best way to develop these blood fingerprints, especially when those blood fingerprints are found on dark surfaces at a crime scene.

This presentation will impact the forensic community and/or humanity by demonstrating how the use of Ninhydrin, Amido Black, and Coomassie Blue are not feasible in these cases where blood is found on dark surfaces because they stain the fingerprint ridges a purple or dark blue color that is not visible on these dark surfaces. The solution may be a different color stain or one that fluoresces the blood print long enough to photograph it.

Latent blood fingerprints found on dark surfaces at a crime scene are not useful when developed with Ninhydrin, Amido Black and Coomassie Blue. These three examples are common techniques used on blood prints that stain the fingerprint ridges purple or dark blue which may not be visible on many dark surfaces. The solution to visualize these prints may be a different color stain or one that fluoresces a blood print long enough to photograph it. The chemical processes used in this study are ABTS, Merbromin, IND, Leucomalachite Green, Fluorescein, DFO, and Leucocrystal Violet. The fluorescent nature of many of these processes may assist in visualizing these latent blood fingerprints.

Latent, Blood, Fingerprint

B32 Evaluation and Comparison of the Electrostatic Detection Apparatus and the Electrostatic Dust Print Lifter on the Development of Footwear Impressions on Paper

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After attending this presentation, attendees will learn that the Electrostatic Detection Apparatus (ESDA) can be used to develop indented footwear impressions on paper; the attendee will learn the ESDA can be used in conjunction with the Electrostatic Dust Print lifter to obtain footwear impressions from paper; the attendee will learn which technique (the ESDA or the Electrostatic Dust Print Lifter) should be used to obtain the highest quality footwear impression; the attendee will also learn that if both techniques are used what order they should be used in to obtain the best footwear impression; and the attendee will also learn the ESDA will obtain footwear impressions on the top sheet of paper if a stack of papers are stepped on and the Electrostatic Dust Print Lifter lifts higher quality impressions as the amount of dust residue transferred to the surface decreases. This presentation will give athe attendees new ideas and uses for the equipment they may have already or plan to purchase.

This presentation will impact the forensic science community and/or humanity by allowing the forensic science community to understand what equipment should be used to obtain the highest quality footwear impressions from paper evidence. Crime Scene and forensic laboratory personnel are always trying to obtain the best evidence possible. This presentation will give the forensic science community new ideas for developing footwear impressions on paper evidence and will give them a reference on which technique should be used. It will also show that if both techniques are used, what order they should be used in to obtain the best evidence. Therefore, this presentation will help the forensic community decide what techniques to use in order to obtain the highest quality footwear impression.

The Electrostatic Dust Print Lifter is commonly used to lift footwear impressions from paper. The Electrostatic Detection Apparatus (ESDA), traditionally used to enhance indented writing, can also be used to develop footwear impressions on paper. This research compared the two methods for developing footwear impressions on paper in order to determine if both processes could be used to develop footwear impressions of the same or similar quality and in what order they should be used to develop the highest quality footwear impression. The sensitivity of each technique was also evaluated. The quality of the footwear impressions developed was determined by comparing twenty-five individual characteristics present on the known shoe to the footwear impressions developed using each technique. These footwear impressions were made by stepping on paper placed over several different surfaces. These surfaces included: linoleum, industrial Berber carpet, nylon carpet placed over a 3/8-inch pad, ceramic tile, cardboard, 1-inch foam, 4-inch foam, cement, asphalt, grass, and mulch. Each of the papers placed on these surfaces were developed using the Electrostatic Dust Print Lifter before the ESDA and using the ESDA before the Electrostatic Dust Print Lifter. The sensitivity test for the ESDA was conducted by placing ten sheets of paper (stacked) onto a carpeted hallway. This stack of paper was then stepped on with the known shoe. Each piece of paper in the stack, beginning with the top sheet, was processed with the ESDA until no footwear impressions were developed. The sensitivity test for the Electrostatic Dust Print Lifter was conducted by placing ten sheets of paper along a carpeted hallway. Each sheet was stepped on with the known shoe in succession beginning with the first sheet. Each of these sheets was processed with the Electrostatic Dust Print Lifter and compared. This study determined the footwear impressions developed using only the Electrostatic Dust Print Lifter were of better comparative value than impressions developed with only the ESDA. On average, 72.4% of the individual characteristics from the known impression were identified on images developed when only the Electrostatic Dust Print Lifter was used compared to an average of 38.9% when only the ESDA was used. Therefore, if only one technique is used, the Electrostatic Dust Print Lifter should be chosen. This study also determined if both methods are used on a piece of evidence, the ESDA should be used first and the Electrostatic Dust Print Lifter should be used second. This order results in satisfactory impressions with the ESDA and the Electrostatic Dust Print Lifter compared to using the Electrostatic Dust Print Lifter before the ESDA, which results in very low quality images with the ESDA. On average, 45.5% of the individual characteristics were identified using the ESDA first and the Electrostatic Dust Print Lifter second compared to an average of 72.4% using the Electrostatic Dust Print Lifter first and the ESDA second. Therefore, if the choice is available, the Electrostatic Dust Print lifter should be used instead of the ESDA. Unfortunately, if the Electrostatic Dust Print lifter is used first and the ESDA second, the results obtained using the ESDA will be of very low quality. The sensitivity test determined the ESDA develops high quality footwear impressions only on the top sheet of paper if the papers were stacked when the impression was placed on the paper. No footwear impressions were developed on any sheets under the top sheet of paper. The sensitivity test also determined the Electrostatic Dust Print Lifter results increase in quality as the amount of dust residue decreases on the surface. Therefore, crime scene technicians should be particularly interested in the top sheets of paper on a surface and footwear impressions in trace amounts of dust residue. These types of footwear impressions will most likely result in higher quality impressions that retain the most individual characteristics.

Footwear Impression, Electrostatic Detection Apparatus, Electrostatic Dust Print Lifter

B33 Seasonal Variation of Phosphatase and Sulfatase Levels in Soil and Their Potential Use in the Comparison of Evidentiary Soil Samples

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After attending this presentation, attendees will understand the possible utilization of enzyme activity in the comparison of soil samples.

This presentation will impact the forensic community and/or humanity by helping with the development of a screening method for the comparison of soil samples.

Enzyme activity in soil may vary according to geographical location and may be useful as a comparative tool in forensic geology. The type of location, weather conditions, and the season may influence the variability of enzyme activity.

Thorton and McLaren (1) were the first to propose enzymatic characterization to differentiate soil. Their study, however, is somewhat limited since seasonal variation was not accounted for. This study is designed to examine the role of seasons and to better assess the use of enzymatic analysis for comparative purposes in soil.

Soil samples were collected from four areas of differing topography and geography and assayed spectrophotometrically for the presence of two specific enzymes: phosphatase and sulfatase. Samples were taken from a location near water, an open field, a wooded area, and a sample from a hillside. Samples were collected during the spring, summer, fall, and winter. During each collection, five samples were taken fifty feet from a central point and mean values for enzyme activity determined.

Statistical analysis using one way-analysis of variance at 95% confidence was conducted to determine significant differences in enzyme concentration among the sites. Greater variation exists between collection sites than within samples from the same site for each individual season. Results indicate that variation in enzyme concentration does exist between sites but the extent of the variation changes with season. Sample locations show greater differences in the spring and summer than in the fall or winter.

The application of the method as a screening method used in conjunction with soil color comparison and particle size distribution will also be discussed.

1. Thorton JI, McLaren AD. Enzymatic characterization of soil evidence. *J. of Forensic Sci.* 1975; 20: 674-92.

Soil, Phosphatase, Sulfatase

B34 Detection and Identification of Personal Care Products in Sexual Assault Cases

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The goal of this presentation is to detect and identify key ingredients of ointments, creams, lotions and personal lubricants on evidence submitted in sexual assault cases where there is no DNA present.

This presentation will impact the forensic community and/or humanity by allowing the forensic scientist to determine if a personal care product was used in a sexual assault. This analysis may provide supportive case evidence and corroborate victim/suspect statements

Personal care products such as ointments, creams, lotions, and personal lubricants used by assailants in sexual assault cases may serve as important evidence when there is no DNA present. Detection and subsequent identification of key components of personal care products on clothing and in sexual assault kits may also provide supportive case evidence and corroborate victim/suspect statements.

A representative sample of eighteen personal care products, including hydrophobic petrolatum based ointments, water based lotions, sunscreens, face and hand creams, were examined in this study. These products were smeared onto clothing and cotton swabs to simulate case evidence. A flowchart used for the detection of smears and analysis of key components of each type of personal product will be presented.

This study describes the detection of smears on clothing and cotton swabs using a combination of visual observation, short and long wavelength ultraviolet light, the Forensic light source, and attenuated total reflectance Fourier transform infrared (ATR-FTIR) spectroscopy. In addition, polarized light microscopy (PLM) is used to detect anisotropic smear components.

This study also describes protocols for the extraction of smears from the substrates and the identification of key components using various analytical methods, including Fourier transform infrared spectroscopy (FTIR), gas chromatography / mass spectroscopy (GC/MS), pyrolysis gas chromatography / mass spectroscopy (pyrGC/MS), scanning electron microscopy /electron dispersive x-ray spectrometry (SEM/EDX), capillary electrophoresis, and/or high performance liquid chromatography (HPLC).

Ointments Creams Lotions, Sexual Assault, FTIR GC/MS CE

B35 Comparison of Pressurized Fluid Extraction Methods of Adsorbents For Use In Human Scent Evidence Collection

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After attending this presentation the attendee will learn the uses and applications of pressurized fluid extraction methods and their implementation for the purpose of the removal of organic volatile compounds from adsorbents used to collect human scent.

This presentation will impact the forensic community and/or humanity by providing a better awareness for the selection of adsorbent materials used in the collection of human scent. The removal of the organic compounds present initially on collection materials will lead to a more "chromatographically clean" medium from which to analyze human scent for evidentiary purposes.

The use of human scent identification by canines has been featured recently in a number of recent high profile court cases within the United States. While accepted in several European countries, the strict requirements for scientific evidence admissibility in the United States, set forth by the *Frye* and *Daubert* rulings have restricted the application of canine human scent identifications within the U.S. This is due in part to a lack of definitive studies demonstrating the reliability and validity of this approach, which has led to successful legal challenges to the use of these biological detectors in a court of law. As part of the scientific investigation into the forensic validity of canine identification of human scent, the chemical composition of scent must be proven to be unique to an individual and the scent profile must be proven to be stable over time. The instrumental determination of the organic compounds present in human odor plays an important role in determining the uniqueness of human scent, and thus the optimization of mediums for the collection of human odor is also of great interest.

Presently, there are two main methods for the collection of human scent for the purpose of both instrumental and canine scent identification. The direct method is collecting the actual object, and the indirect method is collecting the odor on an absorber such as sterile gauze. Sterile gauze can be placed either in direct contact or placed close to the person or object of

interest. Air is also commonly drawn through the gauze pad in an attempt to increase the collection of odor. Canines have shown the natural ability to discriminate between odors in the presence of a high background, whereas instrumental analysis requires a significantly lower background. Despite sterilization through autoclave cleaning, the headspace analysis of sterile gauze pads using Solid Phase Microextraction with Gas Chromatography - Mass Spectrometry (SPME-GC-MS) has highlighted the presence of several organic compounds present within the sterile gauze prior to use. Thus sterile does not equate to chemically clean, and the contamination of the gauze observed has proven to be a serious limitation of the use of sterile gauze as an effective odor collection media for the instrumental identification of the compounds present in an individual odor profile.

This paper discusses the use of carbon dioxide Supercritical Fluid Extraction (SFE) as a potential method of chemical cleaning of the gauze pads. A parallel study of the effect of SFE and Subcritical Water Extraction of absorbers will be presented. Optimization of the extraction parameters evaluated includes temperature, pressure and extraction time, and the use of chemical modifiers such as methanol and water will also be presented. Soxhlet extraction of absorbers through the use of various solvents, such as methylene chloride, methanol and chloroform, will also be presented.

The chemical odor of gauze pads from various manufacturers and the absorbers currently used in European countries for the collection of scent evidence will be presented before and after SFE cleaning. This study is intended to demonstrate the importance of informed selection of gauze pads with minimal background odor, and those which can be cleaned most effectively to minimize any potential distracting odors from the gauze. With the use of chemically clean odor absorbers it is proposed that a better understanding of the composition of the chemical profile of human scent may be obtained, in turn benefiting the scientific acceptance of human scent identification by canine.

Human Scent, Supercritical Fluid Extraction, SPME-GC/MS

B36 Terminal and Secondary Effects of Bullets Fired Through Automobile Windshield Glass

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After attending this presentation, attendees will learn about data regarding trends in terminal ballistics and secondary effects of bullets fired through automobile windshield glass. These trends include effects on the glass, on witness panels, and in body armor vests that correlate to factors in bullet type, velocity, and weight retention.

This presentation will impact the forensic community and/or humanity by demonstrating to forensic professionals and laymen how fired bullets react when passing through a glass obstruction, and the terminal results of said projectiles on the target. Law enforcemnt personnel will have a better understanding of ammunition characteristics in such a situation, and thus, will be better informed regarding choice of ammuniton to produce the effects desired by their agency.

While many studies have been conducted to explore terminal ballistics, most have been in response to requests from military and law enforcement agencies for data concerning penetration and wound patterns. Additionally, several studies have been completed addressing the terminal ballistics of bullets fired into body armor. However, very little literature currently exists that seeks to observe effects of bullets fired through obstructions.

In a laboratory environment, results obtained reflect ideal shots. In reality, many situations encountered by law enforcement personnel are much less than ideal. The high stress nature of such moments has a high impact on officers and suspects alike, and can cause widely varying results in reaction time and aim. The environs of the conflict further compound altercations of this nature. In other words, most situations occur as parties are firing at one another from behind some solid object or glass rather than a one-on-one confrontation on open ground. Any obstacle in the bullet path will change the effects of that bullet upon its final target, if it reaches the target at all. A controlled environment is necessary to observe any phenomena or trends of bullets fired through solid objects, but this will necessarily reduce the random nature of the very act the experiment is trying to replicate.

In particular, this experimentation was geared toward recording effects produced by firing through a glass obstruction. Glass was deemed a better material in which to visualize effects while keeping incidence of low angle impact (ricochet) low. Such cases involving glass are often experienced in shootouts as well as on the highway during driveby shootings. One such scenario encountered by law enforcement personnel occurs when they use their vehicles for cover from fire. With the support of the West Virginia State Police and its Firearm/Tool Mark section laboratory, this scenario was replicated for study. Shots were fired from approximately six feet away through a windshield and into a stabilized body armor vest. The setup was accomplished in part from the generous donation of windshields from a local supplier.

This poster will display the examined effects of bullets fired through an auto glass obstruction as well as the affect of velocity and weight retention upon the observed results. Additional factors in ammunition performance such as bullet type and manufacturing process are discussed. Seventeen forty-caliber (.40) common-duty ammunitions currently in use by law enforcement agencies were fired through glass windshields and witness panels into body armor. Velocity and weight retention as well as diameter of all bullet holes and other secondary effects were measured and recorded. Control tests of body armor vests as well as bullet recovery tank testing were also performed. Study of multiple test fires revealed general trends in bullet interaction with the windshield glass, the witness panel, and the body armor, respectively. Type of bullet played a significant role in the presence or lack of fragmentation. Of all brands tested, Federal Cartridge Co. Tactical law enforcement ammunition produced the highest area and approximate volume of damage upon impact with target. However, the philosophy of a particular agency or a particular situation in which shots are fired may determine which ammunition should be used to obtain desired result.

Terminal Ballistics, Firearms, Glass

B37 LA ICPMS and IRMS Isotopic and Other Investigations in Relation to a Safe Burglary

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After attending this presentation, attendees will appreciate the strong discriminating power of isotopic technique such as (LA) ICPMS and IRMS, not only for these specific safe burglary investigations but for a wide spectrum of other forensic investigations.

This presentation will impact the forensic community and/or humanity by making forensic community further aware of the strong power of LA ICPMS and IRMS isotopic techniques.

Safe wall filling material was released when an old safe was burglarized. During a search at the suspect's residence, visually similar material (mixture of glass like particles and sawdust) was retrieved from a plastic bag containing money. Small iron-containing particles were also retrieved from both samples. The safe wall filling material was found to

consist of a mixture of alum or potassium alum (KAl(SO4)2.12H2O) crystals (XRF/XRD) and sawdust (vis, FT-IR). All three material fractions (alum, sawdust, metal particles) were intercompared for the two samples.

The material combination of alum and sawdust appears very rare. Information was collected on the history of its use as safe wall filling, alternative applications of this material combination and how often Dutch police organisations encountered this material in the last two years. It was concluded that this material combination was only used for safe wall filling in the period before the 2nd World War, that no alternative applications were found and that no police organisation reported encountering this material combination.

Alum investigations: The glass like particles in both material samples were classified as alum. ICP AES results were obtained using a PE OPTIMA 3000 instrument. Apart from the major elements Al and K (S was not measured) Cr and Tl were observed at similar levels in both samples. Other elements observed (Fe, Sr,..) were present at much higher concentrations in the red-brown powder so that these are not confidently attributed to the alum samples.

LA ICPMS results using a PE ELAN 6100 DRC PLUS instrument were obtained on freshly cleaved inner alum crystal surfaces. Elements observed in both samples are Mg, Si, P, Ti, Cr, Cu, Zn, Ga, Rb, Sr, Sn, Ba, Tl and Pb.

IRMS services were provided by Iso-Analytical Ltd (Sandbach, UK) using standard methods on a Europa Scientific Geo 20-20 instrument with an EA-IRMS interface. Different isotope ratios were measured in separate experiments using different experimental configurations of the instrumentation. The mean $\delta^{34}S$ values for the suspect and crime scene alums (both 2.2 ± 0.1 ‰, n = 6) were undistinguishable using an experimental uncertainty of 0.24 ‰ (2s). This is compared to a variation range of -3.9 to +30.6 ‰ as reported [1] for $\delta^{34}S$ values obtained for a large number of alum minerals from various locations throughout the world and a variation range of 1.7 to 9.8 ‰ for a small test set of four different alum samples as obtained from alum suppliers in the Netherlands.

Sawdust investigations: The suspect and crime scene sawdust samples are visually similar and exhibit the same red brown color. A mixture of wood species, both soft and hard woods, was observed in both samples during botanical species investigations at the National Herbarium of the Netherlands. Over five species were identified in the suspect sample.

IRMS isotope ratios $\delta^{2}H$, $\delta^{13}C$ en $\delta^{18}O$ for both the suspect and the crime scene sawdust fractions agree within the experimental uncertainty (2s, n=6). $\delta^{13}C$=-25,71± 0,15 is e.g. compared to a variation range of -32 to -22 ‰ as reported for the $\delta^{13}C$ values of C3 plants [2]. Applicability of this information for the local situation is tested by collecting a limited set of sawdust samples in the Netherlands market and analysing these by IRMS. For $\delta^{13}C$ e.g. a variation range of -23 to -28 ‰ is measured.

Metal particles investigations: In both samples many minute metal particles were observed that were magnetically separated from the sample matrix. Corresponding variations in morphology of the particles (round balls of various sizes and curved lint like particles) indicate that metal particles in the two samples were formed through a similar process consistent with abrasive cutting of a safe [3]. µ-XRF (EAGLE) results for the round balls and lint particles show a high abundance of Fe as well as the presence of other elements such as Al, Si, P, S, Mn and Cu. Similar results were obtained for the fine metal particle fractions in both samples.

Conclusions: Combining the information from the various sources and the analytical results for the various material fractions (sawdust, alum, metal particles) provides a strongly discriminating method to compare the (combination of) material fractions as found in the two samples at the suspect's residence and at the scene of crime.

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ICPMS, IRMS, Safe

B38 An Analytical Approach to Comparative Bullet Lead Analysis: Physical and Chemical Aspects of Discrimination

Diana M. Wright, PhD, Charles A. Peters, BS, and Marc A. LeBeau, MS, FBI Laboratory, Chemistry Unit, Room 4220, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, attendees will understant the methodology used for the physical and chemical analysis of bullet lead specimens. The protocol, method validation, report terminology, and significance assessments generally conveyed in testimony regarding positive associations of comparative bullet lead evidence will be presented.

This presentation will impact the forensic community and/or humanity by educating the forensic community to the steps taken to validate a protocol for quantitative analysis of a manufactured product. It will describe how the protocol was validated and provide the community with examples of the language used in reports and during testimony to convey the conclusions drawn from the analysis.

Comparative bullet lead analysis is the physical and chemical examination of lead bullets, fragments, or shot pellets. It is performed when a firearm is not recovered or if a bullet or lead fragment lacks sufficient marks of value for a firearms examiner to determine conclusively that the specimen can be associated with a specific firearm. This examination is not as probative as a positive association between a firearm and the ammunition it discharged. However, comparison of recovered cartridges to the bullets or fragments from the victim or scene can provide a circumstantial link based on the ammunition used in the commission of a crime.

This poster will describe the most current protocol used by the FBI Laboratory to perform this examination, which has been used in support of local and federal law enforcement investigations for over 35 years. While the sample described in this work requires certain parameters, the methodology can be easily adapted to analysis of any of the wide range of specimens increasingly encountered in modern forensic laboratories in the 21st century. For example, small modifications would allow the digestion procedure to be readily adapted to the analysis of glass or steel specimens.

The protocol begins with a physical comparison of the items submitted. Many discriminating features are commonly found on ammunition that can be used to disassociate items quickly and conclusively. These differences and the documentation necessary to describe them will be discussed.

In the absence of physical discriminators, a chemical analysis of the submitted lead specimens is required. The procedure will be described in detail to include: documentation of the physical alterations necessary to sample the evidence; the chemical digestion process; quality assurance and controls; and instrumentation used. Validation data for the chemical analysis of bullet lead specimens will be offered for consideration. The parameters that were measured in validating this method include: limits of detection and quantitation, accuracy, within-run precision, between-run precision, precision using separate analysts for data collection, linear range, sensitivity, and analyte recovery.

Results will be offered for a sample case in which the physical and chemical examinations could not differentiate between two or more specimens. The language used to report these findings will be provided. Lastly, the conclusions or interpretation that a qualified examiner would place on these findings will be described as a guideline for the strength and limitations of quantitative analysis applications to commercially - available manufactured products.

Bullet Lead Analysis, Compositional Analysis, Comparative Examinations

B39 Forensic Elemental Analysis of Glass by Laser Induced Breakdown Spectroscopy (LIBS), Laser Ablation ICPMS, and X-Ray Fluorescence

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After attending this presentation, attendees will learn about different solid sampling techniques for elemental analysis: laser induced breakdown spectroscopy (LIBS), laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS), scanning electron microscopy with an energy dispersive spectrometer (SEM EDX) and x-ray fluorescence (XRF). The advantages, disadvantages, and application of these techniques to forensic casework will be discussed.

This presentation will impact the forensic community and/or humanity by demonstrating the different solid sampling techniques for elemental analysis: laser induced breakdown spectroscopy (LIBS), laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS), scanning electron microscopy with an energy dispersive spectrometer (SEM EDX) and x-ray fluorescence (XRF).

Materials analysis and characterization can provide important information as evidence in legal proceedings. Although the utility of trace elemental analyses for comparisons of glass, paint fragments, bullet lead and metal fragments has been shown to offer a high degree of discrimination between different sources of these materials, the instrumentation required for the generation of good analytical data in forensic comparisons can be costly and require a high degree of analytical sophistication. Refractive Index (RI) has been used for glass comparisons in combination with elemental analysis using a variety of methods of solid sampling, including; Scanning Electron Microscopy with an Energy Dispersive Spectrometer (SEM-EDX), x-Ray Fluorescence (XRF), Laser Ablation Inductively Coupled Plasma Atomic Emission Spectroscopy (LA-ICP-AES) and, more recently, LA-Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS). A newly developed Laser Induced Breakdown Spectroscopy (LIBS) instrument (Foster and Freeman Ltd., Evesham, U.K.) has been evaluated as a tool for the forensic elemental analysis of glass and compared in performance to other elemental methods in order to determine the utility of comparing casework sized glass samples. Developments in instrumental design of the LIBS system are presented. The discrimination power afforded by the elemental analysis of a sample set having similar refractive indices measured by the LIBS system is reported in contrast to that provided by micro-XRF and LA-ICPMS. The advantages and disadvantages of using these solid sampling elemental analysis techniques will also be presented.

Solid Sampling Elemental Analysis, Glass, LIBS

B40 Choosing a Statistical Method for the Data Assessment of the Compositional Analysis of Bullet Lead

Diana M. Wright, PhD, FBI Laboratory, Chemistry Unit, Room 4220, 2501 Investigation Parkway, Quantico, VA 22135; Robert D. Koons, PhD, JoAnn Buscaglia, PhD, and Heather L. Peters, PhD, FBI Laboratory, Counterterrorism and Forensic Science Research Unit, FBI Academy Complex, Quantico, VA 22135; and Marc A. LeBeau, MS, FBI Laboratory, Chemistry Unit, Room 4220, 2501 Investigation Parkway, Quantico, VA 22135*

The goal of this presentation is to provide a description of five statistical approaches to trace element concentration data is provided. These methods were compared for 93 randomly selected cases. Results will describe how each approach grouped the case data and explain which approach was ultimately selected for use in current casework.

This presentation will impact the forensic community and/or humanity by serving the forensic community through the discussion of several statisitical approaches that one may utilize in determining acceptable match criteria for quantitative analysis of man-made products.

The FBI Laboratory is one of the few forensic laboratories that perform quantitative trace element analyses on a routine basis for a wide variety of specimens, including glass, steel, and bullet lead evidence. The bullet lead protocol was specifically developed by the FBI Laboratory over 35 years ago to assist local and federal law enforcement agencies with shooting investigations where a firearm is not recovered or the fired bullets are badly damaged. The protocol, including the association criteria used to determine if two or more specimens are *analytically indistinguishable*, has evolved over the course of this examination's history. As the 21st century progresses, the FBI Laboratory has revised its analytical protocol for comparative bullet lead analysis. Part of this revision involved a review of the statistical approach used to determine associations.

To that end, this poster will present work that has recently been completed through the collaborative efforts of the FBI Laboratory Division's Chemistry Unit and the analytical research group of the Counterterrorism and Forensic Science Research Unit. Five statistical approaches were applied to the quantitative results collected for 93 randomly selected comparative bullet lead cases that have been submitted to the FBI Laboratory over the last decade. The purpose of this study was to determine if any of the results reported out to contributors using the established criterion would have been affected if a different statistical approach had been used.

The bullet lead protocol for the past decade has employed an association criterion that requires the measured precision of the specimens being compared to overlap within the range of 2□. Therefore, in order for two specimens to be considered *analytically indistinguishable*, an overall range of 4□ was applied to the concentration results. The five methods compared in this study were: range overlap, 2□, the student t test, the successive t test, and Hotelling's T^2 test. The first three methods utilized measured precisions associated with the specific case results as a basis for establishing match criteria. The latter two statistical assessments required the use of pooled historical data in order to calculate precision measurements for the necessary equations. Any assumptions that were made in order to perform the testing on the pooled results will be described.

Results will be presented for the five tested analytical approaches as well as the conclusions issued in the corresponding reports. Ultimately, there were no cases in which a Q/K association was reported in the absence of corroborating associations from at least one of the tested methods. The method chosen for the revised protocol will be described and the rationale for its use will be addressed.

Statistical Analysis, Bullet Lead Analysis, Comparative Examinations

B41 Evaluation of Solvent Systems and Mobile Phases for the Extraction and Identification of Fiber Dyes by Liquid Chromatography Mass Spectrometry (LC-MS)

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The objective of this presentation is to demonstrate the advantages of liquid chromatography – mass spectrometry (LC-MS) in the comparison of questioned and known fibers. The compatibility of LC-MS methods with existing dye extraction protocols will be emphasized.

This presentation will impact the forensic community and/or humanity by emphasizing the need for enhanced methods for the analysis of fiber evidence and demonstrating the compatibility of LC-MS methods with existing FBI SWGMAT dye extraction protocols.

Previous research has shown that cotton fibers that are indistinguishable by means of microspectrophotometry, HPLC analysis and FBI SWGMAT dye extraction protocols, may be discriminated by LC-MS analysis of the extracted dyes. Mass spectrometry provides a molecular-level interrogation of the dye structure and, as a result, allows the differentiation of dyes having differing molecular structures. The same level of discrimination is not possible based only on UV-visible absorption profile, chromatographic behavior or extraction characteristics. The previously reported LC-MS analysis methods have been extended by evaluating their compatability with the solvent systems recommended by FBI SWGMAT protocols for fiber dye extraction. Solvent systemts that were evaluated for LC-MS analysis included pyridine/water, formic acid/water, acetic acid, chlorobenzene, chloroform, and dimethylformamide (DMF)/formic acid (1:1). The dyes that were extracted in each solvent system were readily chromatographed in a methanol/water gradient with the extraction solvent exerting no significant influence on the chromatographic behavior of the dyes. The chromatographic behavior of the dyes was found to be significantly influenced by the addition of 0.1% acetic acid or trifluoroacetic acid to the mobile phase for the analysis of basic dyes in positive ion mode. Similar enhancements were obtained by the addition of TEA (triethylamine) to the mobile phase for the analysis of acidic dyes in the negative ion mode. In both cases the additive enhanced sensitivity and separation efficiency of the dye by ESI-MS analysis and reversed phase chromatographic separation. The analyses were conducted on standards comprised of dyes of known structure that had been commercially applied to fibers of known composition.

This presentation will emphasize the need for enhanced methods for the analysis of fiber evidence and demonstrate the compatibility of LC-MS methods with existing FBI SWGMAT dye extraction protocols.

Fiber Analysis, Trace Evidence, Mass Spectrometry

B42 The Effects of Environmental and Atmospheric Conditions on the Longevity of Latent Prints

Michele Eichenmiller, BA, Marshall University-Forensic Science Center, 1401 Forensic Science Drive, Huntington, WV 25701; Steven King, BA, West Virginia State Police-Latent Print Section, 725 Jefferson Road, South Charleston, WV 25309; and Pamela Staton, PhD, Marshall University-Forensic Science Center, 1401 Forensic Science Drive, Huntington, WV 25701*

After attending this presentation, attendees will learn about the effects of weather and humidity on the permanence of latent prints.

This presentation will impact the forensic community and/or humanity by providing insight into the effects of different atmospheric and environmental conditions on latent prints as they are exposed to varying environments over a specified time. This scientifically gained information can then be referenced in court proceedings when latent print examiners are called to testify about the longevity of latent prints.

As latent fingerprints are deposited on a surface, several factors may affect their recovery particularly as they age. Such factors include subject, substrate and matrix, and environmental factors. "Subject" factors include age, sex, stimuli, occupation, and medical conditions. For example, a car mechanic with motor grease on his hands would leave a greasy latent print that would resist degradation better than a print made up of mostly sweat, as left by a person who has been exercising. In general, latent prints are composed of 99% water and 1% oil secretions.

Some factors can be accounted for by the latent print examiner but other influences affecting the deposited print are unknown. The examiner does not generally know subject factors, such as age and medical conditions, which may influence the hardiness of the deposited print. "Substrate" factors are associated with the distortion or interference created by the surface on which a print is deposited. This is demonstrated by textured surfaces' inability to retain a good impression as opposed to a smooth surface, which would retain a good latent print. Matrix factors are those involving the material making up the friction ridge skin impression and can be deduced and assessed to some point from the submitted evidence. An example of a matrix is the motor grease in the previous example.

While potentially important, examiners rarely receive information associated with atmospheric and environmental factors that may impact the latent print at the crime scene or on the evidence as it ages. These variables include temperature extremes, humidity, and significant weather events such as rain that may have influenced the permanence of the latent print. All of these variables can interact with the water and oil content of the latent print. This interaction will thereby affect how well the print is preserved and how quickly it will degrade before it is rendered completely useless for comparison purposes.

The effect of atmospheric and environmental factors on the permanence of latent fingerprints is an often-raised question that latent print examiners must face as they testify in court proceedings. Up to this point, examiners have relied on personal knowledge to convey to the court their opinion with respect to the longevity of fingerprints. This experience is not based on peer-reviewed scientific research but rather on the experience of the examiner. In fact, when a literature search is conducted of current journal articles, few studies are identified which document the effects of different environmental and atmospheric factors on a variety of substrates and matrices or on the life of a latent print left on such surfaces.

This study shows the effects of an indoor versus outdoor environment on latent prints over the course of four weeks. Latent prints were deposited on a variety of porous and nonporous surfaces and then placed either inside the building or outside, in a sheltered location. Four types of prints were left on each surface and then collected once a week for four weeks. The four types of prints were clean, natural oils, artificial oils, and dirty prints. The results of this experiment show a pattern of marginal latent print longevity on porous surfaces exposed to summer heat and humidity. Prints on nonporous surfaces also exhibited decreased longevity when exposed to outdoor conditions. The permanence of latent prints decreases as a result of the time spent outdoors. This is in opposition to the same surfaces kept in an indoor environment at a constant temperature and humidity, which exhibit greater permanence in regard to the latent prints, regardless of time spent indoors.

This poster will present the work conducted at the West Virginia State Police Forensic Laboratory-Latent Print section during a summer internship. This internship is to fulfill the requirements of the Marshall University Forensic Science Program Summer Internship.

Latent Prints, Longevity, Environmental Conditions

B43 Volatile Compounds Produced by Decomposing Human Blood and Those Detected by Cadaver Dogs

Wilma Jeffris, BA, Samantha Tolliver, BS, and Kenneth G. Furton, PhD, Florida International University, University Park Campus, CP 345, Miami, FL 33199*

After attending this presentation, attendees will earn about the volatile organic compounds that are produced as human blood decomposes and the odor signature compounds cadaver dogs alert to.

By determining the odor signature compounds produced in aging blood, better and less hazardous training tools can be developed. Better training will lead to more reliable detection of human remains and trace blood spatters not readily visible and identification of crime scenes where bodies are not present. This presentation will impact the forensic community and/or humanity by assisting in the identification of the odor signature compounds which will lead to better trained cadaver dogs, more reliable evidence gathered, better results in finding bodies, and future development of instrumental methods with equal or better detection than detector dog teams.

Cadaver detection canines are dogs trained specifically to locate human remains. Although the use of canines as detection methods for items of forensic interest has been accepted historically for many years, the *Frye* and *Daubert* rulings of forensic evidence admissibility require validation of scientific processes. Accordingly, the canines must be capable of locating these remains in many environments, but must not be confused by the decomposition of other animal species. Therefore, the training protocols of most law enforcement agencies stipulate the use of human remains and human blood, both in various degrees of decomposition. Although these training practices are generally accepted within the canine handling community, the safety concerns regarding the biohazards of human tissue, and the possibility of infection of blood-borne disease such as HIV/AIDS, and hepatitis B/C confirms that the training aids used by handlers do pose a significant health risk. Currently available pseudo-odors, those that mimic human decomposition, have been shown to be of limited application to canine training. Training aids that effectively reproduce the odor of decomposition without the associated risk of blood handling have the potential to replace real tissue aids in most circumstances, while maintaining the high standard of odor discrimination.

The process of blood decomposition involves coagulation of the blood, and thus may be limited or modified by the addition of anticoagulants such as EDTA and CPDA1 to the blood samples to extend shelf life or prevent decomposition during storage. To date, the role that each component of blood plays in the decomposition process has not been determined, nor have the compounds formed been identified. However with coagulation playing an important role in the overall process, it is proposed that the plasma component of blood is heavily involved.

Samples of blood and blood components, both with and without anticoagulants, have been allowed to decompose over time. The headspace of these samples has been collected and analyzed using Solid Phase Microextraction (SPME) with Gas Chromatography - Mass Spectrometry (GC-MS). Blood itself is a complex mixture of plasma and cells, hence given the complexity of the blood sample, and the diverse nature of the compounds present, polydimethylsiloxane (PDMS) and polydimethylsiloxane/divinylbenzene (PDMS/DVB) SPME fiber chemistries are combined in complementary analysis.

Several variables were considered during the development of a technique that will provide an efficient means of identifying the volatile compounds. Blood and blood component samples were kept in various temperatures including room temperature, 37 degree Celsius, and under excessive heat. Seven-year-old, one-year-old, three-month-old, and fresh blood samples were analyzed to determine the development and disappearance of the desired volatile compounds in the presence and in the absence of anticoagulant.

This study proposes that the volatile chemicals detected during the decomposition of human remains must also be present during the decomposition of human blood. The use of fresh blood that is permitted to decompose naturally, versus expired blood or plasma from a blood bank, has the potential to affect the decomposition odor observed.

SPME-GC-MS, Blood Decomposition, Cadaver Dogs

B44 Examination of Counterfeit Hong Kong $10 Bimetallic Coins

Nai-Chiu Kwok, BSc, MPhil, Fu-Chiu Kwok, PhD, and Koon-Hung Wong, PhD, Goverment Laboratory, 8/F, 88 Chung Hau Street, Homantin Government Offices, Hong Kong, Nil Nil, China*

After attending this presentation, attendees will learn a general guideline of examination involving the physical parameters and surface features in examination of bimetallic coins.

This presentation will impact the forensic community and/or humanity by providing an examination guide on bimetallic coins including the core-extrusion method which is an effective and reliable supplementary method of examination. Moreover, the core-extrusion method may also be applied to coins with similar construction.

This poster presents a number of important physical parameters, such as surface features of the genuine bimetallic HK$10 coins which can be utilized for the examination of counterfeit coins.

The Hong Kong ten-dollar coin was introduced into common circulation by the Hong Kong Monetary Authority towards the end of 1994. However, just within six month after launching, counterfeit HK$10 coins started to be found in the region. The first case of counterfeit HK$10 coins was delivered to the Hong Kong Government Laboratory in the summer of 1995. Since then, there were significant increases in the number of cases and the actual number of coins submitted for examination. The quality of counterfeit ten-dollar coins which were first found was crude. They displayed significant difference, both in physical dimension and/or surface features, to the control specimen. However, as time progressed, forgery techniques appeared to have improved to such an extent that counterfeit HK$10 coins were almost indistinguishable to the untrained eye from the corresponding control coins.

General guidelines for the examination of HK$10 coins are as follows:

1) The physical parameters of the coin, such as weight and dimensions (thickness and/or overall diameter) are measured, but as the physical parameters of counterfeit coins can most easily be reproduced within a reasonable level of accuracy, thus they would not provide a sound indication of authenticity.
2) The surface and edge characteristics of the counterfeit coin are scrutinized and compared with genuine coins. For example, the color of the bimetallic part is distinctly different from the control specimen, the bonding between the core and the annulus is rough usually; the inscribed words are of different fonts; the milling is poor; the Bauhinia logo lacks clarity and details. In most of the cases, visual examination would normally be sufficient to distinguish a counterfeit coin from a genuine control.
3) Determination of the metal composition of the coins can also be used. Accurate results can be obtained using such techniques as Atomic Absorption Spectroscopy (AAS) or Inductively-coupled Plasma-Atomic Emission Spectrometry (ICP-AES). However, these techniques are destructive, labour-intensive and time-consuming as they involve pre-treatment of sample. An alternative method being used is the Scanning Electron Microscope (SEM) – a non-destructive, reasonably accurate technique that requires minimal sample treatment.

Recently, an effective physical method (core-extrusion method) has been developed in the authors' Laboratory. It makes use of the construction

of the coins itself. The HK$10 coin is bi-metallic consisting of a core made of nickel-brass with a cupro-nickel annulus. The two metallic parts are held together by a physical construction consisting of a groove at the outer-perimeter of the core and a rim at the inner perimeter of the annulus. Therefore, for the genuine coin, a greater force exerted by way of a hydraulic press on the core will be required to separate it from the annulus rim. By comparison that required for separating the core and the rim of a counterfeit coin is only 20% of that for the genuine counterpart.

By far the most time-consuming step in the analysis of HK$10 coins is the metal-composition determination. Whereas the most effective way to distinguish a counterfeit HK$10 coin would be visual examination of the surface features, such as the Bauhinia and the word fonts. Moreover, the core-extrusion method also serves as an effective and reliable supplementary method of examination. The latter method may also be applied to coins with similar construction.

Counterfeit, Bimetallic, Coins

B45 An Evaluation of the Trigonometric Model for Point of Origin Prediction in Bloodspatter Pattern Analysis

Anna S. Duggar, MS, and Rose R. Duryea, MA, New Orleans Police Department Crime Laboratory, 2932 Tulane Avenue, New Orleans, LA 70005*

After attending this presentation, attendees will learn the responsible use of the trigonometric model in applied fieldwork and the value of training by a qualified expert.

The discipline of bloodspatter pattern analysis continues to need peer-reviewed scientific and statistical studies, particularly on essential methods. This presentation will impact the forensic community and/or humanity by meeting that need and providing quantitative arguments for training and responsible method implementation.

The discipline of bloodspatter pattern analysis continues to need peer-reviewed scientific and statistical studies, even on premises as essential as the trigonometric formula historically used in the back-calculation of a point of origin from individual droplet stains in an impact pattern. Structured, objective scientific research in this field in the last two decades has shown that even the most basic assumptions are subject to change as understanding of the science is explored. In addition, recent judicial challenges to the testimony of the bloodspatter analysis expert as neither scientifically valid nor admissible, combined with *Daubert* challenges to other pattern analysis fields of the forensic sciences, have produced a demand for statistical support for the conclusions of the expert analyst. The experiment presented here describes the confidence interval and relative accuracy of the trigonometric calculation used in point-of-origin reconstruction for bloodspatter patterns.

To best test the mathematic model, it was necessary to produce a large number of stains at a known, constant angle. To this end, an apparatus was built allowing for controlled replication of single droplet patterns in bovine blood at a range of incident angles between zero and 80 degrees. The stains were then measured by multiple researchers, both trained and untrained, and the length and width measurements compared. These measurements were used to calculate the angle of incidence using the formula $\angle_{incidence} = \cos^{-1}(d/D)$. The error of the calculated angle as compared to the recorded angle was determined through scatterplots and other statistical analysis.

Results support the conventional wisdom that as the ratio of width to length of the stain approaches 1.0 (impact angle approaches 90 degrees), calculations become less reliable. The impact of even minimal training by a qualified expert is demonstrated, and comparison of the range of calculated angles to the ideal calculated angle provides new insight into the responsible use of the trigonometric model in the field.

Bloodspatter, Bloodstains, Statistics

B46 The Accreditation of College and University Forensic Science Programs

Jay A. Siegel, PhD, Indiana University, Purdue University, School of Science, LD 326, 402 North Blackford Street, Indianapolis, IN 46202*

After attending this presentation, attendees will learn how the process of accreditation is carried out.

This presentation will impact the forensic community and/or humanity by demonstrating how the quality of forensic science education will be improved.

The American Academy of Forensic Sciences in conjunction with the National Institute of Justice has begun a process for accrediting College and University Forensic Science Programs by adopting a set of guidelines developed by the Technical Working Group on Forensic Science Education. This poster will show the process and procedures for accreditation.

Forensic Science, Education, Accreditation

B47 Proof of a Negative?

H. Dale Nute, PhD, Florida State University, 4750 Collegiate Drive, Panama City, FL 32405*

After attending this presentation, attendees will learn an approach to teaching the concept of negative evidence to students or trainees using crime scene search protocols as exemplars.

This presentation will impact the forensic community and/or humanity by introducing forensic science practitioners and educators to the concept of constructing a probability assessment for a crime scene search protocol, in particular to the probability that a negative search can, under the right circumstances, infer a probability that the evidence was not there.

Determining the error rate for many forensic science examinations is relatively straightforward. For example, the probability of correctly: identifying a compound, assigning a DNA pattern to its donor, and reconstructing a vehicle's speed at the time of an accident, have all been considered. But, what if a crime scene search produces no evidence? What is the probability that it really was there (merely overlooked) versus the probability that it really was not there? What is the approach for calculating the error rate for a crime scene search such that one can offer a reliable assertion that an item of interest really was not there when its absence will support an issue in the case, i.e., negative evidence? The reliability associated with locating, or assuring the absence of, an item of evidence is no less trivial than the reliability associated with its examination. The question then is, what is the probability that a particular search protocol will locate (or miss) a particular item in a particular matrix at a scene?

This question is analogous to the concept of limit of detection in toxicological analyses. And, like those tests, the answer depends on the compound of interest, the matrix within which it is hidden, and the technique used to detect it. But, unlike the relatively uniform approaches associated with identifying chemical compounds in body fluids, the variety in forms of evidence, types of matrices, and detection techniques that comprise crime scene searches precludes simple solutions. Indeed, like much of forensic science, the question can sometimes be answered quantitatively but more often it can only be answered qualitatively. Faced with all of this complexity, the educational challenge is first to convey the concept itself.

An approach is presented for teaching students how to consider the question of presence versus absence. An exercise is constructed around the task of locating small items, such as cartridge cases, in an outdoor plot. A variety of search techniques is employed with the varying successes recorded. From these data, a comparison can be constructed as to the relative probabilities of finding the item of interest. One also can determine the relative "cost" in terms of time and equipment required. These findings

lead to another question – What would be the increase in the probability of finding the item(s) if two different techniques were employed instead of just one? This question allows the instructor to introduce the idea of Bayesian probability as applied to an examination, rather than just to its impact on the case as is commonly presented. Considering a Bayesian approach, though, requires a consideration of both false positives and false negatives along with the usual consideration of true negatives and positives. Using cartridge cases as an exemplar allows for plausible scenarios to be advanced in which a probability exists of finding items that have nothing to do with the case at hand. This introduces the idea of combining quantitative data from objective sources with "expert," "background," estimated, thus, subjective information. Although the students do not have the skills, based on the exercise alone, to develop reliable data as to a search protocol's error rate, they know the procedure and have a better understanding of what it takes to "prove a negative."

Negative Evidence, Crime Scene Search, Protocol Error Rate

B48 Unusual Use of Modified Fire Debris GC/MS Method to Analyze Hydrocarbons

Elzbieta J. Kubicz, PhD, Wyoming State Crime Laboratory, 316 West 22 Street, Cheyenne, WY 82002*

After attending this presentation, attendees will learn the adjustment of known GC/MS analysis of fire debries to identify common hydrocarbons. This poster will present the unusual use of GC/MS method for analysis of fire debris.

This presentation will impact the forensic community and/or humanity by demonstrating easy modification of existing method to analyse hydrocarbons.

Case History: The 4-year-old male was found unresponsive inside a tent in the yard of his home. The 911 call was placed about 1:00 p.m. A temperature reading was taken inside the tent, and registered 126°F. The child was taken to egmergency room. The rectal temperature at that time was 108°F. The child was pronounced dead at 1:39 p.m. Toxicologic evaluation identified Ethylbenzene and Xylene in a blood at 0.85 mcg/ml and 4.1 mcg/ml respectively. Cause of death was ruled acute intoxication.

The boy's parents claimed that they were removing lice using "Ortho" and "Hot Shoot" sprays.

To preserve the evidence, immediate analysis was needed. The child's bedding from the tent was subject to analysis to look for trace of Xylene and Ethylbenzene.

Ethylbenzene, GC/MS, Xylene

B49 Reliability Testing of Commercial Containers for Fire Debris Evidence Storage

Michael E. Sigman, PhD, Mary R. Williams, BS, and Denise Fernandes, BS, University of Central Florida, PO Box 162367, Orlando, FL 32617*

The goal of this presentation is to present results from a study on the leak rates of ignitable liquids from commercial containers used for fire debris evidence storage. This presentation will provide information on the reliability of commercial containers as fire debris evidence containers and methods for handling and analyzing the evidence.

This presentation will impact the forensic community and/or humanity by presenting the results from this long-term study by monitoring hydrocarbon retention in quart volume containers of metal cans, glass jars, and polymer bags. Data revealing leak rates of the containers and the behavior of the hydrocarbon vapors will be discussed along with the significance to methods in fire debris collection and analysis.

A common type of evidence collected at a fire scene is the debris suspected of containing ignitable liquids. The total or partial loss of the volatile ignitable liquids in a container subject to leaking can lead to an altered hydrocarbon profile. Previous investigations have reported significant leak rates for various commercial containers primarily paint cans and polymer bags. This study will differ from previous studies based on its approach for determining the leak rates of the commercial containers for fire debris evidence.

One approach utilized in this study was based on the ideal behavior of a hydrocarbon solution in the C7-C10 range in accord with Raoult's law. Leaks in the container would result in a change in vapor phase composition and a subsequent change in the mole fraction of each component in solution. The more volatile components decrease first, and the change is reflected in both the vapor and liquid phase compositions. The composition of the vapor phase thus provides a way to directly monitor the weathering of an ignitable liquid mixture. The composition of the headspace vapors of the containers was monitored by repeated removal of small (c.a. 20 µl) vapor samples from large (c.a. 1 gal.) containers through a septum inserted into the container lid. The dynamic behavior of a mix of volatile hydrocarbons inside a closed container, coupled with vapor adsorption by the portion of the septum exposed to the interior of the container complicated analyte sampling and analysis. The statistical variation in the resulting data did not allow for the determination of slow leaks in the containers.

A second method employed in this study was sampling by passive headspace concentration with activated charcoal. This method utilized activated carbon strips to adsorb the hydrocarbon mixture then elute the hydrocarbons from the activated carbon with a solvent. Early experiments by this method were complicated by the preferential adsorption of aromatic and higher molecular weight hydrocarbons by the activated charcoal. Extensive research into the adsorption properties of activated charcoal was conducted[1], and the results from the research provided a sampling methodology for monitoring the mole fraction of the C7-C10 hydrocarbon mixture remaining in the container over an extended period of time. A set of four types of quart volume commercial containers held for six different time intervals are undergoing extended time testing. Containers subject to induced leaking are under investigation as positive controls for observable changes in the recovered hydrocarbon mole fraction in the presence of a slow leak. Leak proof systems are under investigation as negative controls against unanticipated changes in the adsorptive function of the activated charcoal over long periods of exposure to hydrocarbon vapors.

The results from this long-term study by monitoring hydrocarbon retention in quart volume containers of metal cans, glass jars, and polymer bags will be presented. Data revealing leak rates of the containers and the behavior of the hydrocarbon vapors will be discussed along with the significance to methods in fire debris collection and analysis.

References:

1. Mary R. Williams, B.S., Denise Fernandes, B.S., Candice Bridge, B.S., Derek Dorrien,
Stefanie Elliott, and Michael Sigman, "Adsorption Saturation and Chromatographic Distortion Effects on Passive Headspace Sampling witth Activated Charcoal in Fire Debris Analysis," J. Forensic Science, 2004, submitted.

Fire Debris, Ignitable Liquids, Trace Evidence

B50 Development of a Standardized Field Portable Extraction Gas Chromatography Tandem Mass Spectrometry Method for the Analysis of Ignitable Liquid Residues

Marilyn Prieto, Jeanette M. Perr, BS, Kenneth G. Furton, PhD, and José R. Almirall, PhD, Florida International University, Department of Forensic Chemistry and Biochemistry, 11200 Southwest 8th Street, CP 194, Miami, FL 33199*

The goal of this presentation is to discuss the development of a field portable extraction and standardized gas chromatography ion trap tandem mass spectrometry (GC/IT/MS/MS) method for implementation in the detection and identification of ignitable liquid residues (ILR).

This presentation will impact the forensic community and/or humanity by increasing the sensitivity and selectivity that is necessary to detect minute amounts of ILR remaining after a fire and to differentiate ILR from IP. It is anticipated that the results using GC/IT/MS/MS will not require sophisticated training, longer analysis times, or data analysis programs.

The discovery and recovery of small amounts of ILR in fire debris evidence can be arduous owing to considerable loss of these compounds during the fire, extraction techniques that are not the most sensitive, co-extraction of interfering products (IP), and analysis techniques that provide low discrimination. The main purpose of this project was to optimize a general method that can be used by examiners to improve current analysis of fire debris without significantly altering the workload or time required for analysis. In order to accomplish this goal uniform ionization parameters had to be established as well as chromatographic parameters.

Uniform ionization regions, called bins (chromatographic references), were created using the standard n-alkanes, C_8 through C_{23}, as markers. Alkanes elute from the gas chromatograph in a consequent order depending on boiling point and other factors. The method utilizes an alkane to produce bins that other ignitable liquids (IL) components elute into. The optimized parameters that best fit the IL constituent bin were put forth to evaluate components of interest away from IP thus weakening or even excluding interferences. Distinctive fragments, such as adduct ions, will be utilized to detect the alkane and label the bin. The bin method designed an undiversified and concentrated ionization zone that will result in reproducible mass spectra. Once the optimum MS/MS ionization parameters are selected for each bin, mass spectra will be compiled for IL components. Known IL standards and known weathered IL standards will be tested to generate reference examples using the MS/MS detector through the use of solid phase microextraction (SPME). These acknowledged IL standards will be investigated in the presence of IP, thus exemplifying the advantages, confirm the disadvantages, and establish the utility of this method.

This method is expected to increase the sensitivity and selectivity that is necessary to detect minute amounts of ILR remaining after a fire and to differentiate ILR from IP. It is anticipated that the results using GC/IT/MS/MS will not require sophisticated training, longer analysis times, or data analysis programs.

Ignitable Liquid Residue, GC/IT/MS/MS, SPME

B51 Poking Holes in the Suspect's Story: An Overview of Pharmaceutical Theft and Tampering Analysis

Angela S. Mohrhaus, BS, Heather A. McCauley, BS, Nicola Ranieri, BS, and John R. Urban, BS, Food and Drug Administration's Forensic Chemistry Center, 6751 Steger Drive, Cincinnati, OH 45237*

The goal of this presentation is to present the forensic community with an overview of the analytical approaches used by the FDA's Forensic Chemistry Center (FCC) in casework involving the theft of contents from and/or tampering with pharmaceutical vials and syringes.

This presentation will impact the forensic community and/or humanity by presenting examples as an analytical roadmap for those in the general forensic chemistry community who may lack experience analyzing similar pharmaceutical fraud/tampering cases.

This poster will highlight the approaches used by the FCC in cases involving pharmaceutical theft and/or tampering. The FCC receives suspect narcotic vial and syringe evidence from all over the U.S., and is often asked to answer three basic questions: Has the integrity of the product container been compromised? How much, if any, of the original product remains? What, if anything, was used as a replacement medium (adulterant)?

The type of pharmaceutical theft most commonly encountered occurs in hospitals and nursing homes where an individual removes a portion of a narcotic solution from a vial or syringe. In most cases, the individual will "replace" the contents removed with some sort of diluent, such as saline or bacteriostatic water. The FCC has also received cases where the original narcotic product was replaced with another, less potent narcotic. The motive for using a less potent narcotic may be to minimize the chances of the theft being discovered, as a patient receiving the less potent narcotic would be less likely to complain about the pain medication not working.

When a suspect syringe or vial arrives at the FCC, its first stop is in the Microscopy Lab. There the vials and syringes are examined for evidence of tampering and determination of what may have been used to access and remove the contents of vials and syringes. Using both Polarized and Stereoscopic Light Microscopy (PLM/SLM), the microscopists are frequently able to determine the number of times, for instance, a vial's rubber septum has been punctured. Excessive numbers of punctures can be indicative of product theft, adulteration, replacement, or other types of fraud. The shape and characteristics of the puncture hole(s) provides evidence as to what sort of tool was used to puncture the septum.

The next step in the process is GC-MS analysis. The contents of the suspect vials and syringes are screened for the presence of the active ingredients, as well as any additional drugs or unusual components. If the contents appear to be diluted, this analysis may indicate what was used as a diluent. For example, if benzyl alcohol (a preservative) is detected in the suspect item using the GC-MS screen, but not the controls, bacteriostatic water or saline may have been used for replacement.

After determining the composition of the vial/syringe contents, the compounds present are quantified (if possible) by HPLC with UV detection in order to determine the extent of dilution.

The final step, if necessary, in the analysis of these samples is elemental analysis. If during the GC-MS analysis it is determined that the contents were diluted, ICP-AES analysis can be performed to evaluate the contents for the presence of excess sodium relative to untampered control pharmaceutical samples. The amount of excess sodium relative to the dilution of the active pharmaceutical ingredient may be consistent with the replacement of the stolen contents with saline.

Once all of the necessary analyses are completed, the pieces of the puzzle start to fit together. Generally, the FCC can report back to the case agent with the following information: how many times the suspect product was accessed, what type of tool was used to access the contents, whether there is active ingredient remaining, whether another drug (or a potentially harmful substance) was used in replacement, how much of each identified component is present in the solution, and whether saline was used as the diluent.

Pharmaceuticals, Tampering, Theft

B52 Drug Profile of Urine Specimens From Arrestees in Taiwan

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Not only in the United State but also in Taiwan, using drugs are criminal behaviors and the drug abusers have the tendency of using poly-drug. From this presentation, attendee could learn, retain and even implement into their practice about drug use and profile of urine specimens from arrestees.

Drug abuse is a global phenomenon and its extent and characteristics differ from region to region. This presentation describes the most common combinations including MDMA identified were MDMA/ketamine and MDMA/Methamphetamine use in Taiwan, and will impact the forensic community and/or humanity by assisting forensic community to understand the poly-drug combinations.

Introduction: Drug abuse is a global phenomenon and its extent and characteristics differ from region to region. Club drugs, MDMA, marijuana and ketamine, have emerged in Taiwan in recent years. MDMA and ketamine positive rates as high as 76% and 47% from rave party participants were shown by Lua *et al*. in 2001.[1] Easy accessibility of precursors and of manufacturing know-how, relatively low prices and the trendy and benign image with popular techno-music and rave culture were all responsible for the spread of MDMA, MDA and MDEA rapidly as reported by UNODCCP in Global Illicit Drug Trends 2000. [2] In Taiwan, using drugs are criminal behaviors and the drug abusers have the tendency of using poly-drug which causes complicated and serious health problems owing to its variety of combination. To understand the drug profile and the combinations of poly-drug use in Taiwan, the authors conducted a study of urine drug testing on drug related arrestees who might commit crime(s) by using drugs.

Experiments: 930 urine specimens were collected from police arrestees suspected of drug abuse from twelve of the twenty-three counties in the Taiwan island from Jan 2002 to July 2002. In this study, screened urine specimens were screened with immunoassay reagents adapted to Merck Selectra Vista II and Hitachi 705 automatic biochemistry analyzers according to the manufacturer's recommendations, then confirmed the presence of morphine, codeine, methamphetamine, amphetamine, ketamine, MDMA and marijuana with GC/MS. At the meantime, REMEDi HS Drug Profiling System was used to screen for the other drugs. Thirty-nine drugs were identified positively in 930 specimens.

Results and discussion: The REMEDi HS system is widely used in hospital emergency rooms to identify poisons in a patient's urine or serum. It is highly automated and fast with a potential to screen over 900 drugs and metabolites, including stimulants, local anesthetics, antidepressants, antibiotics and pesticides. In this study, specimens were screened for more than 100 drugs out of the over 200 on Taiwan's controlled drug list. The drugs include benzodiazepines, barbiturates, synthetic opiates and stimulants. Morphine and methamphetamine were verified as still the major drugs detected in Taiwan, followed by Benzodiazepine (18.3%), MDMA (17.7%) and ketamine (7.2%). Complicated poly-drug use patterns were observed and up to six drugs or metabolites were detected in some specimens which included methamphetamine, benzodiazepine, opiate, precursor, MDMA, MDA and ketamine. The most frequently identified drug combinations were morphine/Methamphetamine (19%), Codeine/Methamphetamine (15%), morphine/amphetamine (15%) and morphine/benzodiazepine (13%). The most common combinations including MDMA identified were MDMA/ketamine and MDMA/Methamphetamine.

Conclusion: Morphine and Methamphetamine were verified as still the major drugs of abuse in Taiwan, followed by Benzodiazepines, MDMA and ketamine. Ketamine and benzodiazepines were detected at high rates and became a significant problem. Also for the drug combinations, of ketamine positive specimens, MDMA was most frequently identified and of benzodiazepines positive specimens, morphine, methamphetamine and opioid were found mostly. The detection rates for THC and barbiturates were low in arrestees. These results revealed important information for further research and policymaking.

Reference:

1. Lua, A.C., Lin, H.R., Tseng, Y.T., Hu, A.R. and Yeh, P.C. 2003. Profile of Urine Samples from Participants at Rave Party in Taiwan: Prevalence of Ketamine and MDMA Abuse. Fore. Sci Intl. 136: 47-51.
2. UNODCCP: United Nations Office for Drug Control and Crime Preventions, Studies on Drugs and Crime: Global Illicit Drug Trends, 2000.

Arrestee, MDMA, Urine Specimens

B53 A Blind Trial Evaluation of a Practical Methodology for Deducing Impact Velocity and Droplet Size From Bloodstains

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After attending this presentation, attendees will learn the blind trial results of a novel technique that utilizes bloodstain diameter and number of spines to derive droplet size and velocity

This presentation will impact the forensic community and/or humanity by providing boodstain pattern analysts a methodology that could calculate droplet properties such as size and velocity. Upon the discovery of a bloodstain that meets the criteria (circular with radiating spines), investigators could derive the impact velocity and droplet volume and utilize these variables to:

1. Infer bloodshed forces by correlating impact velocity with an assault instrument.
2. Determine release height of passive droplets impacting on horizontal surfaces.
3. Incorporate projectile motion into trajectory calculations for bloodstains discovered on non-horizontal surfaces.

Crime scene reconstruction is dependent on the ability to establish past events from present variables. Investigators now have a method for uncovering droplet properties from bloodstains, leading to a more accurate interpretation of the crime scene.

Bloodstain diameter and number of spines are independent variables that can be combined to solve for impact velocity and droplet volume. This was established in a prior experiment that utilized mechanical engineering models to solve droplet properties from pig bloodstains. A blind trial study was subsequently undertaken to test the accuracy of this technique using a redesigned crime scene methodology.

Bloodstains found at the scene of a violent crime can often be used to reconstruct the events surrounding bloodshed. However, reconstruction would be enhanced if bloodstain morphology could be used to infer droplet properties. Investigators could then determine the source-of-origin and the forces surrounding bloodshed more accurately. At present, droplet properties are lost upon impact with the surface. As a result, a classification system based on stain diameter has been adopted to dissuade investigators from using bloodstains to estimate droplet properties.

Attempts have been made to correlate impact velocity with stain diameter. However, this has proven difficult since the size of a bloodstain is a function of two unknown variables (droplet size and velocity). Alternatively, Balthazard *et al.* was interested in using bloodstain spines to solve for impact velocity. Spines are commonly found radiating from the periphery of stains, and range in appearance from waves to sharp protrusions. As with stain diameter, Balthazard discovered that spines alone could not predict impact velocity, due to the additional influence of droplet

volume. He concluded that a deeper understanding of droplet dynamics was required. Several mechanical engineering models that have since been developed show a predictable relationship between stain morphology (diameter and spines) and droplet properties (size and velocity).

In a previous study, Hulse-Smith *et al.* evaluated two mechanical engineering models for their ability to predict droplet size and velocity from bloodstains. Pig blood droplets were released over a range of diameters (3.0 - 4.3mm) and impact velocities (2.4 – 4.9m/s) onto four surfaces (glass, steel, plastic, paper). The resulting bloodstains were then used to predict droplet properties. A strong correlation was found between observed and expected results.

To determine if this technique would translate to the crime scene, a redesigned methodology was tested under blind trial conditions. An investigator was presented with images of human bloodstains and samples of each impact surface. The conditions used to create each bloodstain were not revealed. The investigator subsequently performed a calibration to derive two specific equations for each surface. This aided in eliminating any variation introduced by surface irregularities. Finally, the number of spines and stain diameter were quantified from each unknown bloodstain image and integrated into the respective equations to solve for droplet properties. Experimental results are revealed during this presentation.

Bloodstain Pattern Analysis, Blood Droplet, Spines

B54 Paradoxical Effects of Surface Structure and Drop Height on Blood Stain Pattern Formation

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After attending this presentation, attendees will understand the influence of surface structure on shape of blood drops is very hard to predict without extensive experimentation. Even if surfaces seem to be very similar, paradoxical effects occur. Systematical variation using the actual surface from a crime scene will still allow scientifically sound statements, e.g., relating to height of blood source. Ultra-high-speed photography and physical analysis of the edges of blood stains during their process of formation (Karsten Loehr, Université Pierre et Marie Curie, Paris) also help to understand the dynamics between the surface, the blood drop and its later shape.

This presentation will impact the forensic community and/or humanity by demonstrating how extensive experimentation is necessary to understand the influence of the actual environment on the shape of blood drops. Even very reasonable and obvious assumptions about the structure of a surface may easily lead to wrong interpretations, and wrong expert witness statements.

During casework, the authors encountered the problem that height of the blood source became relevant. In order to determine the dependence of different types of underground on the shape of the drops, the authors checked the influence of asphalt, paper, linoleum, and plastic against different dropping heights (5, 100, 250, 500, 1000, 2000, and 3000 mm; n (drops) = 520). Then the diameter of the stains was compared, the number of fingers, the maximum distance of satellite drops to the center of a stain, and the total number of satellites.

Initially, asphalt and paper produced effects of rough surfaces whereas linoleum and plastic represented rather smooth surfaces. However, the general tendency of the diameter to increase with drop height, and to remain constant beyond a certain height, was not observed on asphalt. Instead, the diameter remained constant irrespective of drop height.

Also, the number of fingers ("noses") of stains produced on asphalt did not increase like on the other surfaces. The largest number of fingers was observed on paper.

The maximum distance of satellites to their central stain mostly increased linear with drop height. Asphalt presented the largest distances. Drops on the plastic surface showed constantly small distances of the satellites to the center of the stain.

Exact total number of satellites could only be determined on paper and asphalt. Even though both materials showed properties of the rough surface group, they produced very different results (e.g., on asphalt, the number of satellites increases linearly and steeply with height). In contrast, on paper the number of satellites stayed nearly zero.

In many cases it also seemed as if the relationship between height and the respective measured parameter was initially not linear but exponential, inverse exponential, or following a saturation curve. These effects will only become visible if small intervals between drop heights are chosen experimentally, especially in the often neglected range between 0 and 100 cm.

Conclusion: In casework, extensive experimentation is necessary to understand the influence of the actual environment on the shape of blood drops. Even very reasonable and obvious assumptions about the structure of a surface may easily lead to wrong interpretations, and wrong expert witness statements.

Blood Stain Pattern Formation, Crime Scene Reconstruction, Physics of Drop/Surface Interaction

B55 ESCRIME: A New Software for Bloodstain Pattern Analysis in 3-Dimensions

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The goals of this presentation are to explain the possibilities and the use of a software created to reconstruct 3-D trajectories of bloodstains at crime scene.

This presentation will impact the forensic community and/or humanity by presenting a new tool to deal with bloodstain pattern analysis at the crime scene.

Today, bloodstain pattern analysis is a fully recognized forensic discipline. The shape of stains assists investigators in determining the point of origin when locating the victim and the assailant during the bloodshed. The data obtained are very helpful to confirm witnesses or suspects statements and to support the investigators assumptions.

The forensic science laboratory of the French Gendarmerie and Marne La Vallée computer University created a new software called ESCRIME. The function of ESCRIME is to assist investigators with the interpretation of bloodstain patterns by bringing together three functions.

The first one is to create a virtual 3-D crime scene according to the real furniture and different textures observed. It is possible to know very precisely (within millimeters) the exact location of each item.

The second deals with the exploitation of the pictures of bloodstains. It is important to extract exact information and to measure a stain and locate it at the scene.

The third one allows the software to calculate the half plan the stain pass by and to determine point of convergence. The user can easily move inside the crime scene to obtain different views in 3-D.

The authors will present real cases using the software in real time.

ESCRIME is not only useful for bloodstain pattern analysts but also for other crime scene specialists, and can help to present cases to the court.

Bloodstain Pattern Analysis, Computer Analysis, Crime Scene Reconstruction

B56 Identification of Benzimidazolone Organic Pigments in Automotive Coatings Using Pyrolysis Gas Chromatography-Mass Spectrometry

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This presentation will impact the forensic community and/or humanity by presenting a proposal for an alternate means of identifying benzimidazolone organic pigments in automotive coatings.

Automotive coatings frequently play an important role in investigations of vehicular accidents, including "hit and run" incidents. When an automobile hits an individual, another vehicle, or an inanimate object, some portion of the vehicle's paint is often left behind. This evidence can serve two purposes: 1) If a suspect vehicle is located, a comparison of any questioned paint from the scene or victim to the known paint from the vehicle can be performed; and 2) If a suspect vehicle is not available, any paint left at the scene or on the victim may be useful for developing investigative leads. Of the two possibilities listed above, this paper is primarily concerned with the latter.

In order to provide investigative leads, the questioned paint must be examined physically and chemically. Chemical analysis of the paint evidence should be carried out in such a way so that as many of its individual components may be characterized as possible. The results should then be compared to a comprehensive database to determine whether a possible make, model, and year of suspect vehicle can be ascertained. The collaborative efforts of the Royal Canadian Mounted Police (RCMP) and FBI (FBI) have provided the forensic science community with such a database in the form of the Paint Data Query (PDQ).

The PDQ is based on the input of data obtained from visual, elemental and spectroscopic analysis of questioned samples. Generally, as more components of questioned paints are identified, the discrimination potential of such evidence increases. With recent shifts away from inorganic pigments, which often contain heavy metals such as Pb and Cd, organic pigments have become more prevalent in automotive coatings. Therefore the identification of organic pigments would be advantageous in generating a shorter list of possible suspect vehicles.

In its current state, the PDQ does not include organic pigments in its identification scheme. This absence may be due in part to a lack of research in this area. It has recently been shown that organic pigments can be identified in automotive paints using Fourier Transform Infrared Spectroscopy (FTIR). However, in certain instances the relatively low concentrations of organic pigments typically found in automotive coatings may make it difficult to make an identification using FTIR alone. In addition to the problem of low concentrations of organic pigments, automotive coatings frequently contain inorganic pigments, flakes and fillers that tend to obscure the presence of the lower levels of organic pigments when using FTIR.

To address this problem, this research was undertaken to evaluate the use of Pyrolysis-Gas Chromatography-Mass Spectrometry (Py-GCMS) as a compliment to FTIR for the identification of organic pigments. Py-GCMS can provide lower detection limits so that certain problematic organic pigments may be conclusively identified. This technique also provides for a cleaner separation of the contributions of the organic components from those of the inorganic components, thus offsetting the spectral overlap issues that occur when using FTIR. Py-GCMS also provides information about the polymeric binder or film former.

Organic Paint Pigments, Automotive Coatings, Pyrolysis Gas Chromatography-Mass Spectrometry

B57 Environmental Effects on Automotive Polyurethane Coatings: Implications for Casework

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The goal of this presentation is to present the infrared spectral variability that can occur within the same automotive polyurethane clearcoat to promote a better understanding of how this can influence casework for paint examiners.

This presentation will impact the forensic community and/or humanity by showing paint examiners why it is important to fully characterize polyurethane clearcoats when conducting a comparison analysis of this material. In particular it is important to sample at various depths from the surface or at least to sample at a consistent depth from the surface. Without proper consideration of the internal variability of these coatings incorrect exclusions could be made.

Chemical variability within automotive polyurethane clear coats has been observed in casework at the Centre of Forensic Sciences. These chemical variations were observed in the infrared spectra as differences in the relative intensity of the prominent band at 1690 cm^{-1} with respect to the 1730 cm^{-1} carbonyl band. The differences in intensity appeared to be dependent on the depth from the surface in automotive paints. A common technique of sampling clear coats for IR analysis is to manually slice thin peels, a method that does not permit the depth of sampling to be carefully controlled. This could contribute to the variation, and cause difficulties in interpreting a paint comparison.

It has been documented in the literature that polyurethane paints degrade upon prolonged exposure to UV radiation and water. The chemical changes due to the photo oxidation of these coatings have been studied using infrared and UV spectroscopy. However, in these instances the degradation process was initiated using weathering simulations. It is not known to what extent this degradation occurs under normal exposure to the environment and whether it would vary depending on the location on the vehicle. It has also been reported that the presence of water vapor during the curing process can create depth dependant variability in the polyurethane film. This may also account for the spectral variations observed.

Determining the extent of chemical variation that can occur within polyurethane automotive clear coats of real automobiles (not test panels) would be useful for interpreting these variations when they occur in casework and for developing sampling strategies. Polyurethane clear coats are used extensively as automotive repaints and to a lesser extent as OEM (Original Equipment Manufacture) clear coats, thus they are frequently encountered in cases that require analysis of automotive paint.

Differences of the relative intensities of infrared bands that appear to be reproducible could be interpreted as a differentiating feature between two paints. However, if these differences are due to internal variability of the coating that is not adequately represented then it is not a true difference. Thus, variation within the polyurethane clear coats could cause problems when interpreting infrared data especially when working with very small samples.

Polyurethane clear coats were obtained from a variety of automobiles and were analyzed using Fourier transform infrared spectroscopy to

determine the chemical variations within these paints. Chemical changes in the polyurethane clear coats were assessed as a function of depth (distance from the surface) by the examination of cross-sectioned samples by infrared micospectroscopy. Differences over different locations on the automobile were examined using attenuated total reflectance spectroscopy, which is a surface sensitive technique. Distinct chemical variations were observed both as a function of depth, and of location on the vehicle in a significant minority of the samples investigated. These differences could lead to an erroneous interpretation. While demonstrating the spectral variability within a clear coat is time consuming it can be essential to achieving a correct interpretation.

The data from this analysis will be presented and the implications of these findings on data interpretation and sample preparation will be discussed.

Automotive Paint, Polyurethane, FT-IR

B58 Characterization of Automobile Body Fillers

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After attending this presentation, attendees will understand the characterization of auto body fillers by instrumental means.

This presentation will impact the forensic community and/or humanity by providing forensic scientists a mean to compare and characterize body fillers will be greatly increased.

The objective of this study was to determine if chemical and physical differences in body fillers from various manufacturers exist and could be identified. Extensive research was done to obtain a representative sample of automobile body fillers and spot putties used in the U.S. After all of the samples were identified, 33 samples were obtained. Twenty-four of the samples were body fillers and 9 were spot putties. Nine different companies manufactured the 33 samples. All of the samples were analyzed by FTIR microscopy, stereo microscopy and pyrolysis GC-MS. The results of the analysis showed that 13 of the 33 samples could be correctly identified as to source, while the rest of the samples could be put into groups containing 2-4 types.

Automobile, Body Fillers, Spot Putties

B59 Beyond the Barcode: The Electronic Product Code and the Future of Product Identification

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Attendees will learn about the electronic product code (EPC), the object naming system (ONS), and how the coming tide of product identification technology, such as radio frequency identification (RFID), will affect their ability to identify products and track manufacturers.

This presentation will impact the forensic community and/or humanity by providing forensic scientsts with an understanding of the coming systems of product identification, such as the EPC and the ONS, to better identify products that are submitted as evidence and track the product to its manufacturer or even its point of sale. Without an awareness of this information, crucial evidence to a case may be neglected or lost.

Just as the UPC code has transformed retail operations around the globe over the past twenty years by increasing productivity and efficiency within the supply chain, the EPC (electronic product code) could take supply chain dynamics to the next level. The EPC is a new product numbering standard under development by the Uniform Code Council (UCC) that can be used to identify a variety of items using radio frequency identification (RFID) technology. The 96-bit EPC code links to an online database, providing a secure way of sharing product-specific information along the supply chain. Like other RFID solutions, the EPC's ability to be read without a line-of-sight offers users significant savings to manufacturers and retailers.

The existing UPC code allows retailers to track products at the SKU (stock keeping unit) level by providing every product with a unique identifier. The UPC (and its International cousins, the EAN and JAN) is made up of two key components: a number which identifies the manufacturer of the product, and a number which identifies the product belonging to that manufacturer. Each time a new product is created, or an existing product is modified in any way (including changes in packaging), a new UPC code is assigned to the product. Since each product may go though several minor design/packaging changes over its life, a single product may end-up with several UPC codes that identify it to a retailer, even though the retailer may consider the product as a single SKU.

The EPC technology, in conjunction with the expanding production of RFID capable printers/encoders, has the potential to revolutionize the supply chain by providing more accurate information about product movement, stock rotation, inventory levels and other management information. It also would be a significant tool for product recalls and theft prevention.

A consortium of companies (including WalMart, Proctor and Gamble, and Sun) is currently supporting research into this new technology.

The EPC code is a new product numbering standard that goes way beyond identifying products. The EPC assigns a unique number to every single item that rolls off a manufacturing line—***that is, every single bottle of soda would have its own unique EPC number***. The EPC will allow every company in the supply chain, including retailers, to track products at the individual item level. This means every single item on a shelf could be traced back to when it was made and when it is sold. However, the structure of the EPC does not necessitate every retailer track items at this level. The EPC has been designed to allow it to replace the UPC and allow tracking at the SKU level if desired. Because of the enormous quantity of unique numbers required to track at the item level, the EPC utilizes a "96-bit numbering scheme."

The implications to forensic science are enormous—the ability to track products that appear as evidence back to their point of sale! It is critically important that forensic scientists become aware of this new technology, how it works, and what resources are available to keep tabs on this groundbreaking technology.

Barcodes, Product Identification, Electronic Product Codes

B60 Forensic Science and Homeland Security: A Critical Piece of the Puzzle

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State and local crime labs, for the most part, are unprepared to provide assistance in terrorism acts or mass casualty incidents.

This presentation will impact the forensic community and/or humanity by providing attendees with a clearer understanding that State and local crime labs are not part of a nation preparedness strategy. Attendees will also receive suggestions on how to remedy this situation in their home regions.

Suppose terrorists mount coordinated attacks across the United States and abroad striking many targets simultaneously. Historically, the FBI, FEMA, D-MORT teams, and other organizations provide assistance to local agencies during disasters with or without mass casualties. But what

would happen if the federal response were stretched so thin that local jurisdictions were on their own for a few days or longer? Naturally, the "locals" would fend for themselves and manage as best as they could.

A serious problem exists today. There is no defined role for State and local crime labs who employ thousands of trained scientists throughout the United States in the event of a terrorist incident. Despite their wide use in other areas, local crime labs have largely been ignored as an added resource for homeland security related incidents. The result is that few state or local crime labs are prepared to help out should an incident occur. The idea that forensic science personnel might be among the first responders or support first responders has not been fully considered. Developing a local forensic science response to a terrorist incident while it is unfolding is not the appropriate time to start planning.

While crime labs do not have the capacity to specifically handle certain types terrorist incidents as certain Federal agencies they, none-theless, in a WMD scenario, they will play a role, whether they are prepared or not. The events in New York City following September 11, 2001, demonstrate this when the NYC Office of the Chief Medical Examiner conducted thousands of DNA tests for victim identification.

State and local public safety personnel will be involved with pre and post terrorist events. It is no leap to expect local forensic science personnel to also be involved as either first responders or immediately following the first responders. They could be involved at the scene and in the laboratory as examiners of physical evidence in traditional forensic science efforts such as, DNA testing, latent fingerprint examination, handwriting examination, and so on.

Before forensic scientist show up at a scene or become involved, careful consideration will be given concerning chemical, biological, radiological and nuclear contamination of evidence, analysis of large volumes of evidence, tracking evidence, coordinating information, training and preparedness.

To date, federal planners that would ultimately manage terrorist incidents have not considered what might be the appropriate role for State and local forensic science laboratories in terrorist incidents. Other than medical examiners and coroners, there have there been few attempts to prepare local forensic practitioners for this assignment.

What are appropriate steps that might be taken to remedy the present situation? Just as the Department of Health and Human Services has brought state and local public health labs together under a "laboratory response network" an appropriate federal agency should bring together state and local crime labs along with homeland security stakeholders to develop a role for state and local forensic science laboratories and begin planning how to use these resources.

A national forum is one way to define the relationship of forensic science to homeland security. Some of the issues that might to be discussed include: the identification of mass casualties by DNA; the examining WMD contaminated evidence at the crime lab; the coordination of local crime labs with state and local public health labs; training and equipping forensic science personnel; and integrating forensic science into WMD preparations.

State and local crime labs can also begin preparations now by contacting local stakeholders concerned with terrorism and mass casualty planning. Sometimes it takes the prodding of the "locals" to get the "fed" moving. And now would certainly be a good time to begin, before the next incident occurs.

Terrorism, Homeland Security, Mass Casualties

B61 Bioterrorism in Europe After September 11th: Our Experience in BIOTOX Procedure

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This presentation will impact the forensic community and/or humanity by showing the forensic community that forensic scientists should be involved in bioterrorism for many reasons among which are the protection of the population of penal evidences

At the end of 2001, the United States of America was hit by incredible acts of terrorism. In the months and years following, small groups have tried to increase the stressful climate by using militarized "harmless" bacterial strain. The effects of globalization allowed a wild distribution, not of the bacterium, but of fear, especially in Europe and analysis on different supports suspect to be infected are being perfomed today.

The authors are showing here the impact and the experience of a forensic ward in the fight against bio terrorism.

Systematic bacteriological and judiciary analysis of suspect postal dispatches in France from October 23, 2001 to July 2004 are exposed. Bacteriological and toxicological results, as well as penal consequences for the authors have been studied. The administration sought to implement this procedure for sanitary and economical reasons and for penalty proof protection as well. More than 250 analyses were performed and no anthrax was found.

The organization of this procedure, its history and difficulties are presented. The techniques and bacteriological methods used will be analyzed. Methods implemented in order to preserve judicial proof are also presented along with the difficulties in relation to their qualification for efficient penal procedures.

Bioterrorism, Anthrax, Europe

B62 Census of Publicly Funded Crime Laboratories - 2002

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By attending this presentation, attendees will receive an overview of a recently completed census of the nation's publicly funded crime laboratories.

This presentation will impact the forensic community and/or humanity by providing forensic laboratories and policy makers with crime laboratorie's staffing patterns and caseload characteristics, as well as their resource needs.

This presentation will provide laboratories and policy makers with crime laboratories' staffing patterns and caseload characteristics, as well as their resources needs.

The Department of Criminal Justice at the University of Illinois at Chicago (UIC), in collaboration with the American Society of Crime Laboratory Directors (ASCLD), was funded by the Bureau of Justice Statistics (BJS) to undertake a census of all publicly funded crime laboratories throughout the United States. Because this was to be a census, responses were sought from every, individual crime laboratory in the nation. UIC was asked to gather baseline statistical information for 2002 on the operations and workload of crime laboratories, and to assess where added resources were needed. The objective was to improve public understanding of the work performed and resources committed to crime laboratories.

Staff worked extensively with ASCLD and the crime lab community to develop a comprehensive listing of laboratories. The survey itself had six primary areas: Organization, Budget, Staff, Workload, Outsourcing, and Quality, Training, & Research. First the governmental entity and population of jurisdictions served was determined, and types of forensic functions performed in each laboratory. Next, the budget breakdown of each laboratory was examined, and source of funding. We then determined laboratories' workloads and queried labs about the number of cases received and backlogged, and the volume of requests received, worked and backlogged in 2002. Also determined was the performance expectations that laboratories had of various examiner specialists, and what added resources would be needed to reduce backlogs. Questions were asked about the number of requests outsourced, as well as the cost and funding sources for such testing. Lastly, laboratory accreditation was determined, the types of proficiency tests in which they were engaged, and the dedication of resources to training and research. Facilities had the option to respond either via paper or electronic form.

The process began with a mailing list of 469 facilities that were queried to ascertain if they met the definition of a publicly funded crime laboratory. Ultimately, 126 entities were excluded that were either duplicates, bad addresses, or did not meet the definition of a laboratory; e.g., many crime scene and police ID units were excluded. Three hundred forty three (343) laboratories remained on the list as bona fide crime laboratories. Once it was determined that all survey responses from all laboratories willing to complete the primary survey were received, an abbreviated (short) survey was developed abd directed to the remaining, nonresponding laboratories. Two hundred eighty-six 286 full and 25 short (partial) surveys were received from participants – a total of 311 individual laboratory responses, representing a response rate of about 90%. Also received were 15 aggregate responses representing multiple laboratories in state or federal systems.

Data were initially compiled and published via a BJS Fact Sheet for the fifty largest state and local laboratories in the United States. These facilities employed more than 4,300 full-time equivalent (FTE) personnel in 2002 and had budgets exceeding $266 million. Laboratories received almost one million cases in that year, including over 1.2 million requests for forensic services. The requests represented about *half* of all requests for forensic services handled by publicly funded laboratories nationally. These labs ended the year with over 93,000 backlogged cases including about 270,000 requests for forensic services – more than *twice* the backlog that existed at the beginning of the year. It was DNA analysis were backlog was increasing the fastest; i.e., for every DNA analysis request completed in these laboratories in 2002, an estimated two requests were added or remained outstanding at yearend. A summary of all data collected will be presented at the meeting.

Crime Laboratories, Survey, Backlog

B63 *Biotracks* – Leveraging DNA Technology to Solve Lesser Offense Cases and Reduce Recidivism in Queens County, New York

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The objective of this presentation is to demonstrate the value of recognizing and collecting various types of biological evidence left at burglary scenes. By generating STR profiles from evidence such as perspiration, hair, and blood, and uploading them into local, state, and federal DNA databases, the perpetrator(s) of a no-suspect case may be identified and links between otherwise unrelated burglaries may be established. By maximizing the potential and effectiveness of the DNA databases, this study demonstrates a means of identifying the recidivism rates of convicted offenders within a specific geographical region, as well as identifying any correlation between burglaries and more violent crimes such as sexual assault and homicide.

Research has shown that virtually all offenders begin their criminal careers early in life with lesser offenses. A 2002 study by the Bureau of Justice Statistics shows that burglars had one of the highest re-arrest rates at 70.4% as well as one of the highest recidivism rates for specialists i.e., prisoners who, after being charged with one type of crime, are likely to commit the same type of crime again. Considering that there are over 110,000 convicted offender DNA samples in the New York State database to date, the authors felt it was time to leverage this technology and focus on lesser offenses such as burglary in order to reduce their frequency and ultimately reduce the frequency of more violent crimes.

In order to ensure that the most probative items of biological evidence are collected and analyzed, it is essential to have a well-trained and informed evidence collection team. In addition to targeting conventional items such as cigarette butts, blood, soda cans, and hair, the burglary scene processors in Queens County, New York were trained to recognize and swab contact surfaces such as windows, knife handles, and door knobs which may contain trace amounts of biological material left behind by intruders. Instruction in the protection of these biological samples from contamination, loss, or deleterious change was a key aspect in the training.

This presentation will conclude by discussing which types of biological evidence and contact surfaces yielded the most informative STR profiles and how many profiles were developed from specific types of items. With this type of data, law enforcement will gain a better understanding of which items from a burglary scene are likely to yield probative profiles and how many samples need to be collected and analyzed. By obtaining STR profiles from biological evidence left at burglary scenes and utilizing the expanding DNA databases of convicted offenders, the rate of burglaries and more violent crimes can ultimately be reduced.

Burglary, DNA, Database

B64 Development of Improved DNA Extraction Method for Detection of Biological Threat Agents Collected on Environmental Swabs

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Attendees will learn an improved method for recovering and detecting DNA from biological threat agents collected on environmental swabs.

This presentation will impact the forensic community and/or humanity by demonstrating that sensitive detection can be achieved by using an integrated approach for sample processing that considers recovery of agent from the sampling matrix, release of DNA, counteracting environmental inhibitors, concentration of extract, and robust PCR conditions.

Investigations of crimes involving dangerous biological agents often require the use of swabs and wipes to recover the biological evidence. Current laboratory protocols for rapid extraction and detection of *Bacillus anthracis* (BA) from environmental swabs often rely on the recovery of DNA present on the external surface of spores. Furthermore, these methods generally do not include ways to counteract environmental PCR inhibitors except for dilution of the original DNA sample. As a result, these methods can suffer from poor sensitivity of detection. Additionally, such methods for extraction of spore DNA may not be appropriate for extraction

of nucleic acids from other biological threat agents such as viruses. This study was conducted to determine whether the sensitivity of detection can be increased by incorporating steps for lysis, DNA purification, and optimized PCR conditions.

An extraction method was developed which consists of placing a swab head inoculated with microorganisms into a 2 ml O-ring screw-cap tube containing lysis buffer, glass beads and polyvinylpolypyrrolidone. The microorganisms were lysed by bead-beating and the DNA extracted and purified using the Qiagen DNeasy kit. To counteract the effect of environmental PCR inhibitors, molecular biology-grade bovine serum albumin (BSA; 200 ng/mL) was included in the PCR reaction.

In order to evaluate this method for extraction of nucleic acids from various types of microorganisms, real-time PCR assays were developed for the detection of DNA from BA (a Gram positive bacterium), *Yersinia pestis* (YP; a Gram negative bacterium), Vaccinia virus (VAC; an enveloped virus) and Adenovirus (ADV; an un-enveloped virus). Using this extraction method, the reliable lower limit (10/10 extraction replicates showing positive results in duplicate PCR reactions) of detection by real-time PCR is 100 colony forming units (cfu) of BA spores and 100 plaque forming units (pfu) of Vaccinia virus inoculated directly onto clean, sterile swabs. In order to mimic dirty or dusty environmental samples, swabs were coated with 10 mg of urban particulate matter (NIST SRM 1648) prior to inoculation with microorganisms. Real-time PCR detection following DNA extraction from these dirty samples resulted in reliable lower limits of detection of 500 cfu BA and 100 pfu VAC. Despite the apparent poorer detection limit of BA in dust-coated swabs, 100 cfu could be detected in a majority (95% of extraction replicates and 90% of PCR replicates) of the samples tested. Similar studies are underway to determine the limits of detection for YP and ADV.

In conclusion, the authors have developed a method for the efficient extraction and sensitive detection of BA and VAC DNA from environmental swabs. Future studies will focus on the recovery and detection of other organisms and development of extraction methods for other sampling matrices.

Microbial Forensics, DNA Extraction, Biological Threat Agents

B65 Evaluation of Fabrics for Development of a Low Copy Number Sampling Swab

James A. Sebestyen, BS, Mechthild Prinz, PhD, Robert Shaler, PhD, and Theresa A. Caragine, PhD, Office of Chief Medical Examiner, 520 First Avenue, New York, NY 10016*

The goal of this presentation is to compare different fabrics that were tested in the development of a swab for the High Sensitivity Laboratory.

This presentation will impact the forensic community and/or humanity by developing a swab to improve recovery of DNA from Low Copy Number DNA samples such as fingerprints. The shape of this swab also accommodates robotics, and thus promotes the processing of large numbers of evidentiary samples.

In order to maximize the recovery of DNA from surfaces potentially containing Low Copy Number (LCN) DNA samples, such as fingerprints, several fabrics were evaluated based on their ability to absorb and subsequently release cells. These fabrics were also compared regarding their compatibility with the laboratory's high throughput system.

Studies conducted previously tested a wide variety of commonly available fabrics including but not limited to cotton, polyester, and microfiber, and Dacron® and cotton swabs, which are currently utilized for sample collection. Initially, microfibers recovered the most DNA from fingerprints. Cotton and Dacron® absorb liquid very well, and their poor DNA yield from LCN samples suggests that they trap DNA and liquid within their fibers.

The Dacron® and the cotton swabs were also not compatible with the optimized extraction protocol, unlike the microfiber swab. This procedure consists of a sample digestion step followed by purification and concentration with a microcon 100 (Millipore). Moreover, this procedure can be automated through the robotic removal of the digested DNA from the swab and transfer to the microcons, assembled into a 96 well plate, the Microcon 96 Retentate® Assembly Plate (Millipore). The Dacron® and cotton swabs tended to clog the pores of microcons hindering sample concentration. Moreover, the microcon elution volumes were inconsistent, often unnecessarily diluting the samples.

Since the microfiber also had some problems with liquid retention, additional candidate fibers were selected based on their high absorption potential coupled with the likelihood that their structure promoted fluid release. A series of five analogous, natural fabrics (A-E) were evaluated for potential use for the LCN swab. Fabrics A and B have similar shapes, but had few variations in their weaves, whereas fabrics C, D and E had different shapes, but had few variations in their weaves. To test absorbance, the fabrics were immersed in 10 uL of control DNA in a microfuge tube. When the tube appeared dry, the fabrics were discarded and water was added to the tubes to resuspend any DNA left behind. In order to test the release of DNA, control DNA was deposited directly onto the fabrics, and allowed to be absorbed into the fabric for ten minutes. The fabric was then placed in sterile water and shaken at room temperature for 20 minutes. Following sample concentration, DNA was measured and the percent recovery was calculated. Based on the results, Fabric B and Fabric C were superior. To confirm this finding, fingerprints were collected from volunteers, and were swabbed with each of the two fabrics. Comparable yields resulted.

Subsequently, the fabrics were compared with respect to their performance with the robotic system. Prior to this testing, the optimal length of the fabrics for DNA recovery was determined, although, regarding robotics, the smallest length possible is best. Lengths of 1 cm, 2 cm and 3 cm were used to swab dried cells from a surface and extracted. Fortunately, the shorter lengths of fabrics yielded the most DNA. Therefore, the sample digests were removed from Fabrics B and C on the Biomek 2000. However, Fabric B caused a malfunction whereas Fabric C was compatible with the process, and was selected as the candidate swab fabric.

LCN samples, DNA, Automation

B66 Effect of Lubricants and Nonoxynol-9 Exposure on Biological Evidence From Condom

Ginger Luccero, MFS, and Ismail M. Sebetan, MD, PhD, Forensic Science Program, National University, 11255 North Torrey Pines Road, La Jolla, CA 92037*

Attendees will further their knowledge when dealing with biological evidence exposed to lubricants and spermicides due to use of condom in sexual assault cases. The presented information will provide a starting point for further research on utilization of the rate at which nonoxynol-9 degrades the sperm cell membrane to help in determination of time of incident.

This presentation will impact the forensic community and/or humanity by demonstrating research to those working in the field that will further their knowledge when dealing with biological evidence exposed to lubricants and spermicides due to use of condom in sexual assault cases. The presented information will provide a starting point for further research on utilization of the rate at which nonoxynol-9 degrades the sperm cell membrane to help in determination of time of incident.

Condom use during sexual assaults has increased and, as a result, so has the forensic significance of condom-associated biological samples. Preservation of this valuable evidence has prompted the investigation of condom lubricants and spermicides for potential degradation of biological samples. Integrity of samples can be inferred by the ability to amplify short tandem repeats (STRs) on the Y chromosome. Y chromosome STRs are male-specific and are polymorphic in the number of times a sequence motif is repeated. As a result, Y chromosome STRs provide a great power of

discrimination among individuals. It is important to prove that lubricants and spermicides from condoms do not decrease the accuracy of DNA profiles, and therefore, do not undermine the validity of such evidence in court.

Semen samples were incubated at room temperature and at 37° C for up to three days in the presence of a water-based lubricant, an oil- based lubricant, and the spermicide nonoxynol-9. Untreated samples were also investigated for comparison. Samples were harvested for DNA, which served as a template for PCR and quantitative PCR (qPCR). PCR targets included DYS 385, DYS 389I, and DYS 393 loci. For studying rate of degradation of the sperm cell membrane, Semen samples were incubated in condoms in the presence and absence of nonoxynol-9. Nonoxynol-9 (N-9) is classified as a nonionic surfactant and interacts with lipoproteins of cell membranes. Through a time course, samples were fixed with 4% paraformaldehyde and stained with propidium iodine (PI). Cells were sorted on the Guava PCA cell sorter and the percentage of PI negative cells (viable cells) and the percentage of PI positive cells (non-viable cells) were calculated.

Successful amplification of all DNA samples was demonstrated through qPCR analysis as well as gel electrophoresis of PCR products. Results also indicated that, over time up to three days, the percentage of viable cells decreased in N-9 treated samples but stayed constant in untreated samples.

In conclusion, it has been proven that exposure of semen samples to oil-based lubricants, water-based lubricants, and nonoxynol-9 does not prevent successful Y-STR. In addition, by determining the percentage of viable cells in a sperm sample, the length of exposure to N-9 can be estimated

DNA, Y-STR loci, Lubricants & Spermicides

B67 Optimization of DNA Extraction Procedures for Low Copy Number Degraded Samples

Taylor M. Dickerson, MS, Mechthild Prinz, PhD, Robert C. Shaler, PhD, and Theresa A. Caragine, PhD, Office of Chief Medical Examiner, 520 First Avenue, New York, NY 10016*

Attendees will learn modified versions of common DNA extraction procedures that can be used for low copy number degraded samples

This presentation will impact the forensic community and/or humanity by providing optimized procedures to ensure that a high yield of DNA is obtained when a LCN degraded sample is encountered. Ultimately, a higher yield of DNA from the extraction will provide more DNA for amplification.

As LCN degraded samples are encountered more frequently in forensic casework, it would be useful to optimize current DNA extraction procedures in order to obtain a higher yield of DNA. The following DNA extraction procedures were investigated: DNA IQ™ (Promega), QIAamp™ (Qiagen), 5% Chelex® (BioRad), and a LCN extraction procedure developed at the Office of Chief Medical Examiner with the use of 0.01% SDS. Initial experiments were performed with purified DNA in amounts of 100 pg or less. The DNA was degraded with DNase I and subjected to each of the four extraction procedures, before and after optimization. Human embryonic kidney cells were also degraded with DNase I; and known amounts (~20 cells) were used in each of the extraction procedures. Bloodstains that were degraded with irradiation were also used in this study. As a control, LCN undegraded samples of the same nature were subjected to each extraction procedure, before and after optimization. All of the samples were quantitated with real-time PCR, amplified with the Power Plex 16® (Promega) multiplex system, and separated with the 3100 Genetic Prism® Analyzer (ABI).

For the DNA IQ™ (Promega) extraction procedure, the following parameters were changed to optimize the extraction of the LCN degraded samples: smaller volumes of resin and lysis buffer, shorter incubation time, and the addition of Poly A RNA. For the QIAamp™ (Qiagen) extraction procedure, the addition of Poly A RNA and an increased temperature during the elution step optimized the extraction. The extraction procedures with 5% Chelex® and 0.01% SDS both gave optimal results with shorter incubation times. DNA yield, or percentage recovery, was calculated for each extraction. The results from the optimized procedures were compared to those before optimization. An increase in DNA yield was seen with all of the optimized procedures. Usable DNA profiles were obtained for all of the samples subjected to the optimized procedures.

DNA Extraction, Low Copy Number, Degraded DNA

B68 DNA Extraction of Archived Palm Prints: Implications for Cold Case Evidence

Jason Berger, MS, Mechthild Prinz, PhD, Robert C. Shaler, PhD, and Theresa A. Caragine, PhD, Office of Chief Medical Examiner, 520 First Ave, New York, NY 10016*

Attendees will learn how DNA can be extracted from archived palm prints, allowing for the genereation of CODIS compatible PCR DNA profiles. DNA considerations for the collection of palm print evidence.

This presentation will impact the forensic community and/or humanity by showing how archived palm prints, which may be too smudged or incomplete for traditional fingerprint identification, can be used for PCR DNA typing. This method could allow for the examination of cold cases in which this type of evidence is present. Obtaining a CODIS profile could allow for another way to identify a suspect.

The goalof this presentation is to improve the recovery of DNA and the production of PCR DNA profiles from palm prints that have been dusted with soot based fingerprint powder, and archived by tape lifting.

Archived latent prints are often the only probative evidence in many unsolved cases. Employing protocols previously developed for Low Copy Number (LCN) DNA samples by the High Sensitivity Team in the laboratory of the OCME, the DNA recovered from tape lifts of fingerprints was often insufficient to produce DNA profiles that could be compared to the national database, CODIS. Therefore the extraction method was optimized and applied to archived palm print evidence, in order to maximize DNA recovery.

Samples were collected from ten different subjects on two types of surface (Linoleum tiles and Plastic). Subjects, at least one hour after washing their hands, were asked to press both of their palms onto each surface for five seconds. The prints were then dusted using both black and dual-use fingerprint powders. Following enhancement, the prints were lifted from the surface using a clear adhesive tape and stored on a standard fingerprint lift card. In order to diminish the adhesive properties of the tape, the cards were stored in the freezer at -20° C for at least four hours prior to extraction.

The tape was then removed from the card to allow the digestion buffer, 5 mls of 0.01% SDS and Proteinase K, access to the epithelial cells attached to the tape. Thirty minutes was sufficient to digest the cells, yet still preserve the DNA. Samples were purified and concentrated with a centriplus 100 (Millipore) followed by a microcon 100 (Millipore) with the addition of Poly A RNA to prevent loss of DNA. DNA recovery was measured with SYBR Green I and real time amplification of an ALU sequence. All samples containing at least 6 pg of DNA were amplified for 35 cycles with PowerPlex® 16 (Promega) PCR reagents with a halved reaction volume and a doubled extension time. 4 µL of each PCR product was injected at 3 kV for 20 seconds on the ABI 3100 Genetic Prism® Analyzer. Data is expressed as the percentage of correctly determined alleles out of the possible thirty-two alleles amplified.

Twenty eight palm prints were collected and archived from six different subjects. At least 6 pg of DNA was recovered from 64.3% of these samples. This DNA was amplified to produce allelic determinations that were 57.4% correct. However, many of these samples were multi-component mixtures. Since extraction of the tape alone produced DNA alleles,

the source of this contamination could be due to prior handling of the adhesive edges of the rolls of tape. Therefore, the middle of the tape containing the print was excised and extracted. Control pieces from the center of the tape did not contain extraneous sources of DNA.

Consequently, fifty more palm prints were processed with two methodologies to accommodate contamination from the tape. Half of the prints were collected as described above, but only the middle portions of the tape lifts were digested. Alternatively, the remaining prints were collected on tape that was UV treated prior to sample collection. Similar to the previous study, 65% of these samples contained at least 6 pg of DNA.

However, these experiments demonstrated a significant decrease in the number of drop-ins. The non UV-treated tape averaged 46.34% correct alleles with 5.3 spurious alleles called, and the UV-treated tape produced on average 52.2% correct alleles with 15.2 spurious alleles. Furthermore, in order to generate reliable profiles, samples were amplified twice, and alleles were assigned only if they were occurred in both amplifications. Employing only concurrent correct allelic determinations, usable database eligible profiles were apparent, on average, in thirty percent of the samples examined.

These studies suggest that archived palm and likely fingerprints may provide DNA evidence. In order to avoid sources of contamination, collection tape could be treated with UV and the DNA analyst should only process the center of the tape. Regarding archived prints from cold cases, the latter strategy is feasible, but depending on collection precautions, mixtures should be anticipated.

Low Copy Number DNA, Tape Lifts, Finger/Palm Prints

B69 Select Agent Microbial Forensic DNA Identification Techniques

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After attending this presentation, attendees will have knowledge about select agent microorganisms, DNA quantitation, and microbial DNA identification techniques.

This presentation will impact the forensic community and/or humanity by providing information about microbial forensic DNA identification techniques used in laboratories for the DNA identification of dangerous bacteria that are encountered in bioterrorist incidents.

The microbial select agents that have been historically been weaponized in foreign nations and that pose the greatest bioterrorist threat include *Bacillus anthracis spores*, *Yersinia pestis*, *Francisella tularensis*, *Burkholderia mallei*, *Brucella abortus*, and *Clostridium botulinum toxin*, however, any microorganism or toxin can be used to create public chaos and fright in an act of biological terrorism or as a hoax. These microorganisms are cultured in a Biological Safety Level 3 (BSL3) biological containment laboratory, require special care in handling due to their pathogenicity, and are highly regulated in an effort to prevent further acts of bioterrorism.

Microbial class characteristics, such as gram stain reaction, cell morphology, biochemical metabolic profiles, presence of spores and toxin production are examined in microbial forensic analyses of organisms released in a terrorist incident or hoax. Knowledge of select agent (SA) microorganisms most likely to be used as biological weapons based on historical use, recent terrorist incidents involving SA microbes, and the need for more rapid identification of these microorganisms, has prompted the quest for informative DNA identification tests.

Microbial DNA identification tests require microbial strain population studies to assess the specificity, the informative value of the DNA assay for strain differentiation, and if source attribution of a strain is possible. Therefore, large repository of well characterized select agent microorganisms for the production of microbial genomic DNA for PCR assay comparison studies is being grown in the laboratory of the AFIP. Information on microbiological characteristics of the select agent genus and species, genomic information, as well as any published information is also being collected. Sensitive, specific microbial PCR techniques, performed on specimens submitted for DNA identification, are based on detection of unique genes that are present in quantified microbial DNA and can be detected whether or not the microorganism is viable.

Various molecular biology techniques that have been used in the laboratory for microbial DNA identification include 16S ribosomal DNA sequencing, Amplified Fragment Length Polymorphism Polymerase Chain Reaction, Multi-locus Variable Number of Tandem Repeat Polymerase Chain Reaction, and Real-Time PCR amplification/detection of pathogen specific genes. The strategy of using combined microbiological and molecular biology techniques allows confident DNA identification, but not source attribution of select agent microorganisms.

Bioterrorism, Microbiology, DNA Identification

B70 An Improved Method for the Identification of Menstrual Blood Using Real Time PCR

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Attendees will learn that it is possible to identify the menstrual origin of blood stains using real time PCR and that the question whether blood stains were produced by injury or by menstrual bleeding can be of crucial importance in forensic casework.

This presentation will impact the forensic community and/or humanity by demonstrating a reliable method is available which allows the detection of menstrual blood markers in blood stains. Compared to a previously published paper the new technique is based on real time PCR, is much more specific and senstive and therefore suitable for the use in forensic casework.

In forensic casework type and origin of stains frequently are of crucial importance. Whereas presumptive or specific tests exist e.g. for blood and semen, the question whether a stain was produced by injury or by menstrual bleeding remained unsolved over many years. Some time ago a new technique was introduced based on the detection of mRNA by reverse-transcription coupled to PCR. The evaluation of potential candidate genes showed that matrix metalloproteinases were suitable markers for menstrual blood and never were positive when blood from injuries or other body fluids was examined (*Martin Bauer, Dieter Patzelt. Evaluation of mRNA markers for the identification of menstrual blood. Journal of Forensic Sciences 2002; 47:1278-1283)*.

During the last years the authors have had the opportunity to do some casework for police agencies in Germany and Great Britain. When confronted with "real" stains produced outside the laboratory it became evident that the sensitivity of the method was not sufficient because it had been only tested with artificial stains up to that time. Furthermore, an improved visualisation method with the possibility of quantifying results seemed to be helpful because it frequently was difficult to assess bands in agarose gels stained with ethidium bromide when their fluorescence was very weak. For these reasons, researcher decided to re-establish the test using real time PCR and sequence-specific probes which promised to be the perfect solution for the problems mentioned above. The use of Taqman®-probes allowed to amplify very short fragments with a size of less than 50 bp and the detction of the fluorescent dyes coupled to the probes is much more sensitive and specific than the assessment of agarose gel bands with the naked eye.

Commercially available and self-designed primers and Taqman®-probes for Matrix Metalloproteinases and house keeping genes were used with samples left over from previous studies and from the cases submitted

for examination. In addition, 60 new samples from healthy volunteers have been collected. RNA isolation and reverse transcription were performed as described previously; however, as primer for reverse transcription now random hexamer primers were used instead of an oligo-(dT)-primer.

Results again confirm that the detection of mRNA specific for Matrix Metalloproteinases is a specific and sensitive indicator for the presence of menstrual blood. The use of real time PCR allowed amplification of RNA/c-DNA even in small and degraded samples using primers and probes for housekeeping genes which were negative with the conventional technique. This is particularly important because casework experience showed that it can be essential not only to prove that a given sample is menstrual blood but to state that it is not menstrual blood. With the new technique it is now possible to do this with a reasonable degree of certainty due to the sensitive and quantitative detection of housekeeping gene-mRNA. Negative result can be clearly differentiated from positive results due to the continuous monitoring of fluorescence during PCR.

In this presentation the authors want to introduce the new technique and to show that now reliable and consistent results can be obtained from stains of minimal size and high degradation as it often happens in forensic practice. To demonstrate the relevance of this test casework examples will be presented in which the identification of menstrual blood played an important role in police investigations.

Menstrual Blood, Real Time PCR, mRNA

B71 Methodologies to Employ Porcine Tissue to Simulate Human Tissue: Determining the Efficacy of Radiation for Decontamination and the Subsequent Recovery of DNA From Tissue for PCR DNA Testing

Theresa A. Caragine, PhD, James A. Sebestyen, BS, Ewelina J. Badja, BS, Robert C. Shaler, PhD, and Mechthild Prinz, PhD, Office of the Chief Medical Examiner, Department of Forensic Biology, 520 First Avenue, New York, NY 10016*

The goal of this presentation is to describe assays designed to measure DNA recovery and STR profiles from porcine tissue in order to provide a model to test decontaminated human remains.

This presentation will impact the forensic community and/or humanity by presenting studies which suggest that decontamination of human tissue by irradiation is a possible solution for the safe return of reamins to families. Moreover, these methodologies for porcine tissue provide an easily accessible model for other examinations that may require human tissue samples.

Currently, there are few viable alternatives regarding the identification and subsequently the interment of biologically or chemically contaminated human remains. Studies have demonstrated that irradiation of human tissue, specifically at 51 kGy, destroyed *Bacilus subtilis*, a surrogate for *Bacillus anthracis*, but preserved identifying DNA sequences. Chemical decontamination, however, will likely require much higher doses of radiation. Therefore, the laboratory of the OCME in conjunction with Titan Corporation performed a dose response with electron beam radiation and evidentiary items such as blood, semen, and saliva stains. Even at doses as high as 90 kGy, sufficient DNA to produce usable DNA profiles was recovered, although the absolute DNA yield was compromised. In order to better define the limits of DNA testing of irradiated samples, and to assess penetration through a large tissue sample, pork slabs, simulating human tissue, were irradiated at higher doses, and methodologies were adjusted to accommodate this porcine DNA.

Inserting dosimeters deep within a substantial piece of pork addressed the issue of radiation penetration. With the effective dose known, one could evaluate DNA testing results taken from a pork sample proximal to a dosimeter, with certainty. Moreover, the efficacy of decontaminating tissue could be studied with pork similarly "inoculated" with spore test strips for *Bacilus subtilis*.

In this experiment, six pork shoulder shanks were sliced into four one pound slabs of boneless meat. A small portion of each of twenty slabs was sliced wherein one dosimeter and one spore strip, sealed in waterproof miniature kpac pouches, were inserted. The gap was sewn together with fishing line, and wrapped in brown bench paper. Two slabs of pork thus prepared were packaged in each of ten boxes, where one slab was placed near the bottom of the box and one near the top. Sandwiched between the two slabs were an additional dosimeter and a spore strip. Surrounding these items were dry ice and newspaper.

Titan Scan, San Diego, CA, irradiated two boxes for each of the following doses: 0 kGy, 30 kGy, 60 kGy, 90 kGy, and 120 kGy. The dosimeters and the spore strips were returned to Titan Scan and Raven Laboratories, respectively, for processing. Three 25 mg samples of each of twenty slabs of pork were extracted with DNA IQ™ (Promega) according to a modified methodology developed in the laboratory on the Biomek 2000 that encompassed the use of a stronger digestion buffer and three times more resin than recommended.

DNA recovery was measured with a SYBR Green I based real time PCR assay for ALU fragment. Primers described by J Walker *et al*. (Analytical Biochemistry, 2003) produced a 134 bp amplicon. The assay was modified for the Rotorgene 3000 and a home brew master mix with the addition of 0.5 □g/□L of BSA, 8% DMSO, and 0.25□L of a 1/100 dilution of SYBR Green I (Molecular Probes). The dynamic range of the assay was from 0.78 pg to 6400 pg. The control DNA for the standard curve was procured from control slabs of pork that were extracted as described above, and measured with a spectrophotometer.

Amplification of the ALU amplicon predicted successful genotyping of porcine microsatellites. Three microsatellites from the USDA database, Sw520, S0147, and TNFB, were selected due to their varying lengths, 102-124 bp, 146-174 bp, and 174-213 bp, respectively. Each forward primer was labeled with 6'FAM, and collectively they were multiplexed according to the parameters described by G. Yue *et al.* (Electrophoresis, 1999) with additional KCL. PCR products were separated on an ABI Genetic Prism Analyzer using LIZ (ABI) as a size standard. DNA recovery and STR typing results were similar to previous experiments. Although, as radiation increased DNA recovery decreased, if sufficient DNA was present genotypes were generated.

Radiation, Microsatelites, Animal Model

B72 Determination of the Distribution of DNA to the Faces of Children Aged 0-5 Years Due to Normal Day-to-Day Interaction Between the Child and the Carers

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After attending this presentation, attendees will learn that it is possible to obtain DNA from the skin surface of a child which can be amplified and identified and that this varies from child to child as well as at different ages. The attendee will also learn how DNA can vary in distribution across the face and neck of a child.

This presentation will impact the forensic community and/or humanity by demonstrating how upon completion of phase I and phase II of this research, a series of facial maps will be produced illustrating the distribution of DNA upon the faces of children aged 0-5 years. As childcare

varies as the child ages these maps can be used as a template for determining how much or little DNA is transferred as the level of care changes. Variation in cases of abuse can then be investigated further with a view to determining exactly who is responsible.

The goal of this presentation is to provide information on the normal distribution of DNA present on a child's face and neck for those aged 0-5 years due to the normal day-to-day interaction between the carers and the child.

Hypothesis: That it is possible to retrieve DNA from the face of a physically abused child in order to determine the perpetrator of the abuse. However, to date no one knows what the normal distribution of self and non-self DNA upon the face of children is due to the daily activities of the child for example from carer child interaction or child-child interaction. This is the first study of its type to investigate the normal deposition of DNA on the faces of children aged 0-5 years.

In Britain every year three million children are victims of abuse. Many are too young or too frightened to indicate who is responsible. Victims of physical abuse are generally under the age of 5 years with the highest mortality rates being observed in those under 3 years old. Without witnesses to the event it may be impossible to identify the perpetrator and therefore prosecute them. A method of identifying the individual responsible for physically abusing the child is critically required.

It is hypothesised that when an individual hits a child some of the offenders DNA will be transferred onto the child's skin. However, before this can be confirmed one needs to know what is the normal distribution of DNA on a child. To date no information is available. The aim of this study is to provide that information for children aged 0-5 years. In order to do this the study examines the presence of DNA other than that of the child on the face, its distribution and its source. It considers in the presence of non-child DNA whether this has arisen from the normal day to day interaction between the carer and the child. By studying children aged 0-5 years and considering the care of children and how the interaction between the carer and the child alters at each milestone it is possible to provide facial maps of the normal distribution of DNA found on the faces of children. This can then be considered if DNA is retrieved in the investigation of abuse in whether the DNA present is outside that of the normal handling pattern of the child at that age group.

For the purpose of the study a facial map was designed which divided the face and neck into 12 sections. Sterile, moist swabs were used to swab each area of the face using a number of techniques. The techniques for the swabbing of children aged 0-5 years were developed such that the children could tolerate the process and yet it avoided contamination by the person undertaking the sampling. All swabs were anonymised, frozen and transported to a non-police laboratory for independent analysis. DNA was extracted from the swabs using Chelex and was quantified using Oligreen® ssDNA Quantitation kit (Molecular Probes, OR, USA). DNA was amplified and analysed using AmpF*l*STR® SGM Plus® PCR Amplification kit, ABI PRISM® 377 DNA Sequencer, Genescan® and Genotyper® (Applied Biosystems, CA, USA).

Results from phase I and phase II of a three phase study considered the facial distribution of 80 children. Each facial area showed an average quantity of DNA from the swabs less than 100ng, making accurate quantification difficult. Partial genetic profiles were obtained from the majority of the areas of the face, which were consistent with arising from the child. Extraneous alleles were observed in some areas, particularly the neck and cheeks. These partial profiles had not arisen from the child or from the person undertaking the sampling process. The results show that it is possible to obtain identifiable genetics profiles from the face using simple swabbing techniques designed within the study protocol. Facial maps for each age are being produced to show the distribution of the observed profiles.

DNA Transfer, Children, Facial Mapping

B73 A New High Throughput Easy to Use Differential Extraction Method

Allan Tereba, PhD, Laura Flanagan, BS, Paraj Mandrekar, MS, and Ryan Olson, BS, Promega, 2800 Woods Hollow Road, Madison, WI 53711*

After attending this presentation, attendees will to introduce to the forensic community a new differential extraction method that can rapidly and efficiently separate sperm and epithelial cells in a high throughput format.

This presentation will impact the forensic community and/or humanity by demonstrating a new differential extraction method that will significantly reduce the amount of time needed to process a major fraction of violent crime sample types thus allowing more cases to be solved without increasing personnel. The high throughput method will allow the use of automation and will finally provide a means to significantly reduce the large backlog of sexual assault evidence.

One of the main reasons for the large backlog of sexual assault samples is the difficultly in working with the evidentiary material. Typical vaginal swabs contain a mixture of victim epithelial cells in large excess over sperm cells. Unprocessed, these samples can only be analyzed using male specific markers that provide important evidence but are of limited use in searching national databases due to the inheritance and non-recombinatorial nature of the Y chromosome.

In 1985, Gill *et al.* developed a method to enrich for sperm cells in the presence of an excess of epithelial cells. This process relies on the fact that sperm structural proteins as opposed to epithelial cells contain a large amount of disulfide bonds that inhibit the proteolysis of these proteins. After a controlled proteolysis in the absence of a reducing agent, the sample is centrifuged in a spin basket to remove from the solid matrix intact sperm and solution containing the DNA from lysed epithelial cells. Because the resulting sperm pellet contains loose cell debris a considerable amount of contaminating solution is left and must be diluted out with serial washings and centrifugations. This process is time consuming and results in loss of sperm and variability between examiners.

The authors have developed a new differential extraction method that takes advantage of the nearly two decades of experience using the standard differential extraction. After a standard Proteinase K digestion of the sample, the solid support and DNA-containing solution are centrifuged through a special material that effectively separates the sperm from soluble DNA and cell debris. The samples are washed once without centrifugation to remove any remaining soluble DNA in the sperm fraction. DNA IQ™ Lysis Buffer containing DTT is then added to the epithelial and sperm fractions. This buffer effectively lyses the sperm without need for further Proteinase K digestion. The total time for separating the sperm from epithelial cells following addition of the sample to the Proteinase K Digestion Solution is approximately 1 hour 20 minutes which includes the 1-hour Proteinase K digestion. The purification of the DNA requires 40 minutes so the total separation and purification can be accomplished in 2 hours.

Because the same standard Proteinase K digestion and initial centrifugation is used to help remove the sperm from the solid support and to lyse the epithelial cells, the efficiency of these steps will be identical to what is currently available. However, only one centrifugation is required for efficient separation so the sperm recovery is better. In addition, the hands on time as well as the overall time needed to do the separation has been greatly reduced from the current method. Data will be presented on the sensitivity and successful processing of old samples.

Although the new differential extraction method significantly reduces the time to process samples, there is significant time spent in transferring samples to new tubes following the digestion step. The centrifugation of samples in a single tube format also does not mesh with current automation methods. To increase the throughput of this method plasticware has been developed that allows the incubation and subsequent centrifugation of

samples in the same 96 deepwell format. This eliminates transfer steps where contamination can occur and makes the method fully compatible with current robotic methods. The use of this plasticware also allows the efficient extraction of reference samples on buccal swabs and blood cards to be performed with the same chemistry in the same plate as the sexual assault samples if desired. The time to process a full 96 well plate of samples using this new differential extraction method coupled with automated DNA IQ™ purification on a Biomek® 2000 workstation is approximately 4 hours of which only a small fraction of this time requires manual intervention.

Differential Extraction, High Throughput, Automation

B74 The Efficacy of Sample Pre-Selection in High Volume DNA Analysis

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The goal of this presentation is to describe the benefits of identifying acceptable sample types for analysis, with high likelihoods of success in generating crime scene DNA profiles amenable for upload to the National DNA Databank, in a high-volume casework program.

This presentation will impact the forensic community and/or humanity by demonstrating the efficacy of sample selection in high volume casework and the success of obtaining DNA profiles from high-volume casework

Due to caseload pressures and the volume of break and enter occurrences, these cases have had a lower priority, in the forensic community, than more serious crimes. With the advent of the National DNA Databank (NDDB) in Canada and with a recent increase in trained staff, the Centre of Forensic Sciences (CFS) developed a program for the analysis of DNA break and enter cases where no suspect has been identified. The objective was to provide information that would assist investigations of this nature, where no other avenues existed.

When the program was launched in October 2001, only blood swabs were examined and only one swab per case was analysed. In August 2002, the program was expanded to include a greater range of sample types where DNA evidence stood to be recovered. This included a variety of samples such as cigarette butts, chewing gum, and swabs from discarded drinking containers.

As of July 2004, approximately 2500 cases had been processed. Approximately 62% of the samples submitted were blood swabs. Of the remaining cases, a significant proportion included swabs from drinking containers (19%), cigarette butts (15%), and other miscellaneous items (4%). This review summarizes the success rate in obtaining a DNA profile from the variety of samples tested, excluding blood.

The following results indicate the percentage of samples yielding a complete (AmpF*l*STR® Profiler Plus™ system) STR DNA profile: cigarette butts (94%), swabs of drink containers (66%), chewing gum (100%), worn clothing with no apparent body fluid samples (32%), and miscellaneous samples such as envelopes, hair, nasal samples, and scene swabs reportedly from saliva (63%).

The success of the program is exemplified by the proportion of samples yielding a profile suitable for upload to the National DNA Databank (i.e., a profile with at least 6 of 9 AMPF*l*STR® Profiler Plus™ loci). The data show that on average approximately 81% of the samples accepted generated DNA profiles that were uploaded, validating the acceptance criteria, with roughly 40% of the profiles uploaded generating hits to either the Crime Scene Index or Convicted Offender Index.

This casework initiative highlights the value of defining acceptance criteria based on the anticipated likelihood of success, whilst incorporating a rapid and efficient testing protocol.

DNA, Casework, Review

B75 Automated Sample Processing and Tracking System for DNA Profiling of Single Source Samples

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The goal of this presentation is to demonstrate to the forensic community the usefulness of a tracking system and automated robotic platforms for DNA analysis of single source samples in large volume.

This presentation will impact the forensic community and/or humanity by describing the usefulness of a tracking system and automated robotic platforms for DNA analysis of single source samples in large volume.

The number of samples for DNA profiling has increased exponentially due to the acceptance of short tandem repeats (STRs) in forensic casework analysis and in the court system. High volume sample processing is increasing in importance in forensic laboratory, particularly for single-source samples in data base studies.

The authors have designed an integrated LIMS system for tracking samples with respect to processing status, completion of the results, data acceptability, and generation of reports for ease of review. The samples are processed using Wallac DBS puncher and the extraction is performed using Qiagen BioRobot 8000DNA extraction system. Qiagen BioRobot 8000 Liquid Handling System is used for set up of fluorometric DNA quantitation, normalization of extracted DNA and PCR set up. PCR amplification is carried using 9700 GeneAmp® PCR System, fragment analysis is performed on 3100 Genetic Analyzer, and genotyping is performed with Genotyper®. All instrument platforms are compatible and interact with the LIMS software. The information required and generated at each processing station is integrated in the LIMS database. Use of robotic platforms involves minimal manual intervention and facilitates high-throughput sample processing in 96-well format.

The designed system for automated sample processing and tracking minimizes the potential for error and maximizes the efficiency of DNA profiling of single source samples in high volume.

Automation, DNA, Robotic

B76 Strategies in Large Volume DNA Analysis of No-Suspect Casework

Amrita Lal-Paterson, MSFS, Gina Pineda, MS, Mary Burns, MS, Chris Larsen, MS, Megan Shaffer, PhD, Huma Nasir, BS, Mark Tidwell, BS, Brandi Washington, MS, Zoe Knesl, MS, Sarah Corrigan, MS, Tara Johnson, MS, Penny Reid, MS, Lesley LeBlanc, BS, Kelly Zakel, BS, Heather Overton, BS, Tabitha Benedict, MS, and Sudhir K. Sinha, PhD, ReliaGene Technologies, Inc., 5525 Mounes Street, Suite 101, New Orleans, LA 70123*

The goal of this presentation is to demonstrate to the forensic community the approaches used in large volume DNA analysis of no-suspect casework.

This presentation will impact the forensic community and/or humanity by describing how to process large volume DNA analysis of no-suspect casework.

Analysis for short tandem repeats (STRs) in forensic casework analysis has become popular in the last decade. Further, the results from STRs have been well accepted by the court system. Because of the high power of discrimination of STRs, many States have begun examining earlier forensic case samples, including no-suspect cases for DNA analysis. The desire to process these samples for DNA evidence has overwhelmed

the capabilities of most laboratories. As a result, the number of backlog cases have increased in the past few years and generated a need for designing a sample processing system for high throughput. Many government forensic laboratories are now outsourcing their no-suspect rape cases to private laboratories including ReliaGene Technologies, Inc.

The authors have analyzed about 1500 unscreened rape kits. The samples in these kits were screened for the presence of seminal fluid and sperm cells. Approximately 57% of the rape kits had at least one sample that was positive for either seminal fluid and/or sperm cells and 43% were negative for both seminal fluid and sperm. The cases exhibiting samples positive for seminal fluid and/or sperm cells were processed for autosomal STR analysis. In order to process such a high volume of samples, Qiagen's EZ1 and M48 robots were integrated into the system for rapid analysis. Of the 1500 cases investigated, 50% of the cases provided complete profiles. This presentation will discuss different approaches used in the processing of samples from screening to DNA testing.

Casework, DNA, No-Suspect

B77 Automation of Buccal Swab Processing

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Attendees will learn about an automated method for introducing buccal swabs into the DNA profiling laboratory which assures sample integrity and reduces the man hours currently required to process buccal swab samples.

This presentation will impact the forensic community and/or humanity by demonstrating how the current methods for introducing buccal swabs into the dna profiling laboratory are labor intensive due the need for a witness and if not performed correctly, can lead to sample mix-ups. The presentation will provide the forensic community with a method to rapidly and accurately introduce buccal swabs into the DNA profiling laboratory in order to efficiently and effectively address the ever-increasing number of samples which must be processed.

The testing of buccal cells on cotton-tipped, Dacron®, or sponge applicators in large scale DNA profiling is desirable. The collection of the sample is non-invasive, relatively easy to perform, and collection materials are inexpensive. If collected properly, the cells on the swab yield a sufficient quantity of DNA for STR profiling. Presently, large scale sample introduction or aliquoting practices require manual cutting of the swab and placement into the correct well location in a 96 well tray or into individual tubes. Although this direct transfer of cells from the swab is more reliable and less expensive than performing an initial transfer to paper, the process is labor intensive due to witness requirements, and can lead to sample mix-ups, if not performed properly. With the prospect of collecting over 100,000 buccal swab samples per year in the State of Louisiana, an automated method for introducing buccal swab samples directly into the laboratory testing process was developed. This system reads and records the sample identification number, cuts the buccal swab using a non-contact laser-based method to prevent contamination and automatically places the swab into a designated location in a 96 well tray. The automated self-tracking system assures sample integrity and reduces the man hours currently required to process buccal swab samples.

To demonstrate the effectiveness of this technique, cotton tipped and Dacron® buccal swabs were collected using standard methods. Two swabs were collected from each individual. One swab was cut using the non-contact cutting device, while the other was cut manually by a razor blade. The DNA yields between the samples were comparable, and the samples cut with the laser showed no PCR inhibition or artifacts in the resulting DNA profiles as compared to their controls. A description of the non-contact laser cutting unit and system management software will be presented along with results from proof-of-concept studies and field experience.

Buccal Swab, Automation, DNA Profiling

B78 Microchip-Integrated Purification and PCR Amplification of DNA for Forensic Analysis

Joan M. Bienvenue, MS, Lindsay A. Legendre, BS, Christopher M. Easley, BS, Michael Roper, PhD, Jerome P. Ferrance, PhD, and James P. Landers, PhD, University of Virginia, Department of Chemistry, Mccormick Road, Charlottesville, VA 22904*

The goal of this research project is to integrate the extraction and PCR amplification of DNA into a single microdevice capable capable of downstream STR analysis.

This presentation will impact the forensic community and/or humanity by demonstrating discussing the use of next-generation microchip technology for forensic analysis of DNA. As the forensic community looks for more rapid and cost-effective alternatives to current methods, microdevices become an increasingly more viable option for improving analysis. This presentation will highlight the use of an integrated microdevice for solid-phase extraction and PCR amplification of DNA and its impact forensic genetic analysis.

As genetic analysis for forensic casework continues to evolve, never before has the need for fast, accurate, analysis of samples been more pressing. Current techniques for DNA analysis require labor-intensive and time-consuming processes. These methods, though effective, have led to a dramatic backlog of casework, overwhelming crime laboratories at this time. In addition, databasing efforts are hindered by this backlog of cases. And in the current condition, many cases simply go unanalyzed. As such, research efforts in forensics have focused on improving the methods associated with the analysis of DNA to develop a more rapid and efficient assay for casework profiling. As the field looks for more rapid and cost-effective alternatives to current methods, microdevices become an increasingly more viable option for improving analysis.

The application of microdevices to bioanalytical analyses has the potential to drastically reduce the time required to perform a wide variety of clinical assays. As such, microdevices are currently being designed, developed and tested to improve the efficiency of processes associated with forensic casework analysis. A fully-integrated, microchip capable of performing the steps normally carried out at the bench would not only reduce the time required to perform these tasks, but would also eliminate user intervention and potential sources of contamination, preserving more of the sample for future analysis. PCR and high-resolution DNA separations can currently be carried out on-chip, as well as solid-phase extraction (SPE) of DNA from a variety of clinical, biohazardous, and forensically significant samples. Integration of these processes is the first step towards the creation of a device with genetic profiling capabilities.

The research presented here describes the chip-based approaches for executing DNA extraction (via SPE) and STR allele-specific amplification (via PCR), and how these two processes might be integrated in a single microdevice. The device and its functionality are described, along with results for extraction and amplification of human genomic DNA from sperm cells. Glass microchip devices were designed with domains specific for SPE and PCR. These were patterned using standard photolithographic techniques and the SPE domain vacuum-loaded with silica beads 'glued' into place with a tetraethoxysilane (TEOS) sol-gel have been shown to yield fast, efficient, solid phase extraction of DNA from a variety of biological materials. Microchip PCR amplification of forensic STR loci in sub-microliter volumes containing isolated sperm DNA is accomplished

using non-contact thermocycling (infrared heating and interferometric temperature sensing). Fluidic control of the movement of purified DNA, the solutions necessary for extraction, and PCR master mix into the appropriate domains on the microchip is mediated by an elastomeric valving membrane. The work reported here investigates extraction and purification and subsequent PCR amplification of DNA from semen and/or washed sperm cells on an integrated, valved microchip. This represents one of the major steps required development of a fully integrated microdevice capable of total systematic DNA analysis for forensic casework.

DNA, Ccapillary Electrophoresis, Microchip

B79 Joint Validation of a High Throughput Multi-Capillary Electrophoretic System Using Fluorescent Multiplex Short Tandem Repeats

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Attendees will learn procedures for high throughput processing of samples for STR analysis. The presentation will demonstrate the positive impact of collaboration with the NIJ supported Forensic Resource Network (FRN) when validating a new system.

This presentation will impact the forensic community and/or humanity by validating and implementing high throughput systems in order to reduce the offender backlogs at state laboratories.

Over the past eight years, state and federal laboratories have processed greater than one million convicted offender samples and subsequently uploaded the resultant data into the national level of the COmbined DNA Index System (CODIS). As of June 2004, greater than one million convicted offender samples have been uploaded into NDIS and have produced over 15,100 matches which have assisted in more than 18,100 investigations nationwide [http://www.fbi.gov/hq/lab/codis/success.htm: online]. In order for a state to upload DNA profiles developed from convicted offenders to NDIS, each sample must be comprised of the standard 13 core STR loci. Prior to this NDIS requirement, the Alabama Department of Forensic Sciences generated a state level convicted offender database containing eight (8) of the core 13 STR loci.

The Forensic Resource Network (FRN) is a National Institute of Justice (NIJ) supported group of four institutions, of which Marshall University is one, that provide services, research and training to the Forensic Community. As a component of the services provided by the FRN, Marshall University Forensic Science Center (MUFSC) initiated a collaboration with the Alabama Department of Forensic Sciences (ADFS) to validate a high throughput system for short tandem repeat (STR) analysis.

During the last several years, high throughput systems have evolved which increased the capacity for both processing and analyzing convicted offender samples. Previously, laboratories employed a conventional slab gel electrophoresis approach or a single capillary electrophoresis testing system. While the introduction of single capillary electrophoresis platforms required less analyst laboratory time for electrophoresis setup, the introduction of multicapillary testing platforms provided even greater throughput. Furthermore, laboratories are now using multiplexed single amplification chemistry which is able to co-amplify all of the required core CODIS loci in a single amplification, rather than the previous two (2) amplification approach which was required to obtain results of all 13 loci. Once again, this advancement in forensic molecular biology techniques provides for even greater throughput.

Polymerase chain reaction (PCR) multiplex amplification using commercially available kits, subsequent separation of the DNA fragments by either slab gel or capillary electrophoresis, and data analysis using specific software provides an efficient, accurate method for the compilation of DNA databases worldwide. Many laboratories have validated commercial STR kits for forensic casework, databasing applications, and parentage testing using ABI PRISM® Genetic Analyzers and/or the FMBIO® II Fluorescent Imaging Device. In order to upload data into CODIS, internal validation demonstrating reproducibility, precision, and accuracy shall be performed and documented according to the FBI Director's, "Quality Assurance Standards for Convicted Offender DNA Databasing Laboratories" [Forensic Science Communications 2000: 2 (3): online].

Known human DNA was extracted from blood and buccal swabs. Select samples were quantitated using yield gel and/or QuantiBlot® Human DNA Quantification Kit. Extracted human cell line DNA (9947A) was included as an amplification control. Amplifications were performed in 25 □L reaction volumes in MicroAmp® reaction tubes in the GeneAmp® PCR System 9700 thermal cycler (Applied Biosystems, Foster City, CA) using the Identifiler™ PCR Amplification Kit, a 5-dye multiplex kit with the necessary reagents to amplify 15 tetranucleotide short tandem repeat loci and the gender identification locus Amelogenin. The collaboration between the two agencies expedited the design, validation and implementation of the high throughput system adopted by the ADFS to increase the number of convicted offender samples analyzed in house that qualify for import into the national database. In this paper, the results of the internal validation studies performed as a result of the collaboration between the Alabama Department of Forensic Sciences and Marshall University Forensic Science Center will be presented.

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CODIS, High Throughput, Validation

B80 Streamlining the Analysis of Forensic DNA Testing: New Tools to Allow More Efficient Workflow From Processing to Final Result

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Attendees will gain an understanding of the tools available for DNA testing and utilizing these tools to make decisions during the processing of biological evidence.

This presentation will impact the forensic community and/or humanity by presenting an integrated system for DNA analysis.

This presentation will discuss new tools available for DNA testing that allow clear decisions to be made in the initial and final stages of processing DNA samples. These decisions include:

- Incorporating a screening mechanism to assess the need for further processing of DNA samples,
- Detecting the presence of mixtures of male and female DNA, in order to decide a path for extraction processing and subsequent amplification,
- Evaluating inhibition,
- Deciding a path for extraction processing of compromised DNA samples, and
- Determining if DNA results obtained from a sample meet the interpretation criteria set by the user.

Forensic scientists are often faced with making decisions about the best approach to take when analyzing DNA samples to obtain optimal results. However, often these decisions are made without prior knowledge of the nature of the sample.

The Quantifiler™ Human DNA Quantification Kit and the Quantifiler™ Y Human Male DNA Quantification Kit can be used to assess the need for further processing of DNA samples by incorporating these assays into the workflow as a screening mechanism. The utility of the Quantifiler Human and Quantifiler Y assays in detecting mixtures of human genomic DNA from male and female sources has been demonstrated. Experiments have been designed to simulate circumstances, such as a rape case investigation, in which a small minor component of male DNA must be discerned from a high background of female DNA have resulted in successful detection of the male donor. To this end, the ability to determine if a sample contains a mixture of female and male DNA and the ability to use these assays as a quantitative interpretational aid for DNA mixtures by determining the ratio of each contributor is a new and valuable tool available to analysts.

Additionally, since the Quantifiler kits allow preliminary determination of male:female mixture ratios this information will assist in selecting the appropriate method of extraction and genotyping of these samples. Further, the use of the Quantifiler kits in conjunction with the AmpF*l*STR® Yfiler™ PCR Amplification Kit, produces reliable and accurate Y-haplotypes and provides the forensic scientist with a robust set of tools for Y-chromosome analysis. Part of this set of tools is a valuable haplotype population database based on analysis of the 17-locus haplotype. The Y-STR database allows the forensic scientist to estimate the frequency of a Y-STR haplotype generated with the AmpF*l*STR® Yfiler™ PCR Amplification Kit.

Both the Quantifiler™ Human DNA Quantification Kit and the Quantifiler™ Y Human Male DNA Quantification Kits are useful assays not only for determining the amount of amplifiable DNA, but also for evaluating the degree of inhibition in the sample. Inhibitors can interfere with the reaction at several levels, leading to different degrees of PCR efficiency and even to complete inhibition. A wide variety of PCR inhibitors have been reported, particularly in DNA samples extracted from bloodstains. Data will be shown which demonstrate the utility of the Quantifiler™ Human DNA Quantification Kit and the Quantifiler™ Y Human Male DNA Quantification Kit.

Finally, until recently, genotyping projects required manual examination of all allele calls. GeneMapper® *ID* software minimizes this bottleneck by automating allele calling using a novel process component based quality values (PQVs) system that quickly assesses genotype quality and provides automated concordance checks. Further, for those labs that upload data to CODIS, projects can be exported into a CODIS compatible reporting format allowing easy data uploading.

DNA, Quantification, Y-STR

B81 Operation Iraqi Freedom: AFDIL's Response and Challenges Faced

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The goal of this presentation is to detail the challenges faced processing rush samples, identifying civilians, and maintaining a continuous mass fatality posture during the conflict in Iraq.

This presentation will impact the forensic community and/or humanity by giving the forensic community an awareness of what goes into identifying those who are lost in combat and how a lab has to adapt to challenges during a time of increased and unpredictable caseload.

The opinions and assertions expressed herein are solely those of the authors and should not be construed as official or as the views of the United States Department of Defense or the United States Department of the Army.

The war against Iraq began on March 20, 2003 and the combat phase officially ended on May 1, 2003, with the U.S. military gaining control over the capital city of Baghdad. Currently, hostilities continue to produce a large number of casualties. This presentation will detail the challenges faced processing rush samples, identifying civilians, and maintaining a continuous, high intensity mass fatality posture at the Armed Forces DNA Identification Laboratory during the identification process of Operation Iraqi Freedom (OIF).

The Armed Forces DNA Identification Laboratory (AFDIL) supports the Armed Forces Medical Examiner System by providing DNA analysis on human remains. DNA testing may be performed as the primary source of identification; as a means to supplement other identification methods; and also for re-association of fragmented remains. Currently, one scientific method is required, although 2 or more is preferred, to identify a deceased service member. Any combination of dental records, fingerprint records and/or a DNA comparison to a known reference may be used. Reference bloodstain card samples are maintained by the Armed Forces Repository of Specimen Samples for the Identification of Remains (AFRSSIR). AFRSSIR was established in 1991 for the sole purpose of providing a direct reference sample for DNA comparisons to autopsy specimens in order that no military service member casualty should ever go unidentified. All military personnel and select civilian employees working for the military are required to have a DNA specimen on file at the AFRSSIR.

The 43-day war in Iraq resulted in 142 deaths of Army, Air Force, Marine, Navy, and U.S. civilian personnel. Despite the declared end of combat operations in Iraq, casualties from the U.S. occupation in Iraq continue to be processed through the combined efforts of AFDIL, AFRSSIR and the Armed Forces Medical Examiner's System. Currently, over 805 identifications have been made using a combination of dental, fingerprint and DNA technology. AFDIL has seen an increase in caseload, turn around time, and challenging specimens since the conflict has continued. Currently, DNA analysis is performed on all military deaths regardless of a previous identification by another scientific method. Cases in which there are no other means of identification become top priority and are completed within 72 hours from the receipt of the specimen at AFDIL. To date DNA analysis has been performed on more than 1200 samples with a 99% success rate.

Deaths during Operation Iraqi Freedom (OIF) resulted from combat, homicides, accidents, suicides, and natural causes. Causes of combat deaths during OIF ranged from single gunshot wounds to massive explosions. This resulted in remains that not only varied from fully intact bodies to severely fragmented pieces, but also in the degree of decomposition. At autopsy, every suitable piece of recovered human remains was sampled for DNA testing for either identification, confirmation of identification or in the case of highly fragmented remains, re-association. The reference specimen is retrieved as required from cold storage at AFRSSIR and transported to AFDIL for analysis. A comparison is made between the DNA profiles obtained from the autopsy specimens to the DNA profile obtained from the bloodstain reference. Not all of the victims are military personnel and therefore, do not have a bloodstain reference card on file at AFRSSIR. This requires family references and personal effect to be collected and tested in order to make the identification. The personal effects that are collected are varied and have ranged from toothbrushes to laptops. Many are not suitable for testing.

It is with great pride that the combined efforts of AFRSSIR, AFDIL and AFMES ensure that no service member paying the ultimate sacrifice for their country would remain unknown; but rather expeditious identification, identification confirmation and re-association will be performed to assist in laying that individual to rest. It is hoped that these efforts will provide a sense of closure to the family.

Challenging Samples, Operation Iraqi Freedom, DNA

B82 Comparison of Buccal Cell Collection Methods

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Attendees will learn the most effective and reliable buccal cell collection method(s) for DNA databasing samples.

This presentation will impact the forensic community and/or humanity by presenting the most effective and reliable buccal cell collection method(s) for DNA databasing samples for a high throughput laboratory resulting from large volumes of DNA sample collections.

This presentation will present the research performed at the Louisiana State Police Crime Laboratory to determine the most effective and reliable buccal cell collector samples for databasing samples. Louisiana currently has the most widespread and far reaching DNA databasing law in the country. This law expressly authorizes the collection of arrestees' DNA for databasing purposes. The State of Louisiana has opted to utilize buccal cell collections for all arrestee testing. In order to effectuate this comprehensive databasing collection law, members of the Louisiana State Police Crime Laboratory DNA Unit along with the Unit's contract Technical Leader and CODIS Consultant initiated research to determine the most reliable and cost efficient buccal cell collection method. The results of this research will be applied to Louisiana's existing arrestee databasing program as well as any expansions thereto.

Buccal swabs rather than blood samples are becoming the preferred method of DNA sample collection for high volume DNA profiling laboratories because of the minimized health risks, the relative ease of collection and shipping, as well as low costs associated with this method of collection. Currently, collecting an adequate buccal cell sample in a simple, fast, consistent and cost-efficient manner, while retaining the ability to store the sample, is one of the biggest challenges facing DNA profiling programs. With the anticipation of collecting over 100,000 buccal samples per year in Louisiana, a study was undertaken to compare the consistency and effectiveness of available buccal cell sampling methods and devices. The purpose of this study was to evaluate the DNA yield, the ability to obtain a successful profile, and the efficiency of sample storage using various buccal cell collection methods in order to select the most effective collection method for the State of Louisiana.

Nine different collection methods were used to collect buccal cells from sixteen subjects over a five-week collection period using a collection scheme designed to minimize variability of other factors which might influence buccal cell yield. Collection methods included the Omni Swab collector, Bode Buccal DNA collector, and the Fitzco SampactTM Swab collection device. Additionally, Pur-Wraps® sterile Dacron® polyester-tipped applicator, sterile foam-tipped applicator, and sterile foam-tipped applicator transferred to Whatman® Indicating FTA® Micro Card were collected. Three collections were also performed using the Pur-Wraps® sterile cotton-tipped applicator. These methods included one individual collection, one that was transferred to Whatman® FTA® Micro Card, and one that was transferred to Whatman® Indicating FTA® Micro Card.

The samples were extracted according to a standard protocol which utilized the QIAamp® DNA Mini Kit (Qiagen Inc.). The amount of DNA recovered was determined by both QuantiBlot® and QuantifilerTM Human DNA Quantitation Kits (Applied Biosystems). The samples were amplified with the AmpF*l*STR® Profiler PlusTM and AmpF*l*STR® CofilerTM PCR Amplification Kits. Profiles were generated on the ABI Prism® 3100 Genetic Analyzer and evaluated using Genescan® analysis software (version 3.7.1) and Genotyper® (version 3.7) according to laboratory protocols.

A comparison of DNA yields, reliability and reproducibility of DNA profiles, quality of profiles, and ease of storage among the different collection methods will be presented.

Buccal, Collection, Databasing

B83 The Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG)

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The objective of this presentation is to update forensic drug analysts on the Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) and on the proposals recently adopted as SWGDRUG recommendations. These recommendations include:

- A Code of Professional Conduct for forensic drug analysts
- Validation of Analytical Methods (with an appendix)
- Minimum Recommended Standards for Sampling Seized Drugs for Qualitative Analysis

This presentation will impact the forensic community and/or humanity by discussing the published recommendations which have been available since 2000 to forensic scientists around the world. These recommendations have addressed Methods of Analysis, Education and Training, and Quality Assurance issues and were developed with input from the international forensic drug analysts community.

The last two sets of recommendations (Validation of Analytical Methods (with an appendix) and Sampling Seized Drugs for Qualitative Analysis) have been discussed widely in the forensic science community. During this presentation, the more significant factors from of these two sets of recommendations will be explained. Time will be allocated for questions from attendees. Representatives from the SWGDRUG Core Committee will answer questions and address the concerns of attendees.

In past presentations to the American Academy of Forensic Sciences, a synopsis of SWGDRUG and the goals of the core committee have been presented. This year's program will focus on the specifics described above. However, information is presented here for those unfamiliar with the SWGDRUG process. SWGDRUG has been in existence since 1997. The mission of SWGDRUG is to recommend minimum standards for the forensic examination of seized drugs and to seek their international acceptance.

The objectives of SWGDRUG are the following:

- To recommend minimum standards for forensic drug analysts' knowledge skills and abilities
- To promote professional development of forensic drug analysts
- To provide a means of information exchange within the forensic drug analyst community
- To promote the highest ethical standards of practitioners in all areas of forensic drug analysis
- To recommend minimum standards for drug examinations and reporting
- To establish quality assurance recommendations
- To seek the international acceptance of SWGDRUG minimum standards

The SWGDRUG core committee is comprised of representatives from federal, state and local law enforcement agencies in the United States, Canada, Great Britain, Germany, Japan, Australia, the European Network of Forensic Science Institutes (ENFSI), the United Nations Drug Control Program (UNDCP), Africa, and South America, a forensic science educator, the American Society of Crime Laboratory Directors (ASCLD), ASTM, and the National Institute of Standards and Technology (NIST).

All members of the core committee have worked together over the past six years to build a consensus on the development of recommendations that have impacted forensic drug analysis standards internationally.

Published recommendations have been available since 2000 to forensic scientists around the world. These recommendations have addressed Methods of Analysis, Education and Training, and Quality Assurance issues. All recommendations were developed with input from the international forensic drug analysts community.

Criminalistics, SWGDRUG, Drug Analysis

B84 Purity Determination of Reference Drug Standards and Quantitation of Illicit Drug Samples by NMR

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After attending this presentation, attendees will come away from the presentation with an understanding of how NMR is advantageous in the quantitation of seized drugs and determining the purity of reference standards.

This presentation will impact the forensic community and/or humanity by making the attendee aware of the power of NMR as a quantitative instrument.

Proton (^{1}H) Nuclear Magnetic Resonance (NMR) Spectroscopy is a rapid, sensitive, accurate, precise, reproducible, and versatile method for determining the purity of reference standards and analyzing illicit drugs and adulterants. No reference standard of the target compound(s) is required, and aqueous and organic deuterated solvents enable great flexibility in dissolving the drug(s) of interest.

For quantitative analysis, a weighed sample is dissolved in a deuterated solvent(s) with a high purity internal standard. The 7 minute NMR experiment employs 8 scans using a 45 second delay and 90º pulse. In the determination of reference standard purity, the number of quantitative values available is equal to the number of integrals of the compound. The relative standard deviation (RSD) of these signals is usually <1% for pure standards and results agree well with other instruments determining purity.

Unlike separation techniques such as gas chromatography (GC), high performance liquid chromatography (HPLC), and capillary electrophoresis (CE), NMR does not require a linearity study on every compound. NMR response is proportional to the number of nuclei in a given frequency range, not on a compound's functional groups and is not subject to stationary phase adsorption phenomena. Excellent correlation coefficients ($\geq$0.99995) were obtained using methamphetamine HCl dissolved in deuterium oxide (D_2O), with maleic acid as the internal standard. Average recovery was 99.4% with RSD of 0.7%.

In the analysis of seized drug samples, high spectral resolution usually results in at least one signal of the target analyte being free of interferences. In complex mixtures, multiple quantitation results of the target compound are possible in complex mixtures by subtracting the contribution of an interfering compound from an integral where the target compound also exists.

This method is also applicable to the determination of multiple target components in a seized drug sample. For many exhibits good agreement was determined by NMR and other techniques.

Nuclear Magnetic Resonance Spectroscopy, NMR, Quantitative

B85 Analysis of Seized Drug Evidence by State and Local Crime Laboratories in the United States

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After attending this presentation, attendees will have an understanding of the scope and prevalence of national and regional drug evidence seized by law enforcement agencies for analysis by forensic laboratories nationwide as well as the national and regional estimates of the top 25 drugs identified and reported by the nation's forensic laboratories from January 2004 through June 2004.

NFLIS state and local forensic laboratories analyze substances secured in law enforcement operations across the country and offer a valuable and unique resource for monitoring and understanding illegal drug abuse and trafficking, including the diversion of legally manufactured drugs into illegal markets. This presentation will impact the forensic community and/or humanity by demonstrating how NFLIS is an important analytical resource for drug policy and drug control agencies to support drug scheduling efforts as well as providing timely information on drug trafficking and abuse patterns across the United State.

After attending this presentation, attendees will gain an understanding of the scope and prevalence of national and regional drug evidence seized by law enforcement agencies for analysis by forensic laboratories nationwide as well as the national and regional estimates of the top 25 drugs identified and reported by the nation's forensic laboratories from January 2004 through June 2004.

This presentation will provide timely data on the variation in the distribution of controlled substances and indicators of drug availability across geographic areas based on laboratory analysis and identification from the National Forensic Laboratory Information System (NFLIS). The NFLIS program, which was established in September 1997, systematically collects results from drug analyses conducted by federal, state and local forensic laboratories. NFLIS is a database system that provides national wide drug seizure information. To date, approximately 232 individual forensic laboratories that perform drug analyses participate in NFLIS. The program's goal is to have all 306 forensic laboratories that perform drug chemistry analyses in the United States participating within two years.

Highlighted findings will include the estimated prevalence of selected "drugs of interest" and analyzed drug items by category. Quarterly Trends for the national and regional estimated number of drug items analyzed by state and local laboratories for 2001 through June 2004 will be presented. Aggregate results of drugs identified and reported by participating NFLIS laboratories representing the period January 2004 through June 2004 will be presented. The distribution of drug items by percent and number of total analyzed items in the state and local forensic laboratories will be depicted. The number and percentage of analyzed drug items for the twenty-five most frequently reported drugs, as well as the major drug categories such as narcotic analgesics, benzodiazepines, "club drugs", stimulants, and anabolic steroids will be discussed in tables and graphs. Special study data on (1) comparison to "consumption based" data (NSDUH and DAWN); (2) drug combinations, (3) drug purity, and (4) drugs identified in strategic geographic locations as well as selected major metropolitan areas will be summarized.

During the period January 2004 through June 2004, an estimated 850,000 drug items were analyzed by state and local laboratories in the United States. Cannabis/THC was the most frequently identified drug, followed by cocaine, methamphetamine, and heroin. This has been a consistent pattern for the past three years. About one percent of all reported drug items contained two or more substances, most commonly

heroin/cocaine. Overall, nearly 55% of drug combinations contained heroin or cocaine, or both, while approximately 20% contained methamphetamine.

NFLIS state and local forensic laboratories analyze substances secured in law enforcement operations across the country and offer a valuable and unique resource for monitoring and understanding illegal drug abuse and trafficking, including the diversion of legally manufactured drugs into illegal markets. NFLIS is an important analytical resource for drug policy and drug control agencies to support drug scheduling efforts as well as providing timely information on drug trafficking and abuse patterns across the United States.

Drug Analysis, Drug Seizures, Drub Database

B86 Qualitative and Quantitative Values on Drug Smuggling Files Which Determined in Narcotic Laboratories, Council Legal Medicine, Ministry of Justice Turkey

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After attending this presentation, attendees will understand the quality and the quantity of illicit drugs seized on the routes that pass from Turkey; will understand the purities of illicit drugs in countries closer to production regions; will be briefed on the fight against drug smugling in Turkey.

This presentation will impact the forensic community and/or humanity by providing valuable data about illicit drug trafficking and fighting about, so that the impact will be from police and justice departments.

In this study, which was carried out at the Narcotics Division of Chemical Analysis Department, Council of the Forensic Medicine, Ministry of Justice, results of qualitative and quantitative analysis were illustrated in tables and graphs for 2,375 case reports belonging to a period of 2001 to 2003. During these three years 9,212 packages were analyzed for their contents of heroin, morphine, opium, hashish, cocaine, cannabis, cannabis- tobacco mixes, acetic anhydride, ecstasy, captagon, Legal but with red and green prescription tablets and drugs, lysergic acid diethylamide (LSD) impregnated chips, materials which were examined for their drug contents, powder and liquid amphetamines, powder methylene-dioxymethamphetamine and other solid and liquid materials which were not drugs but found in clandestine.

In this study color tests, TLC and microscopic investigation were used for screening. HPLC, GC, and GC/MS were used for confirmation of the qualitative and quantitative data. It was found that among the solid materials, the highest quantity belonged to heroin and the highest quantity of tablets belonged to captagon. Ecstasy and captagon had significant increases in quantities, if all the analyzed materials are considered. The results of the quantitative analysis have shown that the purities of methylene-dioxy-methamphetamine and amphetamines still approximately at the same mean value while the purity of cocaine samples have increased about 10% in 2002 and 2003 in comparison with 2001. The purity of heroin samples have decreased about 10% in 2002 and 2003 if compared with 2001 values.

In conclusion; international studies and findings concerning the production, trafficking, and purity of illegal drugs take into account the illegal production of heroin, it is believed that the traffic is shifting to neighboring countries due to 10% decrease of its purity.

Illicit Drug, Composition, Trafficking

B87 The Application of Capillary Electrophoresis for Enantiomeric Separation of N,N-Dimethylamphetamine and its Related Analogs: Intelligence Study on Routine N,N-dimethylamphetamine Seizures

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This goal of this presentation is to demonstrate the use of capillary electrophoresis (CE) for chiral separation of the seized N,N-dimethylamphetamine (DMA) samples with aim of obtaining important information for intelligence study.

This presentation will impact the forensic community and/or humanity by illustrating the significance of chiral separation of seized drugs in forensic scince so that valuable information such as intrinsic characteristics of the seized samples and clues for predicting possible synthetic methodologies can thus be obtained.

Methamphetamine (MA), a powerful stimulant of the central nervous system, is one of the most popular abused drugs in Hong Kong. DMA, the *N*-methylated analogue of the MA, is well known of producing behavioral effects that are generally comparable to those of MA but with reduced potency. Cases related to DMA have increased in Hong Kong in the past few years. It may be due to the fact that crystalline forms of DMA and MA ('ICE') share similar physical appearance. Thus, DMA can be sold to abusers as MA. Most of the seized DMA samples are crystalline solids that are either in the pure form or mixed with MA. Apart from crystalline solid samples, some samples are tablets. Like 'ecstasy', these tablets are of different color, marking and usually mixed with a number of dangerous drugs such as 3,4-methylenedioxymethamphetamine (MDMA), 4-methylenedioxymethamphetamine (MDA), MA, and ketamine.

The recent increase in the abuse of DMA in Hong Kong is of great concern to law enforcement departments. However, only a few studies on DMA have been reported in the literature compared to its analogue, MA. Therefore, a detailed study on DMA is important for deriving valuable information for drug intelligence purpose. Both MA and DMA have a chiral carbon centre at the α-position, which is known to affect their potency. For example, *d*-MA and *d*-DMA are known to have stronger stimulatory effect than their corresponding counterparts, *l*-MA and *l*-DMA. By measuring the enantiomeric excesses of the seized samples, intrinsic characteristics of these samples can be obtained. In addition to this, the enantiomeric purities of the seized drugs can provide clues for predicting possible synthetic methodologies. Identification of racemic DMA or MA indicates that these samples are derived from reductive amination of an achiral precursor phenylpropan-2-one (P2P). On the other hand, optically pure DMA or MA may have come from stereospecific reduction of the enantiopure β-hydroxyphenethylamines (i.e., ephedrine, pseudoephedrine, methylephedrine, and methylpseudoephedrine.)

A number of analytical methods have been employed for the separation of chiral compounds. Both GC and HPLC are commonly used methods, however, they do have some limitations. Usually GC analysis requires tedious derivatization with chiral reagents and HPLC analysis involves the use of expensive chiral columns/mobile phase. In contrast, capillary electrophoresis is relatively simple, of low cost and has very high separation efficiency. In fact, previous study in the laboratory has successfully demonstrated the use of CE for enantiomeric separation of *dl*-MA and its related compounds (i.e., *dl*-ephedrine and *dl*-pseudoephedrine). In this study, an optimized CE method for simultaneous chiral separation of *dl*-DMA, *dl*-MA *dl*-ephedrine, *dl*-pseudoephedrine and *dl*-methylephedrine is reported. The method has been subsequently applied to analyze seized DMA samples in Hong Kong. Results show that all the seized DMA samples are predominantly the *d*-form (>87% ee). The MA samples are of

various enantiomeric forms, but none of them is racemic. These results indicate that the seized samples are unlikely to be synthesized from P2P. It seems to be more likely that MA and DMA were obtained by way of reduction of ephedrine/pseudoephedrine and methylephedrine/methylpseudoephedrine respectively

N,N-Dimethylamphetamine, Capillary Electrophoresis, Intelligence Study

B88 Game's Up - The Presence of Tranquilizers and Stimulants in Venison Detected by HPLC-MS

Heather A. McCauley, BS, and Rick A. Flurer, PhD, U.S. Food and Drug Administration, Forensic Chemistry Center, 6751 Steger Drive, Cincinnati, OH 45237*

Attendees will learn of an unusual forensic case in which tranquilzers and stimulants were detected in processed tissue. In the absence of blood and urine, the detection of these drugs was quite challenging. The sensitivity that HPLC-MS provides was advantageous and will be discussed.

This presentation will impact the forensic community and/or humanity by highlighting the advantage of HPLC-MS in the forensic laboratory setting. The sensitivity that LC-MS provides combined with the added sensitivity of the instrument in MS/MS mode permits the detection of drugs of interest in difficult matrices at low ppb range levels.

The preferred matrices for detection of drug residues in biological fluids are blood and urine. While these matrices can prove to be quite challenging, in their absence, with only processed tissue available for sampling, the challenge can be amplified for the analytical chemist. This paper will discuss an unusual forensic dilemma in which the sensitivity of HPLC-MS proved to be advantageous.

The sale of a specific deer for hunting is illegal in most states. Once a deer has been taken in violation of State law and transported in interstate commerce, it becomes a violation of Federal law under the U.S. Fish and Wildlife's Lacey Act. In a recent case farm raised deer were being hunted at a private preserve in violation of State laws. In most instances, the clients traveled to the preserve from out of state, and the hides, meat, and antlers were then shipped across state lines to the hunters in their home states. The case became a joint effort between the state Department of Natural Resources and U.S. Fish and Wildlife. The Food and Drug Administration's Forensic Chemistry Center became involved in the case when it was learned that once the deer were selected by the client, they were unlawfully tranquilized, moved to a small pen, and "reversed" (i.e., revived with stimulants) to then be killed by the client/hunter. The presence of tranquilizing and/or stimulant drugs in meat is a violation of FDA law whereby meat intended for consumption containing these compounds is considered to be adulterated.

The drugs that were specifically targeted for analysis were xylazine, tiletamine, zolazepam, and tolazoline. Xylazine is an α_2-adrenergic receptor agonist and acts as a sedative. Tiletamine is a dissociative agent and is pharmacologically similar to ketamine. It produces immobilization and acts as an analgesic. Zolazepam is a benzodiazepine sedative and muscle relaxant. Zolazepam also prevents seizures associated with tiletamine and is therefore marketed as the combination drug Telazol®. The drug mixture of xylazine and Telazol is commonly referred to as a "cocktail" and is considered an effective way to sedate large animals. The Telazol can be purchased as a powder and rather than reconstituting the powder with 5 mL of sterile water, 5 mL of xylazine drug solution is used and the mixture is injected intramuscularly. Tolazoline is a mixed α_1 and α_2 adrenergic receptor agonist and is used to reverse the effects of xylazine sedation.

A number of factors made the detection of these drugs challenging for the analytical chemist. The drug dosages ranged from 250mg to 400mg and the half-lives of the drugs spanned from approximately 50 minutes to 4.5 hours. However, the laboratory did not have any information regarding the time frame in which the deer were drugged before being killed. Average adult bucks range in weight from 100lbs to 250lbs, and most of the drugs readily distribute to all body tissues though tolazoline tends to concentrate in the liver and kidneys.

The initial samples received in the laboratory consisted of highly processed meat. The samples were prepared using in part a method published in the "Handbook of Analytical Toxicology" which generates residues for weak acid/neutral drugs, strong acid drugs, and basic drugs. Initial sample preparation was done by weighing approximately 10g of meat and making a slurry with water. The slurry was acidified, saturated with salt, and placed in a hot water bath for 30min. The solution was then filtered and extracted with an equal volume of ethyl ether. The drugs of interest are basic and therefore only the aqueous extract was taken through further extraction procedures while the ethyl ether layer was discarded. The aqueous extract was made basic and extracted with equal volumes of chloroform. The resulting basic extract was first analyzed using GC-MS and no drugs were detected. Control deer meat was obtained to conduct spiking experiments. Based on these experiments, between 5 and 10ug/mL was the detection limit for the drugs of interest operating this instrumentation in full scan mode. Due to the sensitivity limitations and the absence of data regarding the stability of the drugs during the meat processing, detection by GC-MS did not appear to be feasible. The original sample extracts resulted in approximately 300 mL of chloroform. These extracts were taken to dryness and then reconstituted with 200µL of 10% MeOH/0.5% formic acid in water, thereby increasing the concentration by approximately 1500 fold. The samples were then analyzed using HPLC-MS. The samples were analyzed with a gradient mobile phase of 0.1% formic acid and acetonitrile on a C18 column and were introduced into the MS by electrospray ionization. The sensitivity that the LC-MS provided combined with the added specificity of the instrument in MS/MS mode permitted detection of the drugs of interest in highly processed venison at low ppb range levels.

Stimulants, Tranquilizers, HPLC-MS

B89 The Important Role of Classical Analytical Techniques in Modern Problem Solving Approaches in Non-Routine Cases

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The goal of this presentation is to stimulate thinking concerning the highly varied nature of physical evidence problems that arise with regularity in criminalistics and to draw attention to the dangers of over-reliance on modern technology at the expense of thoughtful scientific approaches to these problems. Modern instruments are merely very useful tools. They do not replace the experienced scientist's brain.

Introduction: Technological developments over the last few decades have made an impressive array of powerful analytical tools available to the modern forensic science laboratory. The development and refinement of chemical instrumentation over the past sixty years has revolutionized analytical chemistry and molecular biology. Physical methods have largely replaced wet chemical ones. The changes are nothing short of astounding. This has not necessarily translated into better criminalistics case solutions across the board. It certainly has improved the ability to provide better answers to relatively straightforward questions, such as "did the bloodstain found in the suspect's car come from the homicide victim" and many similar associative evidence questions? Criminalistics is not limited to these questions. Such simple routine questions are often posed by scientifically naïve investigators or attorneys before the evidence reaches the laboratory. For many cases the laboratory-generated answers to these

questions suffice to provide an adequate case solution. In other case situations evidence amenable to such easily developed routine questions may not exist or such questions may not be particularly relevant in the context of the case. One of the most challenging aspects of criminalistics is that the physical evidence problems that are presented by anything but the simplest cases do not define themselves. Modern forensic science laboratories have many sophisticated tools. However, before these powerful tools can be applied to the case solution, the analytical problem must be defined. A scientific assessment of the totality of the potential evidence is required before an approach to the analysis of the physical items in the case can be designed. This is the role of the criminalist.

Routine and Non-Routine Analyses: Narrow predefined questions can be answered readily with the routine application of modern instrumental techniques. For such problems, where throughput is important, they are unsurpassed. What is refered to as the microanalytical or microchemical approach is much more flexible and general. It may involve the use of many techniques including the most appropriate instrumental methods . It is an approach, not a method or technique. The experienced analyst's brain is the most critical part of the process. The quality of the analysis does not depend primarily on instrumental parameters. It depends most critically on the experience and quality of the scientist carrying them out. With this approach the first step is most often simply looking at the sample macroscopically and microscopically. Much is learned in this way. Much is lost otherwise. Consider the information that can never be retrieved where something as simple as merely dissolving a sample in preparation for testing by certain instrumental methods comprises the first step. Such seemingly innocuous "cut and extract" or "dilute and shoot" steps often result in the loss of information including contextual information, the degree of homogeneity or heterogeneity, and something about the number and nature of physical components. For some routine analyses, where a simple question is posed, the loss of information may be of little consequence. In criminalistics applications some of these simple first steps in sample characterization may be critical. Follow-on microchemical steps may provide even richer information.

A key adjective used to modify "analyses" in the above discussion is "routine." Indeed, for routine analyses the ascendancy of instrumental methods has been an unalloyed advance. The useful role of microchemical testing in high-throughput, a routine analysis is very limited. It is with challenging non-routine problems where microchemical methods and crystal tests demonstrate their value. They are indispensable tools in a more general microanalytical approach to sample characterization. Such a general approach is needed in physical evidence investigations. Here every case is different, and a "one-size-fits-all" or "cookie-cutter" approach is inappropriate. These are the kinds of challenges that regularly arise in trace evidence problems in criminalistics and for which the microchemical approach is so ideally suited. Nothing else comes close. The microanalytical approach makes the best use of all available methods, including instrumental ones. It is this approach that defines the problem in detail and informs and guides the selection of the most appropriate tools to be employed in its solution. Crystal tests are a key component of this powerful problem solving approach. Their ready availability is essential for its successful application.

The Microanalytical or Microchemical Approach: There is an unfortunate tendency among members of the public and even among some scientists to associate and perhaps even equate high tech instrumentation with science. This turns reality on its head. A minimally trained technician can often generate valid and useful data for predefined problems using modern instrumentation. This is not the case with crystal tests and microchemical approaches. In-depth knowledge of chemistry and the scientific method is necessary to exploit the microchemical approach. It takes an experienced scientist to define and redefine the problem as the analysis proceeds and to select the best tools. There is no better way to deal with complex trace evidence problems. However, this approach does require experienced scientists. Unfortunately, "penny wise and pound foolish" laboratory administrators might see this as a drawback.

In Summary, at first glance it might seem that many instrumental methods would offer a speed advantage over microchemical testing. However, this is often only true for routine problems where many samples are being analyzed and the instrument set-up time can be averaged over a large number of samples, so that it is a small fraction of the "per sample" analysis time. For the non-routine or "one-off" problems occurring in criminalistics, microchemical methods often enjoy a substantial speed advantage. Typically, when the need is recognized during the course of a complex analysis, the analyst can complete the test (or succession of tests) without breaking stride by having to leave the microscopy bench. T he risk of sample loss and contamination may be reduced.

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Criminalistics, Microchemistry, Crystal Tests

B90 History of Microcrystal Tests for Drug Identification

Hiram K. Evans, MSc, San Bernardino County Sheriff's Department, Scientific Investigations Division, 200 South Lena Road, San Bernardino, CA 92415-0056*

Attendees will learn the extent of literature references regarding the use and validation of microcrystal tests for the identification of drugs and controlled substances.

This presentation will impact the forensic community and/or humanity by supplying a histoprical perspective of use of microcrystal tests for drug identification, including a bibliography.

The early history of microcrystal tests is the history of chemistry and microscopy. By the mid-1830's toxicologists needed something besides the drastic chemical treatments applied to heavy metal poisons for application to alkaloidal poisons. While any history moves forward in small steps, microcrystal tests in forensic science have a series of watershed dates. 1865 brought Helwig's *Das Mikroskop in Der Toxicologie* and Wormley's *Microchemistry of Poisons*. By 1921 and the publication of Behrens-Kley's *Organische Mikrochemische Analyse* and Stephenson's *Some Microchemical Tests for Alkaloids* forensic science had expanded to include the identification of controlled drugs. 1934 and 1935 saw the publication, respectively, of Amelink's *Schema zur Mikrochemischen Identifikation von Alkaloiden* and Rosenthaler's *Toxicologische Mikroanalyse*. From the 1920's through the 1960's, frequent collaborative work was performed and published in JOAC, expanding application and introducing acid reagent media. 1969 was probably the greatest year with publication of E. G. C. Clarke's *Isolation and Identification of Drugs* and Charles C. Fulton's *Modern Microcrystal Tests for Drugs*. Publications on microcrystal tests have decreased in number, concentrating on determination of isomeric forms, but the tests remain part of some training programs, are included in new ASTM Standard Guides, and are accepted by ASCLD/LAB for use in accredited laboratories.

Microcrystal Tests, Drugs, Identification

B91 Practical Identity Using Microcrystal Tests

Wayne Moorehead, MS, Orange County Sheriff-Coroner, 320 North Flower Street, Santa Ana, CA 92703*

After attending this presentation, attendees will learn the role of microcrystal tests in analytical schemes and their usefulness in criminalistics.

This presentation will impact the forensic community and/or humanity by reviewing of some aspects of the essence of criminalistics and suggestions for increasing the visibility of this useful method of analysis.

Most forensic scientists with a modicum of interest in forensic science when asked for the definition of their profession will be able to state that it is the application of science toward civil and criminal law matters. Ask them to describe the core principles of criminalistics and, for many, silence results. Near the hub of the profession of criminalistics resides the practical identity of evidence.

To the criminalist identity has two meanings – to make an identification and to make an individualization. The evidence determines which of the two or if both concepts are to be pursued. Criminalistics is the science of individualization – the pointing to or identity of one object or person to the exclusion of all other objects or people. Often the criminalist must identify the evidence before individualizing it to a unique person, place, or thing. In criminalistics, making an identification of an unknown substance is not unlike other sciences. When the criminalist has an unknown powder suspected of being a drug, an identification of the drug is made by matching the properties of the questioned drug to a known drug having the same properties. Microcrystal tests have been a part of the practical identity of routine controlled substance analyses for many decades as well as for unknown substances in trace evidence analysis.

There are two types of science in practice. The first type is theoretical. The development of new materials and technology requires determining structure and properties, and exemplifies what the public perceives as science. This science identifies never before identified chemicals through structural elucidation by using an array of instrumentation and methods. This type of identification, that of identifying a "true unknown" with a variety of instrumental methods, never occurs in forensic science. The second type of science involves the practical identification or comparative analysis of materials. A comparison of the unknown against a database of known standards is conducted. The standards may be in the form of spectra or the results of chemical reactions called microcrystal tests. The comparison of a microcrystal test result from a questioned sample to a known drug standard is equivalent to the common practice of comparing the infrared or mass spectrum of a questioned sample to a known drug standard. The inclusion of microcrystal tests as the confirmatory tests of an analytical scheme for common controlled substances results in the practical identity of the drug, providing a savings of time per case, and greater case output with no reduction in the quality of the analyses. All scientists, whether from outside the field of criminalistics or from within, must understand the role of microcrystal tests for common drugs of abuse: that of being the last part of a scheme of analysis. For unknowns in trace evidence, the microcrystal tests are used in conjunction with optical properties or other microscopical or instrumental methods. In order to improve the visibility of microcrystal tests some suggestions are offered.

1) Give presentation on microcrystal tests at large venue scientific meetings
2) Publish papers in widely read and respected scientific journals
3) Respond to misleading and misinformed articles on color spot tests and microcrystal tests
4) Do not use an article as a reference that is misleading or misinformed
5) Emphasize the benefit of microcrystal tests for teaching qualitative analysis in inorganic and organic chemistry – e.g., limited amounts of material and safety to students
6) Encourage other scientists to use microscopy and microcrystal tests
7) Join scientific organizations to provide correct information on the use, value, and limitations of microcrystal tests.

Drugs, Microcrystal Test, Identification

B92 SWGDRUG, ASTM, and SDSO: How the San Diego Sheriff's Lab Uses Microcrystalline Tests in Drug Analysis

Marty C. Fink, BA, San Diego Sheriff's Crime Laboratory, 5255 Mount Etna Drive, San Diego, CA 92117-6912*

Attendees will learn that there is still a place for 19th century chemistry using microcrystal tests in a 21st century laboratory.

This presentation will impact the forensic community and/or humanity by showing that the use of microcrystal tests still has a place in a modern crime laboratory.

Microcrystalline tests are old; they're anachronistic; they are good for screening only; they offer no structural elucidation; they produce no reviewable data. All of these arguments have been used to preclude the use of microcrystalline tests in drug analysis. However, 19th century chemistry still works and has a place in a 21st century lab.

The Scientific Working Group for the analysis of Seized Drugs (SWGDRUG) formally adopted a set of recommendations on Education and Training, Quality Assurance, and Methods of Analysis of seized drugs in May, 2000. In the forward, SWGDRUG "strongly urges the adoption of this recommendation by any laboratory involved in the analysis of seized drugs." The original recommendations excluded any use of microcrystalline tests as part of the Minimum Standards for Forensic Drug Identification. Several letters and discussions later, microcrystalline tests were included in Category C, the least discriminatory of the categories along with color tests, melting point, and UV spectrophotometry. More letters and discussion moved them to Category B where they currently reside.

The SWGDRUG recommendations were initially submitted to ASTM prior to the 2002 ASTM meeting in Atlanta for adoption as standard methods. They were defeated and returned to committee for revision. At the February 2004 meeting in Dallas, after a few modifications, ASTM officially adopted the SWGDRUG recommendations as the standard for drug analysis.

In the SWGDRUG identification scheme, if a Category A method is not used, two uncorrelated methods from Category B must be used. The San Diego Sheriff's Lab uses a combination of color screening tests, microcrystalline tests, and thin layer chromatography for the majority of the powder identifications. Each analyst receives training in basic microscopy and a core training module in the use of microcrystalline techniques as part of the training program. The examiner is ultimately given 25-30 qualifying samples in which only color spot tests, TLC, microcrystalline tests, and FTIR can be used. GCMS training is a separate module commencing only after the drug chemist has mastered the above four techniques. A second set of qualifying samples is then given in which GCMS may be used.

Microcrystal Tests, SWGDRUG, ASTM

B93 The Characterization of Reloading Smokeless Powders Toward Brand Identification

Wayne Moorehead, MS, and Annie Tibbetts, BS, Orange County Sheriff-Coroner, 320 North Flower Street, Santa Ana, CA 92703*

After attending this presentation, attendees will have an understanding of the value of morphology, micrometry, and instrumental methods in the brand identification of smokeless powders.

This presentation will impact the forensic community and/or humanity with the use of the database of information by providing investigators and prosecuting attorneys with the brand or a short list of brands of smokeless powder used by a bomber. Additionally, the database may be available on CD at a later time for use by other laboratories.

On completion of the presentation, the listener will have an understanding of the value of morphology, micrometry, and instrumental methods in the brand identification of smokeless powders.

By using morphology, micrometry, and other methods, unique brand identification or a short list of possible smokeless powders from an unknown powder is possible. A sample size of 148 smokeless powder brands, with a few repeats, was examined for potential identifying features such as morphology, color, texture, coating, dimensional measurement, weight, and chemical content. The questioned powder sample must contain a sufficient number of unburned powder kernels for comparison.

While the government closely monitors explosives, canisters of smokeless powders can be purchased over-the-counter by sport shooters and hunters for reloading ammunition or by bombers for improvised explosive device construction. Reloading or canister smokeless powders offer an available relatively inexpensive explosive for the criminal element. Explosive fillers from pipe bombs submitted to crime laboratories frequently contain smokeless powder.

Providing smokeless powder brand identification information to an investigator can assist in the investigation or trial of a bombing suspect. Smokeless powders were subjected to different methods of analysis to build a library database for future comparisons for brand identification or provide a selective list of possible powders.

Macroscopic and microscopic features were noted. Unless a unique identifier, such as a colored 'dot', was present the macro-scale examination could not produce a single, unique brand. Using a stereomicroscope with a digital camera and semi-automated measurement software, at least 25 random kernels (and up to 100 random kernels) from each of the 148 samples were measured for their relevant dimensions. Use of micro-morphology and other microscopical features to categorize the powders eliminated significant non-conforming brands for further comparison. Micrometry measurements were statistically evaluated against like morphology. The dimensional parameters were treated to Bonferoni-Dunn statistical analysis. The standard T-test was rejected because it is used for one-against-one comparisons while Bonferoni-Dunn provides one against many, taking into account the effect of multiple comparisons. Often characterization of features such as micro-morphology, color, texture, and coating, along with dimensional measurements permitted unique or limited number of possible smokeless powder brands. The mass of sample of the various powder brands using triplicate samples of 50 kernels at a time for measurement further characterized the powders. Gas chromatography with mass spectrometry was used to characterize the smokeless powders with positive results. Of the 148 samples characterized, most brands could be identified uniquely while some samples resulted in a short list of possible brands. Chemical content was able to resolve several of these.

Smokeless Powder, Morphology, Micrometry

B94 The Development of a Comprehensive Scheme for the Analysis of Electrical Tape Using Instrumental and Chemometric Methods

Amanda B. Sturdevant, BS, School of Criminal Justice, Michigan State University, East Lansing, MI 48824; and Leanora Brun-Conti, BS, Edward C. Bender, BS, and John V. Goodpaster, PhD, Forensic Science Laboratory, Bureau of Alcohol, Tobacco, Firearms and Explosives, 6000 Ammendale Road, Ammendale, MD 20705*

After attending this presentation, attendees will gain an understanding of the capabilities and limitations of some of the techniques available for the forensic analysis of electrical tape. Furthermore, this research will provide the forensic science community with an effective analytical scheme for examining and comparing questioned and known samples of electrical tape.

Polyvinyl chloride (PVC) tape, more commonly known as electrical tape, is often encountered during explosive investigations. Electrical tape may be used in the construction of improvised explosive devices (IEDs) for wire insulation, for sealing openings, and for securing fuses and other components onto a device. If tape is recovered and submitted as evidence, an analyst may be asked to compare the questioned tape with a known source, often a roll of tape obtained from a suspect. On rare occasions a physical match of the tape ends can positively identify the questioned tape fragment as having originated from the known source. However, when such individual characteristics are not present, the analyst must resort to comparisons of class characteristics for association or elimination. Most often these include physical dimensions, surface texture, and chemical composition.

Before carrying out any research study of the class characteristics of electrical tape, a number of challenges must be overcome. First, a detailed understanding of the inherent heterogeneity of the sample population, arising from both chemical composition and product distribution, is needed. Only then can a representative sample of the population be obtained. However, most formulations of electrical tape are proprietary and the manufacturers will not disclose the identity of some of the raw materials used. This limits what information is known about the composition of the product. With regard to distribution, tape from the same manufacturer may often be marketed under many different brand names. Chemically and physically the tapes are considered to be the same, while commercially they are different. Next, following sampling, the use of multiple analytical methods is necessary in order to fairly evaluate the relative merits of each individual method. Finally, using quantitative methods of analyzing the results allows for more reliable conclusions.

There have been numerous articles published regarding the forensic analysis of adhesives and a few that focus specifically on electrical tape; however, none of these have directly addressed the above-mentioned issues. In this study, discussions and plant tours with tape manufacturers and careful attention to manufacturing/product codes has allowed for a greater understanding of the tape industry. The sampling methodology involved acquisition of known exemplars directly from a manufacturer as well as the traditional route of purchasing tape from commercial sources, but with a better understanding of the true manufacturer of a sample. Specifically, nine rolls of tape, including three rolls from three different batches of three different types of tape, were obtained directly from a manufacturer, 3M. Also, 32 other samples from 18 other brands representing a total of 10 manufacturers were obtained. All the samples were analyzed by the following methods: Attenuated Total Reflectance (ATR) Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy with Energy Dispersive Spectrometry (SEM-EDS), Pyrolysis-Gas Chromatography-Mass Spectrometry (Py-GC-MS), and High Temperature GC-MS. The results from each of the techniques were evaluated individually and in various combinations, via principal components analysis (PCA) to determine their relative ability to distinguish between the rolls of tape. With this information, an analytical scheme for electrical tape was developed.

Preliminary results demonstrated that between the three brands of 3M tape obtained directly from the manufacturer, elemental composition alone can discriminate between the general-purpose brand and the professional-grade brands. Initial experiments with chemical extraction of the plasticizer have shown that High Temperature GC-MS may be able to elucidate more information about this particular component of electrical tape than traditional methods have previously allowed (e.g. FTIR and Py-GC-MS). Also in this study, FTIR methods examined in previous work were employed to screen the samples and subsequent separations/extractions provided further discrimination.

Electrical (PVC) Tape, Improvised Explosive Devices (IEDs), Chemometrics

B95 Quantitation of Male/Female Mixed DNA Samples Using the ABI PRISM® 7000 Sequence Detection System

Ashley J. Hinkle, BS, Marshall University Forensic Science Graduate Program, 1401 Forensic Science Drive, Huntington, WV 25701*

Attendees will learn how the ABI PRISM® 7000 Sequence Detection System, in conjunction with the Quantifiler™ Human and Quantifiler™ Y Human Male DNA Quantification Kits, can be used to determine DNA concentration in male/female mixed source samples.

This presentation will impact the forensic community and/or humanity by describing a relatively new technology that can be implemented in a forensics laboratory.

Mixed Male/Female DNA samples are often encountered in the forensic laboratory. Quantitation of each DNA source in a sample can be an important tool in interpreting the final STR profile. The Quantifiler™ Human and Quantifiler™ Y Human Male DNA Quantification kits, in conjunction with the ABI PRISM® 7000 Sequence Detection System use real-time PCR to amplify human and human-male DNA, respectively. Male/female DNA mixtures of known ratios will be amplified with both kits to determine the concentrations of total human and total male DNA present in each sample. Theoretically, the difference between total human DNA and total male DNA should equal the amount of total female DNA in each sample. This project will determine if the ABI system can accurately predict the amount of male/female DNA in a mixture.

Thirty-eight mixtures of male/female DNA were quantitated with both the Quantifiler™ Human DNA and Quantifiler™ Y Human Male DNA quantification kits developed by Applied Biosystems. When the female contribution in a male/female mixture was the minor component and the total DNA concentration was greater than approximately 1.48 ng/□l, the female DNA concentration could not be accurately determined by subtracting the total male DNA concentration from the total human DNA concentration. When the male contribution in a male/female mixture was the minor component, the presence of an excess contribution of female DNA did not interfere with the performance of the Quantifiler™ Y Human Male DNA quantification assay.

The Quantifiler™ Y Human Male DNA Quantification kit did not produce linear results at higher DNA concentrations (greater than 20 ng/□l). This non-linearity was reproducible, but varied in severity from assay to assay. In addition, it cannot be understated how essential correct pipetting techniques and properly calibrated pipettes are to accuracy and precision. Small errors in pipetting can translate to substantial deviation in the final quantitation results.

Quantifiler, Quantification, DNA

B96 Reducing Stutter Artifacts in Forensic DNA Analysis Using Polyhydric Compounds

Elisabeth Schoneau, BS, Lindsey Wander, BS, and Sulekha R. Coticone, PhD, California State University, Fresno, 2555 East San Ramon Avenue, Fresno, CA 93740*

Attendees will learn improvements in the analysis of short tandem repeats in DNA typing.

This presentation will impact the forensic community and/or humanity by improve methods in analysis of DNA typing.

Current methods for PCR amplification of short tandem repeat (STR) loci result in an artifact named "Stutter." These stutter products are shorter than the target allele by multiples of the repeat unit. Due to the presence of the stutter artifact, multipeak patterns are obtained with STRs which results in complication in the interpretation of results specifically in mixture analysis in forensic samples and measuring microsatellite instability in cancer diagnosis.

Polyhydric compounds and specifically polyols have been shown to increase the thermal stability of proteins under stressful conditions. Additionally polyols have been shown to interact with the polynucleotide solvation sites replacing water surrounding the double helix. Due to the combination of the functions of polyols mentioned above, the processivity of the enzyme may be enhanced by the presence of the polyols during the amplification of short tandem repeats. A screening method has been developed to measure the effect of polyhydric compounds on reducing the stutter artifact. The screening method involves the use of a PCR fluorescent multiplex system specifically used for detecting DNA in Forensics. The multiplex system (Profiler Plus ID) is combined with the use of various polyhydric compounds. Following PCR using the fluorescent multiplex the products are analyzed on a capillary electrophoresis system (ABI Prism 310) and detected using the Gene Mapper ID software system. The results are determined based on stutter percentage ratios. The stutter percentage ratio is defined as the ratio of the stutter allele to the main allele peak. Among the polyhydric compounds tested, there was a 2-20% decrease in stutter as compared to the control in all loci. Arabinose, sorbitol, glucose and sucrose contributed to the maximum decrease in stutter reduction. Further studies include varying the concentration of the polyhydric compounds and testing osmolytes for further reduction in the stutter artifact. This will improve genotyping and allele assignment of microsatellites by eliminating errors in genotyping thereby improving the sensitivity of the technique. In the forensic field specifically samples containing mixtures of DNA samples will be easier to decipher simplifying analysis.

STRs, Stutter, Polyols

B97 Using Microscopy to Predict Success or Failure of a Differential DNA Extraction

Julie E. Golden, MS, Jefferson Parish Coroner's Office, 2018 8th Street, Harvey, LA 70058*

Attendees will learn the results of a study examining the usefulness of microscopy in order to predict the success or failure of a differential DNA extraction.

This presentation will impact the forensic community and/or humanity by demonstrating that microscopic evaluation of sexual assault evidence is a valuable tool for determining whether or not the traditional differential DNA extraction method will be effective.

Differential DNA extraction is a commonly used method of examining sexual assault evidence in the forensic DNA laboratory. This extraction method allows the DNA analyst to chemically separate sperm donor DNA from epithelial cell donor DNA resulting in two fractions. A differential extraction failure is defined as incomplete removal of the epithelial cell portion of the sample from the sperm cell fraction resulting in a DNA mixture of the two donors or the presence of the epithelial cell donor only in the sperm fraction. A sperm cell fraction that results in a mixture of epithelial and sperm donor DNA can be problematic when performing statistical analysis of the sample; decreasing the weight of the DNA test results in court. In addition, sperm cell fractions resulting in mixtures can make productive searches of DNA databases, such as CODIS, more difficult.

Microscopic slides have been prepared from 325 vaginal swabs. These slides have been stained via the traditional Christmas tree staining procedure and examined microscopically. The number of epithelial cells and the number of sperm cells was rated for each slide. In addition, DNA from the vaginal swabs has been extracted using a traditional organic differential procedure. The sperm cell fractions of these extractions have been amplified using the AmpF*l*STR® Profiler Plus® and COfiler® amplification kits and analyzed via the ABI Prism® 310 Genetic Analyzer. The resulting sperm fraction DNA profiles were examined in conjunction with the microscopic data in order to determine the correlation, if any, between the microscopic data and the mixed or single source nature of the DNA profile results.

The findings of this study show that microscopic ratings indicating a large number of epithelial cells regardless of the number of sperm cells cannot predict a failure of the standard differential DNA extraction procedure. Likewise, microscopic ratings indicating a small number of sperm cells regardless of the number of epithelial cells also cannot predict a failure of the differential DNA extraction procedure. However, samples that contain both a small number of sperm cells and a large number of epithelial cells will result in a failure of the differential DNA extraction procedure in 70% of cases.

A modification of the standard organic differential method was utilized on a subset of 20 samples that originally resulted in a sperm fraction DNA mixture. However, adding an additional aliquot of Proteinase K during the epithelial cell digest and increasing the number of sperm cell washes only improved samples with microscopic ratings indicating larger numbers of sperm present. This modification did not increase the likelihood of obtaining a single source sperm fraction for samples with the characteristic microscopy (low sperm/high epithelial) indicating a mixed DNA profile is likely. Therefore, these results indicate that perhaps epithelial cell DNA is bound somehow to the sperm heads or is in some other way difficult to remove from the sperm fraction via the traditional procedures.

This study has demonstrated that microscopic evaluation of sexual assault evidence is a valuable tool for determining whether or not the traditional differential DNA extraction method will be effective. If an effective alternative differential DNA extraction method was available, samples identified via microscopic evaluation likely to result in sperm cell fraction mixtures using the traditional organic method could be diverted, thereby increasing the number of single source sperm fraction profiles.

DNA, Mixture, Microscopy

B98 Development of a Semi-Automated Robotic Platform for the Extraction of Forensic Evidentiary Samples Using the Tecan Genesis 150

David E. Sipes, MS, Jason E Kokoszka, PhD, Jonathan Freedman, BS, and Robin W Cotton, PhD, Orchid Cellmark, 20271 Goldenrod Lane, Germantown, MD 20876*

Attendees will learn a cost-effective, semi-automated robotic extraction platform designed to improve throughput and reduce the labor costs commonly associated with manual extraction procedures.

This presentation will impact the forensic community and/or humanity by providing the forensic community with a method by which to implement a robotic extraction platform.

With the vast number of backlogged evidence samples and the infusion of NIJ funding with which to process these samples, the forensic DNA community has been challenged to develop a higher throughput approach to sample processing in response to a growing demand for its services. While the utility of robotic platforms has been clearly demonstrated in clinical laboratories and more recently in the extraction of forensic database samples, automated DNA extraction techniques have now broadened in scope to include forensic evidence samples. Robotic alternatives to the conventional manual techniques must be designed such that the automated systems are as adept at handling the diverse variety of forensic samples as their manual extraction counterparts. Previous validation studies in the laboratory and others have demonstrated that the Qiagen DNA extraction kit is a suitable alternative to the organic method of DNA extraction. It was the objective of this validation to develop a robotic alternative to the liquid handling steps in the Qiagen DNA extraction protocol.

After the manual addition of lysis buffers to the sample and the subsequent incubation, the lysates are then transferred to the Tecan Genesis 150 for the remainder of the Qiagen procedure. When the extraction is complete, the samples are eluted in a microtiter plate and an aliquot of the extracted DNA is robotically transferred to a second plate for quantitation. Because the customary elution volume from the Qiagen column is 200ul, evidence samples are subsequently concentrated using a plate-based microcon. Standard samples usually contain sufficient quantities of DNA and no further concentration steps are necessary. All of the liquid transfer steps in the Qiagen DNA extraction protocol have fixed volumes with no variation from sample to sample. When the volumes vary (i.e., quantitation setup), a worklist containing sample specific volumes and well locations is generated by an internal LIMS system and is exported to the Gemini (Tecan) software.

Ensuring that the robotic sample handling schematic is free of contamination is at the forefront of the developmental process. Once the liquid transfer steps were defined and the instrument performance files were optimized, the deck layout was designed to facilitate the most efficient movement of the robotic arm as well as to minimize the occurrence of tips crossing over open sample tubes and reagent troughs. Because of the wide variety of DNA amounts encountered in evidence samples, a comprehensive contamination study was performed to ensure that any occurrences of contamination would be detected. A series of runs using highly concentrated DNA samples arranged in a checkerboard pattern were performed to detect contamination that may have occurred during robotic processing.

To evaluate the efficiency of the robotic versus manual extraction method, lysates from individual samples were evenly divided into two tubes. One tube was extracted manually and the other robotically. A quantitative comparison of DNA recovery showed no significant differences in recovery between the robotically extracted samples and those that were extracted manually.

While the immediate benefits of extraction automation can be realized in terms of reduced labor cost and higher throughput, the downstream advantages are often overlooked. By eluting samples in a microtiter plate format, subsequent plate-based sample transfers (i.e., amplification and/or instrument sample preparation) are more readily performed using a multichannel pipette, improving efficiency and precluding the need to label tubes.

This poster will show that the extraction efficiency of the Qiagen kit coupled with the versatility of the Tecan Genesis Liquid Handling robot makes the extraction of standard and evidence samples very amenable to automation. Additional automation considerations including low volume pipetting, optimization of liquid classes and the judicious choice of deck layout will be presented.

Tecan Genesis, Qiagen, Automated DNA Extraction

B99 A Comparison of Y-STR Multiplexes

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Attendees will learn how various Y-STR multiplexes compare to one another and their applicability to forensic casework.

This presentation will impact the forensic community and/or humanity by providing an understanding the available types of Y-STR kits and their advantages/disadvantages will enable crime laboratories to make an informed decision when selecting a Y-STR multiplex.

Y-STR testing enables forensic DNA analysts to examine the male contribution of an evidentiary sample without interference from female DNA. This testing can be quite valuable for cases in which traditional autosomal STR testing has been unsuccessful or has yielded inconclusive results. The proportion of forensic cases utilizing Y-STRs has increased as DNA analysts, law enforcement agencies, and lawyers learn of the advantages of Y-STR testing. In response to the increased demand for Y-STR analysis, several multiplexes have been developed to allow for the simultaneous amplification of Y-chromosome loci. The present study compares a

Y-STR 10-plex already employed in casework at Orchid Cellmark, as well as two commercially available multiplexes (Applied Biosystems' Y-Filer and Promega's PowerPlex®-Y). The sensitivity and reproducibility of each multiplex, as well as analysis of female:male and male:male mixtures has been examined. The advantages and disadvantages of each multiplex as they relate to its applicability to forensic casework will also be presented.

Y-STR, Multiplex, DNA

B100 Evaluation of Poly(ethylene oxide) as a High-Speed, High-Resolution Sieving Matrix in Shortened Capillaries or Microchips for Forensic STR Analysis

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The goal of this research project is to demonstrate the use of poly(ethylene oxide) (peo) as a high-resolution sieving matrix for forensic analysis of DNA.

This presentation will impact the forensic community and/or humanity by discussing the evaluation of an alternative polymeric sieving matrix for high-resolution separation of DNA, as well as its potential inclusion in next-generation microchip technology for DNA analysis.

Capillary electrophoresis is now the sanctioned method for separation and analysis of short tandem repeat (STR) fragments of DNA for forensic application and genetic mapping. Increased speed, separation efficiency, and automation have made the technique indispensable in the forensic laboratory. In order to accomplish the high-resolution separations required for STR analysis, a limited number of polymeric solutions have been evaluated systematically for suitability in this application. Linear polyacrylamides have become the separation matrix of choice because of their stability, reliability and ability to yield high-resolution separation DNA fragments differing in length by a single base. However, the high cost of commercial products, poor resolution over shorter capillary distances resulting in longer separation times, and the high viscosity of some polymers, has created the need to search for alternative sieving matrices. Though current commercial products accurately and reproducibly separate fragments with high resolution, in lengthy capillary systems, their cost and separation efficiency over short distances become prohibitive when making the shift from capillary-based separations to microchip-based systems. These considerations become increasingly significant when attempting to translate conditions from capillary-based methods to the microchip platform, where channel length and total device area of are utmost importance. As the forensic community moves towards fully integrated micro devices capable of sample preparation and full genetic analysis, choice of separation matrix will play a major role in device design, analysis time, and ease of use. Thus, as polymers are evaluated using capillary electrophoresis, attention must be paid to the feasibility of the sieving matrix for microchip-based analysis. Critical evaluation of polymer viscosity, resolution over short distances, device preparation, reproducibility of separations, ease of polymer preparation, and cost of analysis must occur when developing a polymer for separation of STR fragments for forensic genetic analysis with the goal of translation to the micro device.

The work presented here describes the evaluation of poly(ethylene oxide) (PEO), an inexpensive, commercially-available polymer, for separation of STR fragments in capillaries and potentially for inclusion in the microchip platform. Accurate, repeatable separations of STR fragments with single base pair differences are reported using a denaturing, low-viscosity, low-molecular weight solution of PEO. The effects of buffer composition, capillary temperature, polymer weight and concentration and capillary length are described. A variety of polymer weights are explored at varying concentrations to determine the polymeric conditions that result in the highest resolution separation. Shortened capillaries were used to simulate separation lengths similar to feasible microchannel lengths in analytical microdevices for evaluation of polymer properties. Reproducibility of the separation is evaluated, as well as the use of epoxy-poly(dimethylacrylamide)(EPDMA)-coated capillaries for minimization of electroosmotic flow (EOF). Urea concentration and capillary temperature are also evaluated and optimized conditions for high-resolution separation of samples in shortened channels are presented. Comparisons of PEO to conventional commercial products are highlighted and the appropriateness of this sieving matrix for translation to the microdevice is appraised.

DNA, Capillary Electrophoresis, Microchip

B101 Mexican (Chiuahua) Population Data for the 15 STRs Loci Included in the Identifiler Kit

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The goal of this presentation is to present the results and parameters of forensic interest (HWE, PD, PE) of the Mexican population for the 15 STR loci included in the Applied Biosystems Identifiler kit.

This presentation will impact the forensic community and/or humanity by demonstrating data of great interest for the forensic community, since they are necessary to perform statistical calculations, both in the paternity and forensics fields, after DNA identification analysis.

The 16 STR loci D3S1358, TH01, D21S11, D18S51, D5S818, D13S317, D7S820, D16S539, CSF1PO, vWA, D8S1179, D2S1338, D19S433, TPOX & FGA, and the locus amelogenin can be amplified simultaneously using the the Identifiler kit (Applied Biosystems, Foster City, CA, USA).

This paper presents allele distribution data in the Mexican population of the State of Chihuahua, Northern-Central part of the country. Whole blood was obtained from 161 unrelated volunteers and spotted on FTA paper (Whatman, USA); all individuals were actual residents along the state of Chihuahua, Mexico. Extracted DNA samples were amplified at the 16 loci using the Identifiler kit. Samples were analyzed using the ABI Prism™ 310 Genetic Analyzer (PE Biosystems, Foster City, CA) according to the manufacturer's recommended protocol.

All 15 loci are highly polymorphic in the Mexican sample population with the locus TPOX (55.3%) having the lowest observed heterozygosity, and the locus D2S1338 (88.8%) displaying the highest heterozygosity. The most discriminating loci were D18S51 (PD=0.969) and FGA (PD=0.968). The combined probability of exclusion for the 15 STR loci is 0.99999926. There was little evidence for departures from Hardy-Weinberg expectations (HWE) in this sample population. Based on the exact test, the loci that departed significantly from HWE were D31358 and D13S317. After employing the Bonferroni correction for the number of loci analyzed, these observations are not likely to be significant. An inter-class correlation test analysis was performed to detect any correlations between alleles at any of the pair-wise comparisons of the 15 loci. A resume of the PD and PE are shown in the following table:

Locus	PD (Obs)	PD (Exp)	PE
1 D8S1179	0.92805062	0.92517508	0.59304848
2 D21S11	0.94649126	0.95136413	0.66976540
3 D7S820	0.91709425	0.91988693	0.57759331
4 CSF1PO	0.85112457	0.86167114	0.45289261
5 D3S1358	0.91007291	0.91709457	0.57058241
6 THO1	0.90675514	0.91223821	0.55668406
7 D13S317	0.93368311	0.94236962	0.64004831
8 D16S539	0.92789630	0.93190281	0.60855433
9 D2S1338	0.95675321	0.96159279	0.70663845
10 D19S433	0.92889935	0.94148490	0.63921864
11 vWA	0.90289726	0.91729619	0.57252133
12 TPOX	0.79086455	0.79308289	0.36674141
13 D18S51	0.96909841	0.97232966	0.75147290
14 D5S818	0.85405656	0.88179848	0.49866824
15 FGA	0.96801821	0.97219246	0.75055161
Total	>0.99999999	>0.99999999	0.99999926

In conclusion, a Mexican – Chihuahua database has been established for the loci D3S1358, TH01, D21S11, D18S51, D5S818, D13S317, D7S820, D16S539, CSF1PO, vWA, D8S1179, D2S1338, D19S433, TPOX & FGA. All loci are highly polymorphic. The application of the product rule is valid for estimating the rarity of a multiple loci profile for these 15 loci.

STR, Identifiler®, Mexico

B102 A Comparison of KPS Fluorescein to Other Presumptive Blood Identification Techniques and Its Effects on PCR Based DNA Analysis Methods

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Attendees will gain an awareness of another chemical enhancement tool for detecting blood stains and its effects on PCR Based DNA analysis methods.

This presentation will impact the forensic community and/or humanity by providing another tool to the forensic community when searching for blood stains.

This study was designed to examine the following factors involved with processing evidence for blood staining: 1) to determine if KPS Fluorescein is more sensitive for blood detection than other presumptive tests, 2) to determine if KPS Fluorescein will result in false positives by cross-reacting with various substrates or cleaning products, and 3) to determine if the use of KPS Fluorescein will adversely affect the quality of STR-based DNA profiles developed subsequently.

Dilutions of blood were applied to substrates such as dry wall samples, treated and untreated wood samples, and carpet samples. Some of these substrates were then cleaned with typical household cleaners such as Joy Dishwashing Detergent and Clorox Bleach to determine the ability of the process to detect blood as well as assess potential cross reactivity with these cleaners. Some of these substrates also were treated with either latex or oil based paint in order to determine the ability of the process to detect blood covered by paint. Some substrates also were exposed to environmental conditions for a period of seven days in order to determine potential effects on KPS fluorescence.

All of the substrates also were tested using the presumptive tests that employ phenolphthalin or Hemastix strips in comparison with KPS Fluorescein. It was determined that KPS Fluorescein and phenolphthalin sensitivity are comparable, but KPS Fluorescein exhibited cross-reactivity with some cleaning products. Hemastixs were observed to have the greatest sensitivity for blood detection, but exhibited a high frequency of cross-reactivity with a variety of substances. KPS Fluorescein consistently detected blood under latex paint on wood. These substrates were retested at later intervals (i.e., 3 months and 6 months) after KPS Fluorescein treatment, and continued fluorescence was observed at these later times.

Both cuttings and swabbings were collected from these samples and processed by DNA extraction and subsequent STR analysis. It was determined that samples that were cut, rather than swabbed for DNA extraction, yielded higher levels of DNA and complete STR profiles. It was determined that KPS Fluorescein does not alter the ability to obtain DNA profiling results.

Fluorescein, Blood, DNA

B103 Obtaining Typable DNA From Bloodstains That Serologically Test Negative

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The goal of this presentation is to make the forensic community aware that typable DNA may be extracted from bloodstained material even when negative presumptive and/or confirmatory test results are obtained.

This presentation will impact the forensic community and/or humanity by changing collection and screening protocols and/or interpretation guidelines for biological evidence testing to assure that valuable forensic evidence is not overlooked.

The goal of this presentation is to make the forensic community aware that typable DNA may be extracted from bloodstained material even when negative presumptive and/or confirmatory test results are obtained. This research project was undertaken to determine if typable loci could be obtained from washed and treated bloodstains and how these results compare to serological results, specifically with the ABAcard HemaTrace confirmatory test.

Human blood was diluted down to a concentration of 1:500 (undiluted, 1:20, 1:100, 1:250, 1:500), applied to a cotton t-shirt, and then subjected to treatments of machine washing in water, Tide, or bleach. Each sample was then tested using the confirmatory ABAcard test. DNA was extracted by traditional organic methods (phenol/chloroform) followed by quantification of human DNA by the Quantiblot method. Multiplex STR amplification was performed using the ABI AmpF*l*STR® Profiler Plus PCR kit. The resulting PCR products were separated and detected by capillary electrophoresis on the ABI 3100*Avant* Genetic Analyzer and data analysis performed using ABI GeneScan and Genotyper software.

The untreated whole bloodstains and undiluted Tide-treated bloodstains were the only samples to produce a positive reading for hemoglobin with the ABAcard test. All other treated *and* untreated diluted bloodstains gave a negative ABAcard result after washing. However, previously published reports suggest that the ABAcard tests are quite sensitive and possibly able to test positive for whole blood or bloodstains that have been diluted down to 1:1,000,000. Thus, it is noted that traditional

washing procedures (regardless of treatment) can significantly alter the hemoglobin molecule such that negative results may be shown even when stain extracts actually contain human blood.

Results from the DNA profiles indicated that typable DNA was present in many of these treated and diluted bloodstain samples that initially tested negative using the ABAcard confirmatory test. While negative ABAcard results were obtained for all but two stains (undiluted, untreated and undiluted Tide-treated bloodstains), complete or partial STR profiles were obtained from all untreated stains (all dilutions) and several of the treated stains (bleach or Tide). In washed, untreated whole bloodstains, complete profiles were easily generated. In addition, partial profiles (>50% of STR loci successful) were obtained from untreated bloodstain samples that had been diluted down to 1:500. Interestingly, complete and/or partial profiles were also generated from the Tide-treated samples that were either undiluted or diluted down to 1:20. Furthermore, the undiluted bloodstains that were treated with bleach yielded a near complete profile, generating successful results at an average of 89% of all STR loci tested despite the fact that the confirmatory blood serology test on those bleach-treated samples had yielded negative results. This was a significant and unexpected finding because bleach is thought to severely denature most biological molecules, including DNA. Many additional trends were noted with the data generated from these experiments. As one may anticipate, the severity of DNA degradation increases with harsher treatment and along with that, the heterozygote balance decreases, the peak intensity diminishes, and the larger alleles are more prone to allelic dropout.

The data produced from these experiments show that confirmatory serology tests are not always reliable predictors of successful STR amplification. Because confirmatory tests such as the ABAcard may often be used in the field and the laboratory to determine what biological evidence to collect and submit for DNA analysis, a negative reading could (in some labs) prevent DNA analysis and thus result in lost forensic evidence. This research demonstrates the value of performing multiple serological screening tests prior to DNA analysis, as well as cautiously interpreting negative results, as typable DNA may be present at trace levels even when the serological protein marker is present at levels below the limits of detection for that test. Further research could investigate amplification of these treated samples using methods designed to detect low copy number DNA since these samples have limited quantities of DNA that vary in quality, similar to what is commonly seen in forensic case samples.

DNA, STR, ABAcard HemaTrace

B104 Decontamination of Bacterial Spores Without Affecting DNA Molecular Analysis

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After attending this presentation, attendees will realize that protocols can be used to kill bacteria without destroying the ability to molecularly analyze the DNA contained within the organism.

This presentation will impact the forensic community and/or humanity by giving attendees a validated procedure for decontamination without destroying the DNA. The value of this approach is to preserve evidence while allowing clean up in cases where bacteria may be present. In addition, if decontamination has taken place in a rogue laboratory, there may still be evidence that can be evaluated for its DNA signatures. The evidence should not be discarded in such cases.

Following the accidental or intentional release of pathogens, surfaces become contaminated and must be treated with a chemical agent to kill the organisms. In rogue laboratories, where pathogens are cultured for criminal or terrorist acts, the perpetrators may decontaminate surfaces and equipment used to grow the organisms in order to destroy evidence. Although the non-viable pathogens cannot be characterized by their growth characteristics following decontamination, the question remains whether the DNA inside the cells can still be utilized in assays for identification and attribution. Thus, there is a requirement to determine the effects of common decontamination procedures on the activity of DNA in downstream analyses. Research was performed to characterize the effect of several decontamination procedures on DNA as determined by PCR and restriction enzyme analysis. Bacterial spores of *Bacillus cereus*, a simulant for *B. anthracis*, were chosen for the studies, because these are very challenging organisms to kill and thus require rigorous decontamination procedures to effect a standard kill of 6-logs in concentration. Suspensions of organisms and dried deposits of the organism on various materials and surfaces of forensic relevance were examined. Manufacturer's suggested protocols, CDC (paraformaldehyde), and EPA (bleach) protocols were followed to kill the organisms. The materials examined included tile, wood, carpet, cubicle cloth, and painted dry wall. Real-time PCR and pulsed field gel electrophoresis (PFGE) were performed to evaluate the effects on both amplification and restriction digestion, respectively.

It was found that 10% bleach was effective in killing the spores at both pH 7 and pH 11, but the matrix on which the organisms were deposited significantly affected the ability to kill the spores. Actril (a mixture of peroxyacetic acid, hydrogen peroxide, and acetic acid), a commercial agent used in hospitals, was as efficient at killing spores as bleach. Actril worked well on all the surfaces and materials tested. DNA extracted from spores exposed to Actril can be amplified more efficiently and consistently than DNA extracted from spores exposed to bleach. PFGE did not reveal differences between the untreated control and Actril-treated spores. Paraformaldehyde (which is converted to formalin gas during the procedure) was very effective, but the DNA was minimally useful for molecular analyses. L-gel, a decontaminating agent reported to be capable of destroying both chemical and biological warfare agents, was not very effective on the spores when the agent was spread over the sample. DNA could be subsequently amplified from the recovered organisms treated with L-gel, but it could not be ruled out that this DNA was derived from cells that remained viable. Sterilox could kill the spores, but the efficacy of this agent was highly affected by the matrix on which the spores were deposited. The DNA was not damaged by Sterilox treatment of the spores. Actril and bleach are the most effective sporicidal agents, and Actril has the least effect on the molecular assays.

A validated protocol for the detection of bacteria collected from different surfaces that have been decontaminated by a variety of processes will be presented.

Decontamination, Nucleic Acid Amplification/Digestion, Pathogenic Microorganisms

B105 Enzymatic-Mediated Digestion of Cellulose for Enhanced Cell Elution for DNA Analysis

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The focus of this project is the development of an improved method for the elution of cells from a cotton swab taken from a sexual assault victim. The procedure incorporates enzymes for the digestion of the cellulose matrix, resulting in the removal of intact cells, in an effort to circumvent conventional differential extraction.

Genetic analysis of perpetrator and victim mixed profile DNA samples obtained from vaginal swabs is a well-established technique in the investigation of sexual assault and rape cases. Unfortunately, the procedures involved in a typical forensic DNA analysis require a great deal, of laboratory time dedicated to a single case, particularly in the sample preparation steps. Because of the time and funding constraints involved in the

investigation of such cases, a significant backlog exists in many large-volume DNA analysis laboratories.

The current protocol used by law enforcement agencies for recovery of cellular materials from a cotton matrix involves a great deal of sample handling, which directly increases the chances of sample contamination and human error. Furthermore, it is a time-consuming process often requiring overnight incubation of a swab sample for optimal DNA recovery. The extraction solution used in the recovery of DNA from swabs includes proteinase K in the presence of SDS, a combination that selectively lyses the fragile epithelial cells while eluting sperm cells intact. The solution is then centrifuged to pellet the sperm cells, removing them from the solution containing the victim DNA, allowing independent genetic analysis of male and female DNA.

The time required for forensic DNA analysis can be greatly reduced by performing the electrophoretic separation on microfabricated glass devices. The speed and efficiency of microchannel separations are due largely to the increased surface to volume ratio of the etched-channels over conventional slab gels. In addition, these devices allow for the integration of additional processing steps, including sample preparation methods. Because centrifugation on a microchip is not trivial, a microchip method for isolating separate male and female DNA fractions has been proposed. This method relies on recovery of intact cells from sample swabs, thus a cell-desorption process that greatly reduces extraction time while leaving cells intact would be advantageous for developing genetic analysis on a micro-total analysis system (μ-TAS).

Microscopic examination of a cotton swab on which a semen sample had been applied and allowed to dry suggested that sperm retention on the swab was due to adhesion of sperm cells on the surface of polysaccharide cellulose strands. Preliminary studies have shown that cellulase-based enzymes, which digest cellulose, reduce the time required for sperm and epithelial cells to be released from the swab into solution. In an effort to optimize cellular elution conditions, several different enzymes were evaluated both alone and in combination. Sperm and epithelial cells eluted from a cotton swab were counted using a hemacytometer. Results indicate that elution using enzymes improved the recovery of sperm cells without lysing epithelial cells, and enzymatic sperm cell desorption is greater than that seen with current elution methods. Optimum cellular elution conditions using the enzyme cellulase will be presented. In addition, information regarding the development of a receptacle that interfaces a cotton swab sample with a μ-TAS on a microfabricated glass device will be discussed.

Cellulose, Elution, Enzyme

B106 Development of Multiplexed Microsatellite Markers in *Cannabis sativa*

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Attendees will learn that there is a genetic test to provide evidence of cooperation in the production of cannabis.

The association of cannabis to sellers, growers and buyers could track networks and show common orgin. This presentation will impact the forensic community and/or humanity by broadening the scope of the DNA analyst and give a genetic test to drug chemists.

Cannabis sativa L. (marijuana) is the most frequently used illegal drug in the United States. The marijuana plant can be easily identified through morphological examination and chemical analysis; however there is a need for a method to track distribution networks and to compare plants to determine a common source of origin. A genetic test can enable this association and provide evidence of cooperation in production. Microsatellite markers have distinct advantages over other genetic methods. They have multiple alleles at a single locus, they are reproducible between laboratories, they have a high discrimination power and they can be multiplexed. In this project, a set of *Cannabis* STR primers previously described by the group and a set of STR primers previously described by Gilmore's group in Australia were combined and multiplexed into two reactions. The primers include nine trinucleotides, one compound trinucleotide and one imperfect trinucleotide. Both hemp (low THC) plants and marijuana (high THC) plants from different regions of the United States and multiple countries will be tested with the multiplexed primers. The previous studies using these microsatellite markers were able to distinguish clones from non-clones. Efforts are underway to construct a comprehensive genomic map of *Cannabis sativa*, where the positions of these micorsatellite loci on various chromosomes/linkage groups could be defined.

The goal of this project is to determine the level of polymorphism, to show the usefulness for DNA fingerprinting and to measure the genetic relationships between different *Cannabis* plants, all using a practical set of reactions that can be performed in an operational forensic laboratory.

Cannabis Sativa, Multiplexed Microsatellites, STR Primers

B107 Evaluation of Track-Etch Filters for Isolating Sperm DNA in Rape Kits

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The goal of this presentation is to evaluate the efficacy of track-etch filters as an alternative approach to the standard selective lysis protocol for isolating sperm DNA profiles from sexual assault samples

This presentation will impact the forensic community and/or humanity by providing the forensic community with a tool to evaluate the effectiveness of track-etch filter for the processing of rape kit evidence.

The large number of unprocessed sexual assault cases nationwide constitutes an ongoing concern for the forensic community. Many of these cases have sufficient numbers of sperm to generate DNA profiles that could be used to query the CODIS database and identify rape suspects. The standard method for purifying sperm from these swabs is to first resuspend the sample and to selectively digest the epithelial cells with Proteinase K. The intact sperm are then separated from the contaminating solubilized DNA by centrifugation, careful removal of supernatant, and extensive washing of the sperm pellet, all steps that are difficult to automate. The authors have evaluated a vacuum driven filtration method as an alternative approach for separating sperm from digested epithelial cells that is more easily automated in a 96 well format. First, the sample is digested with Proteinase K for 1 hour at 56ºC (in standard DNA extraction buffer). Sperm are collected on 2 micron track-etch filters, while the epithelial cell DNA is collected in the filtrate (vacuum pressure = 300 torr). The filters are then washed, and the sperm DNA is solubilized with a reducing agent and collected in the filtrate. The goal of this project is to optimize and validate a faster, more effective, less-labor intensive, and more cost-effective method to isolated sperm DNA from sexual assault samples to address the backlog of unprocessed biological evidence.

Mock body fluid sample mixtures (5,000-100,000 sperm per swab) were processed by the vacuum filtration method and the standard differential extraction procedure to determine their ability to separate the male profile from the female profile using the Profiler Plus and CO*f*iler STR kits from Applied Biosystems, Inc. Various parameters were tested to optimize the filtration method including efforts to overcome the recurring problem of filter clogging. These efforts included introducing centrifugation and filter

washing steps, using 10 micron pre-filters to remove cell debris, pre-warming washing reagents, using different reducing agents (BME and DTT, various concentrations), adding additional Proteinase K, and slowly adding the sample to the track-etch filter. Membrane clogging can be overcome by centrifuging (3000 G) the sample through the membrane in lieu of vacuum filtration. However, both approaches are less sensitive than the standard differential method and the centrifugation steps are not easy to automate.

The authors have shown that use of track-etch filter can be effective for identifying the DNA profile of the semen donor from mixed body fluid samples. To date, the efficiency of separation using track-etch filter has been variable and the method is not as sensitive as the standard differential procedure.

This project has been funded by the National Institute of Justice, Grant #2003-IJ-CX-K103

Track-Etch Filters, Sperm DNA Isolation, Differential Extraction

B108 Validation of SE33: A DNA-Based Screening Method

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Attendees will learn of a single STR locus, SE33, that can be used as a DNA-based screening method for heavily bloodstained evidence.

A single STR locus such as SE33 can be used to screen heavily bloodstained evidence thus greatly reducing the number of samples requiring a full 16 loci profile. This presentation will impact the forensic community and/or humanity by providing a faster and more cost effective method for forensic laboratories.

Forensic laboratories typically identify biological fluids and then, if warranted, the analyst performs DNA analysis to generate a 16 loci genetic marker profile. In most cases this is the most efficient way of processing the case; however, in cases where a large amount of bloodshed has occurred it is time consuming, costly, and it may not be necessary to generate a full 16 loci profile for every stain. In these types of cases it is often necessary to test numerous stains to find the one most probative stain for DNA testing. A faster and more cost effective method would be to screen heavily bloodstained evidence with a single DNA locus to determine if the stain is probative and warrants the full 16 loci testing. HUMACTBP2 (SE33) located on chromosome 5 or 6 is a highly polymorphic STR locus (AAAG repeat sequence) with 32 alleles in the range of 202-323 bp and is one of the loci included in the European STR database, EDNAP. SE33 has numerous microvariants; therefore, it is crucial to fine tune the procedure with regards to the proper gel concentration needed to allow the 1-bp separations. In this study SE33 (Promega's kit) was extensively validated utilizing the ABI 377 and ABI 310 instrumentation. One hundred buccal swabs were collected and extracted with Chelex, quantitated with QuantiBlot, amplified on an ABI 2700 using 10/20 cycles, and separated on the 377 and 310. This validation included reproducibility/precision, sensitivity, mixture studies, past proficiency samples, and environmental studies. The reproducibility portion of the validation consisted of within-gel and between-gel analysis. The sensitivity study included several sets of samples in the range of 0.03125ng to 5ng. The SE33 types obtained from samples in five proficiency tests were compared to results obtained on the FMBIO II. The mixture study included several mixtures with the following ratios: 1:0, 1:1, 1:2, 1:4, 1:9, and 1:19. In the environmental study ten different blood samples were applied to five substrates (denim, leather, silk, cotton, polyester blend) and exposed to a full year, including rain and snow, of northeastern Pennsylvania weather. The results presented will include the fine-tuned procedure and a comparison of samples analyzed on the 377 and 310. Future work in this validation will include analysis of samples from non-probative/no analysis casework. The SE33 types obtained from the samples used in this validation will also be verified at a different laboratory.

SE33, HUMACTBP2, DNA

B109 "Taking a Bite Out of Crime": STR Typing of Biological Evidence Left on Food Remnants

Ismail M. Sebetan, MD, PhD, and Heather A. Zarsky, MFS, Forensic Sciences Program, National University, 11355 North Torrey Pines Road, La Jolla, CA 92037*

The goal of this presentation is to demonstrate the amenability of bitten foodstuffs to DNA profiling using current STR methodology and identifies some of the limitations and problems that may be encountered when dealing with food evidence. This research will provide an evaluation of the STR profiles obtained from different types of food possibly encountered at crime scenes and a guide for crime scene investigators and police officers on what kind of evidence should not be overlooked at a crime scene.

This presentation will impact the forensic community and/or humanity by showing that DNA typing from bitten foodstuffs is an efficient and reliable alternative source for biological evidentiary samples, and identifies some of the limitations and problems that may be encountered. These results can be used to educate crime scene investigators and police officers on what kind of valuable evidence should not be overlooked at a crime scene.

The advancement of DNA technology has increased the capability of DNA profiling to a level in which its greatest boundary is innovation. It is well known that the common biological fluids encountered at crime scenes provide ample DNA for testing. However, in many cases analysis becomes challenging due to the direct deposit of DNA on an unusual surface or item. Bite marks are a piece of evidence that offer an odd, yet fairly common mode of DNA transfer when dealing with burglary, larceny, robbery, and at times, more serious and violent crimes. The number of cases involving bitten foodstuffs is increasing, suggesting a need to look into the DNA profiling of this type of evidence.

A potluck was staged as a mock crime scene in which foods such as pizza, corn on the cob, chicken wings and ribs, bite size Hershey's peanut butter cups, cheese, apple slices, and carrots were partially consumed and remnants discarded. The unconsumed food commodities were swabbed for biological evidence, analyzed for cellular material by microscopy followed by organic extraction, concentration and quantification by slot blot. The AmpF*l*STR® Profiler Plus™ PCR Amplification kit was used for all PCR reactions. Samples were concentrated to a final volume of 25□l of which 20□l was used in the amplification reaction. Amplicons were electrophoretically separated using the ABI Prism 310 Genetic Analyzer and analysis of raw data and calling alleles carried out by GeneScan® and Genotyper® softwares respectively.

The research results showed that high quality DNA could be extracted with successful STRs typing was obtained. Analyses of the profiles outcomes will be demonstrated. The presence of nucleated epithelial cells in preliminary microscopic results suggested that typing results could be obtained from bitten food products. It was indeed seen that full DNA profiles (9 STR loci + Amelogenin) were obtained from 43% of swabs collected, between 6-9 loci was seen in 33% of samples, 16% showed 1-5 loci and only 8% failed to type at all. Profile variation based on food-type dependent factors (portion size and eating style, food preparation and natural composition, and swabbing location), are also discussed. Poor profile quality manifesting as allelic dropout is attributed predominantly to PCR inhibition. Degradation and stochastic effects are also considered as sources of allelic dropout but only minimally. Mixed profiles as a ramification of improperly packaged samples are also addressed.

In conclusion, this research has largely shown that STR typing of food can be carried out in a highly successful manner, therefore when food evidence is available, DNA results should definitely be sought. Limitations due to low DNA yield and presence of PCR inhibitors can be overcome to produce high quality DNA profiles. Since cross transfer of cellular material was readily evident in a number of samples, any and all occurrences of food items touching must be noted while applying proper packaging protocol.

Bite Mark, STR Typing, Foodstuffs

B110 Quality and Throughput From a Highly Integrated, Automated Casework Sample Processing Platform

Benoît Leclair, PhD, Timothy D. Kupferschmid, MFS, Corey L. Schwensen, MS, Stephen Gresko, BS, Victor Thompson, BS, Brian E. Ward, PhD, and Tom Scholl, PhD, Myriad Genetic Laboratories, Inc., 320 Wakara Way, Salt Lake City, UT 84108*

Te attendee should have a clear understanding of what current automated sample processing technologies can do for current casework loads and backlogs, in terms of process quality, flexibility and throughput.

Currently, long manual processing times give offenders ample opportunity to re-offend. Highly integrated automated solutions have the potential to eliminate backlogs, provide quick turn-around on newly submitted cases, increase crime resolution rates, and deny repeat offenders the opportunity to re-offend. Countless victims of violent crimes could be spared their ordeal.

The demanding nature of forensic casework evidence makes of sample processing a labor-intensive manual undertaking. Submissions of criminal casework involving biological evidence currently exceed installed processing capacity in numerous jurisdictions. It is currently estimated that across the United States, over 500,000 criminal cases with biological evidence are awaiting processing.

Highly integrated, automated biological specimen processing platforms have been in use in high-throughput clinical and large-scale genetic research facilities for many years, and more recently in felon genotype data banking initiatives. These systems have reached a level of maturity that warrants leveraging this experience into the casework sample-processing arena, despite the demanding nature of casework biological evidence. This report presents the result of the development efforts towards the implementation of highly integrated, automated casework sample-processing platform.

The development goals were to achieve performance standards comparable to or better than a traditional manual process with regards to genotyping results, sample consumption, process flexibility, and chain-of-custody. In addition, the platform fully exploits process tracking, throughput and scalability capabilities. The entire process is overseen by a custom-built LIMS addressing the specific requirements of forensic casework. It tracks samples, their derivatives and associated process-generated data from the moment the samples enter the facility. It controls all robotic processes, ensures process integrity and sample tracking through the extensive use of barcodes. It automatically computes quality metrics and performs trend analysis to monitor / document process quality.

Experienced analysts manually search exhibits for biological stains. According to the specifics of the case, cuttings enter the automated processing platform under the "Differential" or "Non-Differential" pathways. TECAN robotic liquid handlers perform all processes from cell lysis to the production of capillary loading plates. Robot-based chemistries are optimized to deliver quantitative DNA extraction yields from scarce samples. DNA is extracted with ChargeSwitch para-magnetic beads, and quantification is performed with the Quantifiler Autosomal and Y kits. All commercial STR megaplexes are supported. The high precision, accuracy and reproducibility of robotic pipetting contribute significantly to overall process quality. The batching of samples for robotic processing yields considerable efficiencies in process execution time.

To support process flexibility and minimal exhibit/extracted DNA consumption, the LIMS provides the analyst with customizable re-work pathways from any given step within the platform, as well as process branch-off points to return a sample to offline processing. The LIMS incorporates numerous user interfaces that allow the analyst to follow / audit the processing path of a sample and maintain total control on the processing of samples. The entire system is built under a novel architecture that allows for new processes or submitting agency preferences to be quickly integrated, extensively tested and validated.

A complete developmental validation study was conducted according to SWGDAM guidelines and demonstrated the reliability of the platform. This presentation will showcase case examples processed by this high quality, automated system.

Automation, Casework, Validation

B111 A Concordance Study Comparing Different Amplification Chemistries and Electrophoretic Platforms for a Databasing Program

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The goal of this presentation is to present the results of an extensive concordance study and collaboration performed by the Alabama Department of Forensic Sciences (ADFS) and Marshall University Forensic Science Center (MUFSC) in order to address the State of Alabama's backlog of convicted offender samples.

This presentation will impact the forensic community and/or humanity by demonstrating that either multiplex reagent kit or instrument platform can be effectively used to process convicted offender samples. The study demonstrates that the procedures employed are robust and valid. Furthermore, this study will present recommendations for the forensic community regarding the interpretation of DNA profiles developed from convicted offender samples and their subsequent entry into CODIS in order to maximize the current searching algorithm to aid in the identification of the perpetrators of violent crimes.

Concordant results using different fluorescent-based STR (short tandem repeats) genotyping systems for the analysis and databasing of convicted offender samples are critical for accurate matching to non-suspect casework and to link serial crimes. In order for a state to upload its database of convicted offender DNA profiles into national level of the COmbined DNA Indexing System (CODIS), each profile must be comprised of the standard 13 core STR loci. Prior to this requirement, the ADFS had generated a convicted offender DNA database with eight (8) STR loci of the 13 core STR loci. With the support of the National Institute of Justice, the Alabama Department of Forensic Sciences (ADFS) and Marshall University Forensic Science Center (MUFSC) initiated a collaborative study to conduct additional DNA testing on these convicted offender samples to develop results for the remaining five (5) core STR loci and to demonstrate concordance of the STR results obtained, regardless of the testing platform employed. The STR results submitted by MUFSC were generated using System 1, the ABI PRISM® 3100 Genetic Analyzer, the AmpF*l*STR® Identifiler® PCR Amplification Kit, ABI PRISM® GeneScan® Software version 3.7 and Genotyper® Software version 3.7.1 (Applied Biosystems, Foster City, CA). The STR results from samples previously processed by the Alabama Department of Forensic Sciences were obtained using System 2, the Hitachi FMBIO® II Fluorescent Imaging Device (Hitachi/Miraibio Genetic Systems, Alameda, CA), the PowerPlex® 1.1 System (Promega Corporation, Madison, WI), and FMBIO® Analysis and STaR Call ™ (Hitachi Genetic Systems). This study demonstrates that the combination of instruments, reagents, procedures, and analyses employed by both of these institutions provided concordant and accurate genotyping results for databasing purposes.

Beginning in April 2002, the MUFSC submitted 5,000 STR profiles to the ADFS using System 1 had previously been processed using System 2 by the Alabama Department of Forensic Sciences. Overall, there is incredible concordance for all 5,000 samples between the two (2) systems. Greater than 99.98% concordance is achieved when comparing the overlapping eight (8) loci present in both systems. Any differences noted have been identified and summarized into the following categories: lower resolution when using System 2; stochastic amplification; and allelic dropout. An example and respective percentages of each category will be presented.

Resolution with the capillary electrophoresis platform is much better than resolution using slab gel electrophoresis. Further, it is known that the amplification kits from various manufacturers incorporate dissimilar different primer sets which may result in differences in the amplification conditions and may lead to destabilization of the amplification and eventually stochastic effects and/or allele dropout. The frequency of stochastic effects and allele dropout is extremely low. The manufacturer of the kit with the loci exhibiting the highest frequency of allelic dropout observed in this study (i.e., D13S17 and D16S539) has subsequently modified PowerPlex® kit(s) to incorporate amplification of the null alleles. Rare observations of stochastic effects and/or allelic dropout were observed and documented at various loci in both testing systems. The searching algorithms available within the CODIS software which employ moderate stringency searches and allow for a selected number of mismatches can address any low frequency differences between testing platforms.

This concordance study demonstrates that either multiplex reagent kit or instrument platform can be effectively used to process convicted offender samples. The study demonstrates that the procedures employed are robust and valid. Furthermore, this study will present recommendations for the forensic community regarding the interpretation of DNA profiles developed from convicted offender samples and their subsequent entry into CODIS in order to maximize the current searching algorithm to aid in the identification of the perpetrators of violent crimes.

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CODIS, Concordance, Databasing

B112 "Safe in the Crosshairs": One-Way™ Bullet Resistant Glass

Susanna Rudy, RN, MSFS, University of California Medical Center at San Diego, 200 West Arbor Drive, San Diego, CA 92103*

After attending this presentation, law enforcement, investigators, ballistics specialists, and criminalists will be informed of this unique type of glass, who produces it, how it is manufactured, how it works, the ammunition that it repels and the types of individuals and organizations that have access to this technology and are currently using this product as well as others offered by Labock Technologies in order to protect against terrorism and criminal activity.

An awareness of the existence of this type of glass has a significant impact on the way law enforcement and various other governmental agencies may chose to outfit their personnel for security purposes. This presentation will impact the forensic community and/or humanity by benefitting to criminalists and ballistic specialists in solving forensically significant cases involving such glass.

As the World focuses its attention on the sad demonstration and threat of terrorism and increasingly more violent crimes, hopes for safety and security lie in the skills and intelligence of science and technology. They are the minds that work quietly behind the scenes to develop state of the art deterrents and safety devices necessary to protect the lives of those who speak for a greater World peace and stay one step ahead of those who mastermind to destroy it.

Labock Technologies Inc., a research, development and manufacturing company known to many government agencies and corporations for its armoring technologies has come to the forefront in the war on fighting terror by introducing a revolutionary new concept in a bullet proof glass design. One-Way™ bullet resistant glass. Labock is the only company that has successfully produced a bullet resistant, high clarity/glass/plastic armor system that offers protection against hostile fire while allowing successful return fire from within the confines of the vehicle or structure without damaging the integrity of the glass.

The glass is made of a series of polycarbonate, acrylic and glass layers merged in a special manufacturing process. It is significantly lighter, has lower distortion and gives up to 90% clarity. Passing all of the standard governmental agencies ballistic tests 100% of the time, the One-Way™ protection system (unidirectional armor) is resistant up to NIJ level III standards. This technology is offered to distinguished clients only. This technology has been featured in several publications including Discover Magazine, New Orleans city Council News and the History Channel. This state of the art technology is being used as the primary source of protection in many vehicles and buildings that are currently in the rebuilding phase of Iraq.

Terrorism, One Way (TM) Bullet Resistant Glass, NIJ Level III Standards

B113 Effects of Aging on Pressure Sensitive Tape Analysis: A Preliminary Study

Rebecca Bucht, BSc, 309 West 76th Street, #4A, New York, NY 10023*

The goal of this presentation is to present preliminary results on how accelerated aging and prolonged exposure to moderate heat affect the IR spectra of the backing and adhesive layer of tapes, as well as microspectrophotometry of the backing.

The comparison of tapes to database information and standards often involves the use of IR spectra of the backing and adhesive, as well as MSP of the backing. This presentation will impact the forensic community and/or humanity by showing the important of considering how exposure to different environments can affect these features.

Forensic tape analysis involves either attempting to match two pieces of tape or attempting to identify a tape by comparing it to standards in a database. Parameters contained in the database include a number of physical features and chemical properties.

Physical features include functions of dimensions and morphology, which are not necessarily stable when the tape is taken off the roll and applied. More stable and objective measurements such as determination of the components of the backing and adhesive, as well as MSP measurement of the color of the backing, have been proposed to add more stable dimensions to the databases. IR spectra of the backing and adhesive have been proposed in order to identify the components of the backing and adhesive layers. However, both the polymers and additives used in pressure sensitive tape backings and adhesives degrade when exposed to a number of factors such as oxygen, humidity, mechanical stress, aggressive media and ionizing radiation and temperature. This degradation has the potential of altering the appearance of the IR and MSP spectra.

A selection of tapes was obtained, including office, duct, electrical and packing tapes. The backing layers were analyzed by ATR-FTIR and MSP, and the adhesive layers by DRIFTS. One set of tapes was then exposed to moderately heat in an oven set to 55°C and another to accelerated aging according to the ISO 4892-2 standard. T he tapes were attached to two different plastic films, PVDC and LLD-PE. Spectra of the backing and adhesives were then obtained by ATR-FTRI and DRIFTS and compared to those of the unexposed tape.

The main polymer component of the spectra did not change significantly, but noteworthy changes were observed in smaller peaks that could be used to differentiate between tapes of the same base polymer but

different manufacturers. As expected, not all types or brands of tapes reacted similarly to the environmental exposure. In addition, some changes in the adhesive spectra appear to be influenced by the substrate the tape was deposited on during its exposure to heat or weathering. Only one set of tapes was exposed to each of the environments, and only one set of analyses performed on each sample, so the results would have to be confirmed by a more comprehensive study.

More work needs to be done to validate and further define these results, but it seems clear that effects from exposure to different environments, and potentially substrate effects should be taken into consideration when analyzing pressure sensitive tapes.

Pressure Sensitive Tape, IR, Database

B114 A Comprehensive Training and Professional Development Program for an Accredited Forensic Laboratory in the Public Sector

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The goal of this presentation is to provide a laboratory seeking American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB) accreditation with guidance and a framework for implementing a successful Training and Professional Development program.

This presentation will impact the forensic community and/or humanity by providing a model that can assist an organization in creating a training and professional development program and policy that meets or exceeds ASCLD/LAB requirements and is considered by all staff as an integral component in their employment.

This presentation will describe the design of a comprehensive training and professional development program suitable for an ASCLD/LAB accredited forensic laboratory in the public sector.

The relevant ASCLD/LAB principle, standards and criteria are:

- 1.3.3 TRAINING AND DEVELOPMENT PRINCIPLE
  Training and development of employees must be emphasized to improve accuracy, increase productivity, and enable them to assume greater responsibility.
- STANDARDS AND CRITERIA
  A training program to develop the technical skills of employees is essential in each applicable functional area.
- 1.3.3.1 Does the laboratory have and use a documented training program in each functional area for employees who are new, untrained or in need of remedial training? (E)
- A formalized personnel development program is important to prepare employees to assume more responsible jobs.
- 1.3.3.2 Does the laboratory have an employee development program? (I)

The Centre of Forensic Sciences (CFS) Training Manager is accountable for ensuring that high-quality, relevant training and education services are made accessible and provided to staff on a regular basis.

This work is facilitated through a Training and Education Committee, which consists of a manager from each section/unit (total 11) and is responsible for providing the Training Manager with:

- Assistance, advice and support in the development of CFS-wide training initiatives.
- Staff and resources for the delivery of CFS-wide training initiatives.
- Assistance, advice and support in the development of an annual training plan of external educational commitments.
- Staff and resources for the delivery of all external educational commitments.
- The development and implementation of internal training program(s) specific to each section/unit.
- The training and development plans for each member of their staff.
- Assistance in the development and maintenance of a process for the allocation of funds for specific and general training initiatives.
- A forum for representatives from each CFS section/unit to discuss general and specific training needs.

The Training Unit is responsible for implementation of committee resolutions and decisions.

The training and professional development program at the CFS, which meets ASCLD/LAB requirements, is detailed in the lab's *Training and Professional Development* policy. Opportunities for training and development are provided to all CFS staff (operational/administrative support staff, technologists, scientists, and managers). The training and development program for all staff commences with the offer of employment, when each new staff member receives an outline of his/her training and development program for the first year.

Additionally, each staff member, in conjunction with her/his manager, develops an annual performance and development plan that includes training and development opportunities identified during each individual's performance review.

The manager responsible for training and development in each section/unit compiles the individual learning plans into a section/unit plan and submits it to the CFS Training Manager for organizational integration and implementation within the funding envelope of the Centre's annual training budget, which is sheltered from erosion. Dispensation of training funds is influenced by many factors including the size of each section/unit, available operational and developmental opportunities, and organizational pressures.

The CFS training and professional development budget's funding is approximately 4 to 6% of the Centre's salary budget. This level of funding is aligned to the benchmark established by both the Government's Human Resource Strategy – which outlines that high performance and high technology organizations provide approximately 6% of their salary budget for training – and the American Society of Training and Development's annual reports of funding levels for leading edge organizations (Training Investment Leaders).

New staff complete an orientation program that provides health and safety training, information on the role of the CFS in support of the justice system and public safety, access to Human Resources information and an introductory tour of the facility.

Basic training for new staff, in addition to the orientation program, consists of organization-wide and section/unit-specific programs that differ depending on the section/unit and the nature of the individual's job. Organization-wide training includes some or all of the following elements: Policy training; Quality Assurance, Training, and Library information sessions; Miscarriages of justice training; Court system training; Centre Receiving Office training; and autopsy attendance. Section/unit specific training includes practical and theoretical components and a variety of competency tests.

Professional development is based on individual learning plans and often includes consideration of the technical and behavioral competencies identified for the individual's job, as well as section/unit, organizational, Ministry and Ontario Public Service needs and requirements.

Generally, professional development opportunities include: attendance at seminars and courses; attendance at administrative, professional, scientific, or management conferences; membership on inter- or intra-ministry work projects/committees; membership on scientific/technical working groups; cross-assignments or re-assignments; and secondments. In addition, professional development may include behavioral competency assessment in alignment with the Ontario Public Service competency models developed for scientists, technologists and managers at the Centre. Staff may also be provided with opportunities to deliver client education as part of their development program.

Training, Professional Development, Accreditation

B115 Potential for Brand Name Identification by Tomato Seed DNA Typing

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In recent years, DNA has been successfully extracted and analyzed from a variety of plant materials including seed pods, leaves and other vegetative matter from plant species such as *Cannabis sativa* (marijuana) and other ornamentals (Palo verde, *Sutera*). The ultimate goal of plant DNA typing is to extend the microscopic analysis of vegetative trace materials to further classify or individualize the sample. Since seeds are small, often adherent to clothing, and edible (stomach contents), they are a good choice to optimize for DNA typing from crime scene evidence. As a model system, the authors are using the amplified fragment length polymorphism (AFLP) method for DNA individualization of *Lycopersicum esculentum* (tomato) seeds that are common to many cuisines around the world.

The results indicate that high quality DNA could be extracted from fresh tomato seeds after they passed through the human digestive system using a commercially available plant DNA extraction kit. Although the sample weight was significantly less than the recommended amount for the kit, high quality and sufficient quantity of DNA was isolated from a single tomato seed to generate an AFLP profile. When DNA profiles were compared from different seeds, several variety-specific markers (DNA fragments) were identified. Although the sample size was small (n = 4 seeds each per 5 different tomato varieties), these markers look promising for tomato variety identification. Additional screening of larger tomato populations is in progress. Not only will new markers be identified and correlated with a tomato variety, but the percentages of shared markers can be estimated by comparisons of samples from the same variety and between varieties. A brief description of tomato varieties and their cultivation history will be provided in this presentation. Tomatoes have been extensively cultivated and many share a common genetic ancestry and so have been notoriously difficult to distinguish genetically due to high levels of inbreeding. The AFLP technology has been specifically developed to generate high marker saturation across plant genomes to overcome the inbreeding issue.

In addition, a comparison of fresh and processed tomato seeds and the subsequent recovery of DNA were performed. Fresh tomato seeds, both digested and undigested yielded an average of 62.5 ng/ 50 uL of DNA per seed embryo. Interestingly, DNA was not recoverable from processed tomato seeds from spaghetti sauces or canned tomatoes presumably due to the pressure and heat treatment during processing. Further studies are in progress to define if other forms of cooking (e.g., oven baking, boiling etc.) affect the ability to recover PCR quality DNA from tomato seeds. In summary, the data demonstrate that AFLP analysis is appropriate for individualization of unprocessed tomato seeds and may be useful for linkage of stomach contents back to a location, especially once variety-specific markers have been determined.

Forensic Botany, Plant DNA, Tomato Seed

B116 Progress in the Individualization of Gasoline Residues

J. Graham Rankin, PhD, Jeremy Wintz, MSFS, and Raymond Everett, BS, Marshall University, Forensic Science Program, 1401 Forensic Science Drive, Huntington, WV 25701*

After attending this presentation, attendees will have a better understanding of the methodology of gasoline individualization, the problems associated with comparing neat gasoline samples with residues from fire debris and the use of multivariate statistical methods in making those comparisons.

This presentation will impact the forensic community and/or humanity by providing better methods for individualizing gasoline residues in suspected arson cases.

Gasoline is a frequent accelerant used by arsonists. Identification of gasoline in fire debris is relatively easy even when greatly evaporated. However, when a suspect is apprehended with gasoline residue on his clothes or a gasoline can in his vehicle, the question arises if the gasoline residue from the fire debris can be matched with that found with the suspect. This has proven to be a more difficult challenge. Further recent legal challenges to comparison evidence have stressed the necessity of establishing a statistical probability for that match.

Julia Dolan (ATF National Research Lab, Ammendale, MD), at the 2002 meeting of AAFS, presented a high-resolution GCMS method for comparing gasolines based on 20 sequential area ratios of 34 target compounds from 3-methylpentane through the 1-methylnaphthalene. Her data set included 36 different gasolines, including both regular and premium, mostly from around the Washington, DC area. In addition to neat gasolines, 25% and 50% evaporated samples were analyzed. Mark Sandercock (RCMP, Edmonton, AB, Canada) has developed an alternative method for gasoline individualization based on two and three ring polyaromatic hydrocarbons that he was able to differentiate even at 90% evaporation. Neither study involved simulated fire debris.

As part of an ongoing study, the authors have assembled a collection of over 100 gasoline samples from across the U.S. and have analyzed many of these by both the Dolan and Sandercock methods. In addition, analyses of simulated fire debris (charred wood and carpet pad) comparing the gasoline residues with their corresponding neat gasoline will be presented. The ASTM method E1412 (activated charcoal strip adsorption, ACS) is typically used in fire debris analysis but discrimination effects have been reported in the past. Effects of the ACS method on comparison of gasolines by both methods will also be presented.

Gasoline Individualization, Fire Debris Analysis, Principal Components Analysis

B117 Adsorption Saturation and Chromatographic Distortion Effects on Passive Headspace Sampling With Activated Charcoal in Fire Debris Analysis

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Attendees will emerge from the talk with an appreciation for the complicating effects of adsorbent saturation on the resulting chromatographic profile in ignitable liquid analysis. Audience members will be provided with an understanding of the causes of chromatographic distortion and ways to alleviate these effects in arson investigations.

This presentation will impact the forensic community and/or humanity by presenting results which will be discussed along with their relevance to ASTM methods and possible impacts on the analysis of ignitable liquids residues for pattern matching and source identification.

The recovery of hydrocarbons from an equimolar test mixture containing C7 – C10 components has been investigated to determine the influence of hydrocarbon vapor phase concentration on the molar quantities and ratios of the components recovered by passive headspace sampling with activated charcoal. In a one-quart container, hydrocarbon volumes as small as 24 µl (liquid) were sufficient to saturate a 99 mm^2 activated charcoal square. Hydrocarbon displacement from the saturated surface of the activated charcoal resulted in significant distortion in the molar ratio and chromatographic profile of the recovered hydrocarbons. Hydrocarbon adsorption data for the C7 – C10 equimolar mixture was used to estimate the average surface area of the activated carbon at 1128 ± 197 m^2/g. In order to demonstrate the effect of adsorbent saturation on a commonly encountered commercial accelerant, similar experiments were performed with gasoline. Passive headspace sampling of similarly small volumes of unweathered gasoline resulted in significant distortion of the chromatographic profile of the components recovered from the headspace by passive sampling. The chromatographic profile of the recovered hydrocarbons closely resembled 75% weathered gasoline. A method of subsample collection and analysis was demonstrated as a way to alleviate distortion from samples containing heavy loadings of ignitable liquids. Carpet and carpet padding were placed in a quart container and a heavy loading of unweathered gasoline was placed in the center of the carpet and padding. The container was closed and heated to 60ºC for a period of 16 hours to bring the volatile components from the gasoline into the vapor phase. The container was then cooled to room temperature and a subsample of the carpet padding was removed and placed into an empty one-quart container along with a 99 mm^2 activated charcoal strip. The subsample was heated to 60ºC for a period of 16 hours and the activated carbon was subsequently extracted with CS_2 and analyzed by GC/MS. The resulting chromatogram closely resembled the chromatographic profile of the unweathered gasoline.

These results will be discussed along with their relevance to ASTM methods and possible impacts on the analysis of ignitable liquids residues for pattern matching and source identification.

Fire Depris, Ignitable Liquids, Trace Evidence

B118 Application of a Standardized Gas Chromatography Tandem Mass Spectrometry Method for the Improved Detection of Ignitable Liquid Residues

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The goal of this presentation is to decribe an approach to improve the detection and identification of ignitable liquid residues (ILR) through development of a standardized gas chromatography ion trap tandem mass spectrometry (GC/IT/MS/MS) method that is simple to implement and interpret.

This presentation will impact the forensic community and/or humanity by describing an approach to improve the detection and identification of ignitable liquid residues through development of a standard GC/IT/MS/MS method that is simple to implement and interpret. Data in support of the method will be provided and the advantages of the method will be shown through examples where GC/MS analysis alone does not provide conclusive results. This method allows for improved analysis of ILR evidence by overcoming previous disadvantages of MS/MS methods without increased examiner labor or time or the need for complicated interpretation software.

The detection and identification of small quantities of ignitable liquid residues in fire debris evidence can be difficult due to: significant alteration of these mixtures during the fire, recovery methods that afford poor selectivity and/or sensitivity, and co-extraction of interfering products (IP). The objective of this project was the development of a standardized GC/IT/MS/MS method that can be employed on an ion trap mass spectrometer, independent of manufacturer. Flexible chromatographic parameters and uniform ionization parameters were incorporated in the creation of a standardized GC/MS/MS method for ILR analysis.

Regions of uniform ionization, termed ***bins***, were created using the standard n-alkanes, C_8 through C_{23}, as markers. The general approach described in this presentation can be used in any GC/IT/MS/MS instrument and the spectra generated can be shared as a guide between instruments. An examiner can generate his/her library for use in their laboratory or use a previously created IT/MS/MS library due to the uniform ionization. Changes in chromatographic parameters would require minor adjustments of the bins. A searchable mass spectral database produced from this method would facilitate identification of components found in ignitable liquids (ILs) and interfering products (IPs). Chromatograms obtained using the standard IT/MS/MS method will be presented and compared to data generated by typical MS methods for different ILs and their corresponding weathered fractions in the presence of interfering products. Data in support of the advantages of the method will be shown through examples where GC/MS analysis alone does not provide conclusive results.

These experiments will improve current analysis of fire debris without significantly changing the workload of the examiner or the time required for analysis. It is anticipated that the results using GC/IT/MS/MS will not require sophisticated training or data analysis programs. This method is expected to allow for the identification of ILRs that might currently go undetected.

Ignitable Liquid Residues, Interfering Products, GC/IT/MS/MS

B119 Fire Debris Analysis Using GC/MS/MS: Detailed Case Study Interpretations

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Attendees will gain a better appreciation and measure of the increase in specificity gained through the use of the GC/MS/MS method, how it is used, and the benefits of potentially using this method in their practice. The conferee will also gain an insight into recent research published on the use of GC/MS/MS on fire debris.

This presentation will impact the forensic community and/or humanity by providing forensic scientists with a mean to better evaluate and consider the importance of the use of GC/MS/MS for the analysis of ignitable liquids in fire debris. These scientists are being asked to vote on the publication of this method as an ASTM guideline and it will afford them the chance to interact and see detailed results from the use of this method as explained by one of the most experienced forensic scientist in the use of this technique. Scientists in this field will then further understand it's capabilities as a more specific analysis with an associated higher level of confidence in the result and how it applies to presentation in the courtroom. Through ASTM publication this method will reduce the occurance of false negative results and allow this forensic field to keep abreast with the current level of science.

The use of GC/MS/MS in the analysis of fire debris is being proposed by an ASTM sub-committee of the Criminalistics section. A guideline has been written, reviewed, revised and is now pending appropriate voting by members. This instrumentation and use of GC/MS/MS is well proven and has been used in other fields of testing such as Environmental, Pharmaceutical and the Drug Testing field for several years. The analysis of fire debris using GC/MS/MS itself has now been published in journals

for over seven years. The use of a second coupled mass spectrometer based segment significantly improves the selectivity of the analysis and is the instrument of choice when presented with the objectives to detect and identify trace contaminants within highly complex matrices. The analysis for ignitable liquids in fire debris fits this situation and GC/MS/MS is the instrument of ultimate choice for such mixture analysis. The advent of GC/MS in this field, through today's wide use of ASTM E-1618 represented a significant step forward in the reliability of the analysis of fire debris. However, when these samples are highly weathered or contain possible trace quantities of an ignitable liquid in a particularly complex debris sample, GC/MS may not yield confident court presentable results or may not illustrate to the scientist enough ignitable liquid characteristics to determine a confident positive identification. In such circumstances the scientist may often suspect the presence of an ignitable liquid but without sufficient presentable characteristics the result may be undetermined. The use of GC/MS/MS may often more clearly illustrate the required characteristics for the identification of an ignitable liquid when present and thus potentially avoid the reporting of a false negative determination. This method can provide profiles of superior comparability to reference ignitable liquid analyses than with GC/MS as the effects of pyrolysates on the profiles of various compound class characteristics of ignitable liquids can be vastly reduced. The aspect of presentability is becoming more important for the courtroom so that the judge and members of the jury can clearly conclude similarity of the results of fire debris analysis to reference ignitable liquids and thus have more confidence in the result and better information to make their conclusions. The use of GC/MS/MS has already been presented in court specifically for the analysis of fire debris samples.

This presentation will focus on the step-by-step interpretation, using a class pattern recognition approach, of two samples from different case studies that will illustrate the specific advantages and limitations of the analysis of fire debris using GC/MS/MS versus the GC/MS method outlined in ASTM E-1618. The presentation will also address previous concerns of sensitivity with reference to the abilities of the trained K9 often used to locate samples at the scene.

Analysis, GC/MS/MS, Debris

B120 Transfer and Adherence of Gasoline Vapors Onto Clothing in an Enclosed Room

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The goal of this presentation is to provide information regarding the exposure of clothing to gasoline vapors in an enclosed room and the subsequent laboratory testing of the clothing.

Chemists who analyze fire debris are sometimes requested to examine a suspect's clothing for the presence of ignitable liquids. The presence or absence of ignitable liquids on a suspect's clothing may play a significant role in a trial. Several factors may have an effect on the retention of ignitable liquids and or vapors on the clothing. These factors include whether or not liquid was spilled on the clothing, duration of exposure and the time between exposure and collection of the clothing.

This study was conducted as part of the ATF certification program for certified fire investigators and examined the transfer and adherence of gasoline vapors to various clothing materials and the effect of time between exposure and collection. The clothing items used in this study were swatches from a pair of 100% cotton jeans, a 100% cotton t-shirt, a 100% polyester t-shirt, and a 50:50 cotton:polyester sweatshirt. In order to simulate a standard room, a 1:12 scale model of a 10-foot by 12-foot room was constructed using plywood, drywall and pressboard flooring. No doors or windows were cut into the walls in order to minimize the escape of vapors. The interior of the room was not finished in order to minimize the available material on to which the gasoline vapors could adhere. These factors were selected to simulate a worst-case scenario for an enclosed room. Four rooms were constructed - one for each type of fabric. A metal baking pan was placed on the floor of each model to contain the liquid gasoline. Fishing wire and binder clips were used to suspend five three-inch square swatches of each fabric material approximately three inches above the metal pan.

It was assumed that one-half gallon of gasoline would be a sufficient amount to pour around a 10-foot by 12-foot room. This volume of gasoline was reduced by a factor of 12 and poured into the metal pan. A drywall ceiling was put into place and the room was enclosed for a period of 15 minutes. After 15 minutes, the ceiling was displaced and the fabric swatches were removed. One swatch was immediately placed into a quart can, and the can was sealed. The remaining swatches were exposed to atmospheric conditions for 15 minutes, 30 minutes, 60 minutes, and 24 hours. After each time frame, one fabric swatch was placed in a quart can and the can was sealed. This process was repeated twice more with fresh gasoline for each trial. A control sample of each fabric was also collected.

Each fabric sample was extracted using passive headspace concentration with a charcoal strip (ASTM E-1412). Each sample was heated at 65°C for 16 hours and extracted with 150 µL of carbon disulfide. The samples were then analyzed using a gas chromatograph – mass spectrometer. The total ion chromatogram and the aromatic (m/z = 91 + 105 + 119 + 133) extracted ion profile were used to evaluate the data.

All of the control samples were negative for the presence of gasoline. Each fabric sample packaged immediately after exposure showed indications of gasoline in both the total ion chromatogram and the extracted aromatic profile, but the patterns were not significant enough to warrant a positive identification of gasoline. After 15 minutes of atmospheric exposure, only the polyester t-shirt and the sweatshirt showed indications of gasoline in the aromatic extracted profile. After 30 minutes of atmospheric exposure, none of the samples showed any indications of gasoline.

This test was repeated with 20 µL gasoline placed on each of the fabric swatches to simulate approximately 12 drops of gasoline spilled on each fabric sample. Positive identification of gasoline (evaporated) on each of the fabric materials could be made on the samples immediately packaged and after 15 minutes of atmospheric exposure. After 30 minutes, gasoline (evaporated) could be identified on the jeans, the cotton t-shirt, and the sweatshirt. After 60 minutes gasoline (evaporated) could be identified only on the jeans.

This study demonstrates that in an enclosed room the volatile components of gasoline may adhere to various types of clothing material. However, a positive identification of gasoline by the laboratory would be unlikely even if the clothing was packaged immediately after the exposure. After being exposed to the environment for a short period of time, any indications of gasoline are eliminated. However, when liquid gasoline comes in contact with clothing, the laboratory can make a positive identification of gasoline if the clothing is collected a short period of time after the exposure.

Gasoline, Clothing, Ignitable Liquid

B121 High Speed High Resolution GC/MS of High Explosives

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Attendees will learn the use of high speed GC/MS to perform rapid, efficient, and reliable analysis and identification of trace levels of high explosives in post-blast debris.

High speed high resolution GC/MS has the potential to be a powerful tool in routine analysis by increasing sample throughput and improving laboratopry productuivity. Significant savings in time and money can be acheived through this technique without sacrficing sepration efficiency. This presentation will impact the forensic community and/or humanity by providing useful for the fast analysis of organic explosive mixtures in post-blast investigation where a short "time-to-result" is urgently required.

Introduction: The rapid, sensitive, and specific identification of trace levels of high explosives has taken center stage with the escalating threat of terrorist acts worldwide. High speed high resolution GC/MS has the potential to be a powerful tool in explosive analysis by increasing sample throughput (save time and money) and improving laboratory productivity.

This paper focuses on a faster separation of a mixture of 14 organic explosives with improved resolution compared to the conventional method. It explores the scope and limitations of the speeding approaches for the analysis of high explosives. The objective is to demonstrate that rapid analyses are possible and can be achieved without sacrificing resolution and separation efficiency.

Three columns were used in this study: the conventional long middle bore column (30 m x 0.25 mm x 0.25 µm), a short middle bore column (10 m x 0.25 mm x 0.25 µm), and a short narrow bore column (10 m x 0.1 mm x 0.1 µm). Different speeding approaches were adopted and each of their significance and impact in reducing the analysis time was evaluated by comparing the column efficiency, peak resolution, areas, heights, and widths. The speeding approaches used include:

(a) Fast temperature programming
(b) Higher initial oven temperature
(c) Increased carrier gas velocities
(d) Pressure programming
(e) Decreased length, bore size, and film thickness of columns

The effects of a temperature programmed injection temperature on peak broadening and sample decomposition were also investigated using a programmable temperature vaporiser (PTV). Peak resolution, areas, heights, and widths obtained under PTV conditions were compared to those performed using various constant injection temperatures.

Materials and Methods:

Instrumentation

The analyses were carried out using a GC/MS with programmable temperature vaporiser (PTV). Three columns were used:

(a) HP-5MS (30 m x 0.25 mm x 0.25 µm)
(b) PTE-5MS (10 m x 0.25 mm x 0.25 µm)
(c) DB-5 (10 m x 0.1 mm x 0.1 µm)

The analytes were injected into the PTV at isothermal temperature and with temperature programming, using different ramp rates.

Analytes: The explosive mixture used in this study comprises of a 70 ppm solution of nitroglycerin (NG), ethylene glycol dinitrate (EGDN), 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2,4,6-trinitrotoluene (TNT), 4-amino-2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene, nitrobenzene, 1,3-dinitrobenzene, 1,3,5-trinitrobenzene, and cyclotrimethylene trinitramine (RDX).

Results and Discussion:

Characteristics of analytes

The 14-component explosive mixture comprises of analytes which are thermally labile (requiring low injection temperature) and those which are non-volatile with high boiling points (requiring high injection temperatures).

Conventional GC/MS

Conventional GC/MS for the analysis of high explosives is performed using a long middle bore DB-5MS column (30m x0.25mm x 0.25 µm) at an injector temperature of 150°C and oven temperature of 50 to 200°C at 15°C/min. The analysis time is 14.8 minutes. The objective of this study is to apply various speeding approaches to reduce this long analysis time to achieve a short "time-to-result" analysis.

High speed GC/MS

(a) Injection system
Sample introduction is the most critical step in high speed GC because it affects band broadening. The advantage of a PTV is that it combines a cool injection step with controlled vaporisation. The smaller i.d. liner of the PTV can also be heated or cooled more rapidly and this helps to reduce peak broadening.
There was poor sensitivity of the high boiling point analytes at an isothermal injection temperature of 100°C while thermally labile components decomposed at higher temperatures. On using a PTV temperature program from 100 to 250°C, the decomposition of the thermally labile analytes was greatly reduced and better detection limits of the higher boilers were obtained.
The ramp rate for the PTV was investigated at the various temperature programming rates from 50°C/min to 250°C/min. At low ramp rates, resolution was poor for two critical pairs. There was a marked improvement in peak separation, peak shape, area, and height at higher ramp rates. Hence, PTV was employed in all the analysis with the three columns.

(b) Long middle bore column (30 m x 0.25 mm x 0.25 µm)
It was observed that only the initial oven temperature has some impact on reducing analysis time but overall results of the other speeding approaches are relatively insignificant with some loss of resolution. Although increasing the ramp rate produced significant changes in analysis time, peak separation was poor and hence, faster temperature programming rates could not be implemented in this analysis.

(c) Short middle bore column (10 m x 0.25 mm x 0.25 µm)
An effective way to reduce analysis time is to reduce the column length. Increasing the ramping rate from the conventional 15°C/min to 70°C/min produced the most significant change in analysis time with good resolution. Combining all the speeding approaches resulted in a significant reduction in analysis time by 80%.

(d) Short narrow bore column (10 m x 0.1 mm x 0.1µm)
Narrow bore columns with thin films are more efficient and have better resolution. It is also possible to work at higher linear gas velocities with less loss in efficiency. Increasing the ramping rate from the conventional 15°C/min to 70°C/min produces very significant changes in analysis time. The shortening of column length, constant pressure programming and higher initial oven temperature produced marginal reductions in analysis.
Combining all the speeding approaches resulted in a significant reduction in analysis time by 80%.

Comparison of the three columns

(a) Analysis time
There was a significant 4.5 fold reduction in analysis time for both the short middle and short narrow bore columns but a marginal 1.5 fold reduction was obtained for the long middle bore column.

(b) Column efficiency
Plate height was used as a measure of the efficiency of the columns. Plate heights obtained for the 3 columns were similar.

(c) Peak width and resolution
The peak widths were similar for the two short columns, which were only ½ the width of the peaks obtained for the long middle bore column. The resolution-calculations were carried out using the two critical pairs. The two short columns gave good resolution for the two peak pairs and a baseline separation of these pairs was obtained. The data indicate that the gain in speed was achieved without sacrificing resolution.

(d) Repeatability
There is usually a concern that high speed GC will produce peaks that are not ideal in shape with the presence of fronting and tailing, poor baseline resolution or poor precision of the retention

times and peak areas and heights with faster temperature programming. To determine the precision of the high speed GC method, six repeated injections of the explosive standard mixture were performed. From the results obtained, the repeatability of the retention times, peak areas, and heights in high-speed analyses were found to be satisfactory.%RSD of these parameters for the columns were found to be similar to each other.

(e) Limits of detection (LODs)
Better LODs were observed for the narrow bore column. This is probably due to the increased signal to noise ratio for the much narrower peaks.

(f) Limiting factors
The use of high speed GC is usually hindered by a lack of instrumentation. A high power GC oven is required to allow for high programming rates up to 100°C/min. Pressure can also become a limiting factor for a number of speeding approaches. The use of shorter columns is limited by the minimum inlet pressure required for stable operation of the carrier gas system while long narrow bore columns require sufficiently high pressures. The use of columns with a reduced i.d. is one of the most logical approach for high speed GC but sample capacity has to be compromised. Sample capacity of a column with small i.d.s is lower than that of a middle bore column.

Sample matrix

Sixteen different materials were swabbed with acetone and the swabs were concentrated and analysed using the narrow bore column. The materials tested include: metals, plastics, paper, polymeric materials, wool, soil, sand, tape, and rubber. Only two materials gave co-eluting interference with two of the analytes. A plastic container had a co-eluting peak with TNT and the chromatographic profile of newspaper had a peak that co-eluted with EGDN.

Conclusion: This new technique allows the Criminalistics Laboratory to perform rapid, efficient, and reliable identification of trace levels of organic explosive residues in post-blast exhibits without sacrificing resolution and separation efficiency. There is a significant decrease in analysis time by 4.5 fold (from 14.8 minutes to 3.3 minutes) Fast temperature programming rates significantly decreased the analysis time, much more than other speeding approaches. Compared to conventional GC techniques, a significantly higher sample throughput is now possible. The new approach has the additional advantages of lower limits of detection, better peak separation, and resolution and a reduction in thermal degradation.

High Speed GC/MS, Programmable Temperature Vaporiser, Fast Temperature Ramping

B122 Realizing the Science Behind Canine Detection of Explosives

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Attendees will learn scientifically sound methods and applications of canine detection of explosives, an understanding of the ability and limitations of canine detection, and the future of this recognised method of explosives detection.

This presentation will impact the forensic community and/or humanity by allowing members of the forensic community who are not familiar with canine detection to become familiar with the abilities and limitations of explosives detection canines, whilst at the same time providing specific scientific suggestions to those in the field who wish to improve upon training and operating practices.

Police and private agencies have used canines for many years now, to locate items of forensic interest such as explosives, controlled substances, currency, ignitable liquid residue, hidden or missing persons, and human remains. Up until recently however, this practice has remained more of an art than a true science, and with the increasingly strict standards of forensic evidence admissibility, including *Frye* and *Daubert*, validation of canine detection, to provide peer reviewed acceptance of scientifically sound practices, is becoming urgently required. Although viewed as older technology, now competing with microchip laboratories and micro sensors, the canine must still be considered one of the best real-time methods for the detection and location of explosives.

Solid Phase Microextraction has been combined with Gas Chromatography - Mass Spectrometry (SPME-GC-MS) and Gas Chromatography - Electron Capture Detection (SPME-GC-ECD) to analyse the headspace of samples of explosive obtained from local and state law enforcement agencies. The SPME-GC-ECD method used in this study is also being optimised for potential field application. A rapid SPME exposure followed by a 15 minute GC program provides ECD spectra of all EPA 8330 explosives, in addition to EGDN, NG, PETN and DMNB. A dual column method is under investigation for confirmatory analysis.

Samples analysed include cast explosives, plastic explosives, detonation cords, powder explosives, and commercially available non-explosives training aids. Results of analysis indicate highly similar odor signatures within the cast and the plastic explosive groups. The cast explosives feature predominantly 2,4-dinitrotoluene and other aromatic mono-, di- and tri-nitrates, whereas the 2,3-dimethyl-dinitrobutane taggant and 2-ethyl-1-hexanol plasticiser are common in the plastic explosives. Unlike the high explosives, the odor signatures of the powder explosives are not similar within the group, with the odor chemicals highly dependent upon the manufacturer's choice, with no common chemical observed within all samples. Chemicals detected within the powder explosive headspace include dinitrotoluenes, ethyl centralite, diphenylamine, nitrodiphenylamine and nitroglycerin. The non-explosive training aids have been analysed in the same manner as the explosive samples, and whilst TNT, RDX and PETN were detected at low levels in the headspace of the silica powder based products, the petrolatum jelly aids do not have significant odor headspaces, above the petrochemical background matrix.

Fieldwork with local and state police agencies is currently a multi-faceted project. The effectiveness of commercially available training aids has been studied using canines previously trained using actual explosive material, in addition to use as a training medium for new canines. It has been observed that dogs trained on actual explosive have difficulty in locating the non-explosive counterparts, but that dogs trained on the inert aids have little problem in crossing over to the real explosives. Fieldwork is also ongoing with the odor chemicals detected in the headspace of the explosive samples. To date, 2,4-dinitrotolene and 2-ethyl-1-hexanol have been identified as active odors for cast/powder and plastic explosive respectively. The 2,3-dimethyl-dinitrobutane taggant is not utilised by the canines, and is classed as an inactive odor, along with diphenylamine and ethyl centralite, all of which the canines show little or no interest towards.

Further research has focussed upon the permeability of explosive odors through assorted plastic and polymer containers. By varying the thickness and chemistry of the polymer, the rate of odor permeation may be controlled. In-house training aids have been developed utilising the active odors and the permeation study, and these aids are currently in applicability trials with selected law enforcement agencies. Work continues to identify the active odors of explosive samples, and to present figures on the reliability of local and state agency trained canines when presented with hidden explosives. Development of inert training aids that mimic explosive odor is ongoing, and these aids have been designed to release odor at a controlled rate of permeation, giving the ability to 'calibrate' the canines and calculate minimum detection levels. It can be shown, with the data on reliability, and minimum detection levels, that canine detection may be considered a scientifically sound method of detection.

Canine Detection, Explosives, Solid Phase Microextraction

B123 Raman Microscopy of Low Explosives and Their Combustion Products

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After attending this presentation, attendees will learn the use of Raman microspectrophotometry on trace level detection of common ingredients of low explosives and their combustion products

This presentation will impact the forensic community and/or humanity by illustrating the usefulness of Raman for trace level detection of low explosives and their combustion prioducts with minimal sample preparation.

Background: Inorganic low explosives usually consist of oxidiser-fuel mixtures. They can be made using ordinary laboratory chemicals, ammonium nitrate fertilizer, black powder, and pyrotechnic materials from sparklers, flash powders, and fireworks. Formulations and recipes are readily available on the Internet. Common oxidising agents used are nitrates, perchlorates, and chlorates of sodium, potassium, and ammonium. Fuels include sulphur, finely divided aluminium, magnesium, titanium, zinc, charcoal, sugar, red gum and shellac.

This paper illustrates the usefulness of dispersive Raman microspectrophotometry for the detection of low explosives and their combustion products. Major techniques for the analysis of low explosives include stereomicroscopy to mechanically separate individual particles and crystals, scanning electron microscopy with energy dispersive x-ray analysis (SEM/EDX) to determine elemental composition and morphology of particles, polarised light microscopy (PLM) to screen and differentiate crystals, microchemical (spot) tests, ion chromatography (IC) for soluble ions in water extracts, and Fourier Transform infrared (FT-IR) microspectrophotometry for molecular structure elucidation.

Current techniques however suffer from several limitations. SEM/EDX is non-destructive and extremely sensitive and powerful for elemental composition but cannot identify molecular and ionic species. Microchemical tests are destructive and often lack sensitivity and specificity; expected color changes may also be masked by interferences. Ion chromatography is a destructive separation technique and although sensitive, is based on matching retention times since conductivity detectors do not discriminate ionic species. In recent years, advances in Raman spectrometer design, improved lasers and detectors, faster acquisition of Raman spectral data, increased sensitivity, easier optical alignment and instrument operation, new approaches to reduce fluorescence masking, and greater affordability have led to the growing popularity of Raman spectrometry as an alternative vibrational spectroscopic technique.

Raman spectroscopy has widely been reported as having several advantages over infrared spectroscopy. Raman analysis requires minimal or no sample preparation. Unlike IR spectroscopy, the Raman technique is not affected by atmospheric moisture. Glass cells and aqueous solutions may be used to obtain Raman spectra and the sample can often be examined *in situ* non-intrusively. The Raman spectrum covers a wider range from 150 to 4000 cm^{-1}, compared to micro-FT-IR which often uses a mercury cadmium telluride (MCT) detector limited to the range 750-4000 cm^{-1}. The far-IR region below 750 cm^{-1} often has absorption bands with useful molecular information. The IR and Raman spectra of a sample may differ considerably and hence each technique can provide additional, complementary information regarding the sample. Infrared-inactive bands may be observed by Raman spectroscopy, and bands that are weak in IR spectra are often strong in Raman spectra.

Materials and Methods: Analyses were performed on a Renishaw RM1000 Raman spectrometer. The spectrometer was calibrated using a silicon standard.

A) General comparison of oxidisers and combustion products
To ascertain whether oxidisers and their combustion products can be differentiated using Raman microscopy, the following solid phase salts were analysed and their spectra compared: potassium nitrate, potassium chlorate, potassium perchlorate, sodium nitrite, potassium chloride, potassium carbonate, and potassium sulphate. The specificity of Raman spectra for solid phase nitrates, chlorates, and perchlorates were also studied by varying the cation and monitoring Raman shifts for the different vibrational modes. Small amounts of the solids were placed on ordinary glass slides. Samples mounted on graphite stubs for SEM/EDX analysis could also be directly analysed in the Raman microscope.

B) Repeatability of Raman shift measurements
Repeatability of Raman shifts was studied by performing two runs a day over three successive days. Up to 4 principal peaks were monitored for the six runs. The mean, standard deviation and coefficient of variation were then calculated. This study was applied to 8 oxidisers and 4 combustion products.

C) Analysis of aqueous solutions
As water is often used to extract post-blast debris for analysis, aqueous solutions of the oxidisers and combustion products were also analysed using the technique. Solutions of 1% and 5% (w/v) of 24 salts prepared using DI water. A sample volume of 15 µL (0.15 - 0.7 mg solute) of solution was drawn into and sealed in a capillary tube (3.5 cm long x 1.5 mm outer diameter.). The tube was placed directly in the path-length of the laser beam. The effects on Raman shifts from hydration of ions dissolved in aqueous solution were investigated.

D) Analysis of mixed salts recrystallised from aqueous solutions
Ion exchange upon crystallisation of mixed salts from the evaporation of aqueous solutions was studied. A small volume (30 µL) of 1% or 5% solution (containing 0.3-1.5 mg solute) was placed in a cavity slide and evaporated to dryness using the "quick dry" approach or the "slow dry" approach. "Quick dry" consisted of drying on a hotplate at 60°C for 5-10 minutes. "Slow dry" was carried out under natural unforced conditions at ambient humidity and 22°C for 6-8 hours. The crystals were sampled in the same way as for original solid materials. A small amount of the solid was placed on glass slide or mounted on a carbon stub.

Results and Discussion:

A) General comparison of oxidisers and combustion products
The number of peaks, Raman shifts and peak intensities and widths of common oxidisers and combustion products were found to be significantly different, allowing the different oxyanions, sulphate nitrate, chlorate, perchlorate, nitrite, chloride, carbonate, and sulphate to be readily differentiated. Raman spectra are unique for the different functional groups (anions). For each anion, the solid phase Raman spectra were found to be specific for each mating cation.

B) Repeatability of measurements
Good repeatability was obtained for Raman measurements. The worst case occurred for sodium salts; slight irregularities in peak shapes contributed to the apparent shifts. Since identifications are based on several peaks in the spectrum, this repeatability was sufficient for conclusive identification of oxidisers and their combustion products.

C) Analysis of aqueous solutions
In aqueous solution, the Raman spectra of nitrates of ammonium, barium, sodium, and potassium could not be differentiated. The effect of cations disappeared for the salts in solution. The spectra showed higher base-line, peak broadening, loss of small peaks and shoulders, shorter peaks, and lower resolution. Shifts were observed in the peaks between solid state and dissolved salts. Raman spectra of recrystallised oxidisers were indistinguishable from those of the original solid salts.

D) Analysis of mixed salts recrystallised from aqueous solutions
Ion exchange was observed in some cases but not in others. Crystallisation is influenced by the relative solubilities and ionic radii of the competing ions in solution.

Conclusion: Results indicate that Raman microscopy is a very powerful non-destructive technique that can easily identify oxidisers at low detection limits. Spectral resolution was of the order of 1 cm^{-1}, and Raman spectroscopy was found to conclusively identify ionic species, even in aqueous solutions. High spatial resolution was achieved; a microscope objective of 50x gave a laser spot size of 2 microns on the sample, indicating a high sensitivity of approximately 20 picograms of material. Combined with elemental information from SEM/EDX, the new Raman technique allows quick identification of both the cationic and anionic moieties of oxidisers with minimal sample preparation.

Raman Microscopy, Low Explosives, Oxidisers

B124 Raman Microscopy of Low Explosives Obtained From Sparkler Material

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The goal of this presentation is to present results of a study on the Raman microspectrophotometry of common ingredients in sparklers and their combustion products. This paper is the sequel to an earlier paper presented in this Meeting, titled "Raman microscopy of low explosives and their combustion products."

This presentation will impact the forensic community and/or humanity by illustrataing that sparklers are a convenient source of low explosives and that burnt and unburnt sparkler materials can be easily identified using Raman microscopy.

Background: Low explosives are often used in homemade bombs and improvised explosive devices (IEDs). Although low explosives normally deflagrate burning very rapidly at a subsonic propagation velocity, they can generate the gas pressure necessary for an explosion if confined within an appropriate container. Inorganic low explosives usually consist of oxidizer-fuel mixtures. They can be made using ordinary laboratory chemicals, ammonium nitrate fertilizer, black powder, and pyrotechnic materials from sparklers, flash powders, and fireworks.

Sparklers are a convenient source of low explosives for small homemade devices. Two main types of sparklers are widely available: wire sparklers and tube sparklers. Wire sparklers are more common and consist of pyrotechnic mixture coated on a length of fairly rigid metal wire. Variants of wire sparklers include dipped sticks where the pyrotechnic mixture is coated on a stick, whistling sparklers that emit a shrill whistle, and crackling sparklers that produce a series of sharp popping or crackling sounds as they burn. Tubed sparklers (or cylindrical fountains) contain the pyrotechnic mixture in loosely-filled cylindrical tubes that resemble pencils in size and shape. A priming mixture is often painted on the tip of sparklers to make ignition easier. Sparklers are stable at room temperature and normally safe to be hand-held for ignition. Lighting the ignition tip results in a flame that propagates down the wire or tube, producing a flame envelope surrounded by shower of colored sparks.

Pyrotechnic materials can be easily scraped off wire sparklers or emptied out of a large number of tubed sparklers. Alternatively, wire sparklers can be bundled together using tape to increase explosive effects. The typical pyrotechnic composition of sparklers is a mixture of oxidiser, fuel, combustible binder (eg, sugar, starch, gum arabic and shellac) and a color agent. Fuels include fine metal powder (glazed iron, aluminium, zinc, magnesium, titanium), meal gunpowder, sulfur and charcoal. Oxidisers are usually nitrates, chlorates or perchlorates. In wire sparklers, the iron or mild steel support wires also serve as a heat conductor, promoting the smooth propagation of the pyrotechnic reaction along the sparkler. Combustion produces a slight pressure, which ejects glowing metal particles, forming sparks that cool quickly.

Nature of Study: In the earlier paper titled "Raman microscopy of low explosives and their combustion products," Raman microscopy was shown to be a rapid, non-destructive and highly specific technique for identifying inorganic low explosives and their combustion products at low detection limits. Raman microscopy identifies both the cationic and anionic moieties of these substances with minimal sample preparation. This second paper illustrates the application of dispersive Raman microscopy to the identification of sparkler materials and their combustion products. Scanning electron microscopy with energy dispersive x-ray analysis (SEM/EDX) is a powerful screening technique to determine elemental composition, particle morphology and the presence of organic constituents, but cannot identify molecular and ionic species and therefore needs to be complemented by a spectroscopic technique such as Raman microscopy. Raman analysis does not give signals for metals, chlorides and some oxides but these elements are readily detected in SEM/EDX analysis. Water extraction allows separation of water-soluble components and oxidisers from the matrix, simplifying subsequent identifications. A two-prong approach combining SEM/EDX and Raman microscopy is recommended for the conclusive identification of inorganic explosive ingredients.

Materials and Methods: Analyses were performed on a Renishaw RM1000 dispersive Raman spectrometer. The spectrometer was calibrated using a silicon standard. Materials studied were several commercially available wire sparklers. Sparkler materials were analysed before and after combustion, in solid form and aqueous extracts.

Sampling method for Raman analysis: Small amounts of the unburnt, burnt or recrystallised solids were placed on ordinary glass slides. Samples mounted on graphite stubs for SEM/EDX analysis were also directly analysed in the Raman microscope. Aqueous solutions were taken up into glass capillary tubes for direct analysis in the Raman microscope.

Analysis of unburnt sparkler tip and body: Materials were carefully scraped and removed from the different layers of pyrotechnic coating for SEM/EDX and Raman analyses. These materials were also extracted with DI water, and the extracts analysed in aqueous solution and as dried recrystallised form.

Analysis of combustion products: A sparkler was burnt and materials were carefully sampled from different parts (tip, middle, bottom, exterior, core) of it for SEM/EDX and Raman analyses. DI water was also used to extract post-combustion debris for any residual water-soluble products.

Results and Discussion: The results for a 12-inch whistling sparkler are presented in this abstract. Additional results for other sparklers will be presented and discussed further during the oral presentation. The whistling sparklers came in a box of 100, priced at about $4-5 USD a box. Each sparkler was 29.5 cm long and had a pyrotechnic coating measuring 13.7 cm in length. The average weight of a sparkler was 6.05 g. The average amount of pyrotechnic coating on each sparkler was 3.55 g. Each sparkler had a greenish ignition tip, a grey exterior and a white core. The white whistling core was present only in the upper part.

Analysis of unburnt whistling sparkler materials: Raman analysis indicated that the unburnt sparkler tip contained mostly barium nitrate (oxidiser) and antimony sulfide (fuel and enhancer of sound effects). The white core of the unburnt sparkler contained mainly potassium perchlorate (oxidiser) and a small amount of organic ingredients. T he exterior contained mainly barium nitrate, carbon and silicon nitride (a refractory material that raises the flame temperature and prevents caking). SEM/EDX indicated the presence of aluminium powder (fuel).

Analysis of solids recrystallised from water extracts of unburnt sparkler: Recrystallised materials from water extracts of a mixture of exterior and core materials contained barium nitrate and potassium perchlorate, indicating that no ion exchange occurred during recrystallisation.

Analysis of combustion products: The whistling sparkler burned with golden sparks for 45 s and emitted a shrill whistling sound for the initial 5 seconds. The ignition tip and the white whistling core were consumed,

leaving a hollow shell in the upper part of the wire and a reduced diameter in the rest of the wire. The average weight of solid residues left was 1.8 g and the loss on ignition was 1.74 g (49% loss). The upper part of the burnt body yielded materials with no significant peaks in Raman analysis, but SEM/EDX analysis indicated barium, aluminium, oxygen potassium and chlorine peaks, consistent with barium oxide, aluminium oxide, and potassium chloride. The lower burnt body also contained carbon with trace amounts of silicon nitride. Material from the burnt body gave little solid residue when extracted with water.

Conclusion: Sparklers are a convenient and readily available source of premixed low explosives for making small IEDs. The inorganic ingredients used in sparkler compositions and their corresponding combustion products can be conclusively identified using SEM/EDX and Raman microscopy. Raman microscopy provided rapid, sensitive and unequivocal information on molecular and ionic structures. Metal particles, and some metal oxides and chlorides were not detected by Raman analysis but were easily detected by SEM/EDX analysis. A two-prong approach combining the strengths of Raman microscopy and SEM/EDX offers clear advantages over traditional techniques such as polarised light microscopy and microchemical (spot) tests.

The authors are grateful to Mr Wong Soon Meng of the Criminalistics Laboratory for performing SEM/EDX analyses, and taking photographs and scans for the Powerpoint presentation.

Raman Microscopy, Sparklers, Low Explosives

B125 Identification of Household Chemicals Used in Small Bombs via Analysis of Residual Materials

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Attendees will obtain information on methodology for the identification of reactants used in a specific type of bottle bomb (also known as chemical or "MacGyver" bombs) by analysis of product residues that result from the mixing of certain household chemicals with commonly available liquids.

This presentation will impact the forensic community and/or humanity by providing forensic examiners with information and data useful in identifying chemical bombs made from household products containing halogenated organic compounds; the identification of an original reactant can be used to narrow the search for possible household chemical sources and thus provide an investigative lead. This presentation will also raise awareness of the increasing popularity of these types of bottle bombs and the availability of "recipes" for them on the Internet.

Bottle bombs have commonly been made by combining aluminum foil and either muriatic acid (hydrochloric acid) or lye (sodium hydroxide) drain cleaner and water in a plastic bottle, which is then tightly capped and shaken. The resultant build-up in gas pressure causes the bottle to violently burst, and may spray caustic or corrosive liquid. While these devices are often set off as a mere prank, they have been known to cause property damage and/or physical injury. Recently, a growing number of bottle bombs encountered at the New York City Police Laboratory have been not of the afore-mentioned type, but the combination of certain pool and toilet tank tablets with rubbing alcohol. A number of household chemicals contain certain halogenated organic compounds in sufficient concentration which, when mixed with water or other liquids will produce a large volume of gas upon decomposition. These products include pool and spa chlorinators and brominators, and automatic toilet tank cleaners.

The first step in this study was to identify products that contain the organic compounds used in these types of devices. This was done by searching stores, browsing online vendors, and looking through the National Institutes of Heath Household Products Database (http://householdproducts.nlm.nih.gov/).

In the second step, several pool and toilet chemicals containing such compounds as trichloroisocyanuric acid, sodium dichloroisocyanurate, dichloro-5,5-dimethylhydantoin, and bromochloro-5,5-dimethylhydantoin were mixed under controlled conditions with tap water, rubbing alcohol, and soda-pop. The third step was to take reagent quality compounds in the above list and react them with distilled water and solvent grade isopropyl and ethyl alcohols. The solid residues remaining from each were dried, and then analyzed using gas chromatography-mass spectrometry (GC-MS), Fourier Transform infrared spectroscopy (FTIR), dispersive Raman spectroscopy, and x-ray fluorescence (XRF) and x-ray diffraction (XRD). This multi-instrument approach allowed for several points of comparison between the chemical products of steps two and three and reagent grade standards.

It was found that the original solid reactant was easily identified based on characterization of the reaction product. All chromatograms, spectra, and diffraction patterns from the reactions and standards were retained as a reference for future casework.

Chemical Bombs, Household Products, Halogenated Organic Compounds

B126 Inter-Laboratory Study on Bone Extraction for Mitochondrial DNA Analysis

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The goal of this presentation is to present the planned round-robin study to the forensic mitochondrial DNA community and encourage the participation of all commercial and government forensic mitochondrial DNA laboratories in the United States and abroad.

This presentation will impact the forensic community and/or humanity by increasing awareness of this study and maximize participation among government, commercial mtDNA laboratories in the U.S. and abroad

With the implementation of the National Missing Persons DNA Database, the forensic DNA analysis of remains consisting of bone evidence continues to increase. Since the DNA found in bone evidence is frequently limiting and/or degraded, mitochondrial DNA (mtDNA) analysis is often the analysis method of choice. In addition to the government and commercial laboratories currently conducting mtDNA analysis, several additional forensic mtDNA laboratories, including the FBI's Regional mitochondrial DNA laboratories, New York City Office of the Chief Medical Examiner, and California Department of Justice, are completing internal validation studies and are preparing to begin casework. It is anticipated that a substantial portion of this casework will deal with remains from missing persons. However, the availability of human bones for training purposes is limited. Furthermore, to date, no proficiency test is available using bones as the evidentiary material.

The Mitochondrial DNA Subcommittee of the Scientific Working Group on DNA Analysis Methods (SWGDAM) is assembling an inter-laboratory study comparing the extraction methodologies and sequencing results obtained from a single source of bone sample. The study is designed so that similar bones (ie. toe bones) or sections of a long bone (ie. femur) will be obtained from a single donor and distributed to the participating laboratories. Extraction, amplification, and sequencing of the resulting bone DNA will proceed according to the laboratories' standard protocols. Although full HV1 and HV2 sequencing results is desirable and recommended, partial mtDNA sequencing results from mini-primer sets may be acceptable. In addition to mtDNA HV1 and HV2 sequencing data, autosomal STR, Y STR, as well as mtDNA coding region and non-HV1/HV2 control region SNP data will be evaluated if obtainable from the bone sample.

In addition to submitting results of extraction yield and mtDNA sequencing data, participating laboratories will complete a questionnaire

regarding details of their extraction methodologies as well as amplification and sequencing strategies. Comparison of the results and extraction methodologies may highlight differences in methodologies that can be improved to give greater yield of high quality extracted DNA and/or amplified product. In addition, it is expected that this exercise will lend assurance to the field that subtle differences in amplification and sequencing protocols do not lead to differing mtDNA profiles.

In order to provide the most benefit to the forensic mtDNA community, all government and commercial forensic laboratories in the U.S. and abroad currently conducting mtDNA testing are encouraged to participate in this study. In addition, laboratories that anticipate conducting mtDNA testing in the near future are also welcome to participate.

Contact information as well as a time-frame for participant response, sample distribution, testing, results submission, and study analysis will be discussed.

mtDNA, Bone, Inter-Laboratory

B127 The Influence of Skeletal Weathering and Bone Type on MtDNA Analysis

Lisa M. Misner, MS, Michigan State University, Forensic Science Program, School of Criminal Justice, 560 Baker Hall, East Lansing, MI 48824; Douglas H. Ubelaker, PhD, Smithsonian Institution, Department of Anthropology, NMNH, MRC 112, Washington, DC 20560; and David R. Foran, PhD, Michigan State University, Forensic Science Program, School of Criminal Justice and Department of Zoology, 560 Baker Hall, East Lansing, MI 48824*

After attending this presentation, attendees will learn in what way bone type and its level of weathering, as well as age and sex of the deceased, can be used to help predict the success of mtDNA typing of skeletal material.

By using these types of objective comparisons of bone condition and type presented, and individual age and sex, the forensic biologist should be able to better predict the likelihood of successfully amplifying mtDNA from weathered bone, and devise strategies for targeting amplicon length. This presentation will impact the forensic community and/or humanity by increasing the productivity and efficiency of DNA analysis of skeletal material.

Forensic investigation of human skeletal remains may require DNA analysis for identification. In many instances such remains are in poor physical condition owing to weathering. This leaves the forensic biologist with the difficulty of predicting how to commence with the analysis, or whether DNA analysis might be successful at all. The goal of this study was to determine if the degradative state of skeletal remains can be used in a predictive manner with regard to mitochondrial DNA (mtDNA) analysis. Further, bone type was examined to establish what role it plays in DNA recovery from weathered bone. Information regarding the sex and estimated age of each individual was also compared to amplification success. Analysis of Variance (ANOVA) was used to test for differences in amplification success among the samples, considering each of these variables. The likelihood of successfully amplifying DNA based on the outer appearance of a bone, as well as the type of bone in question, and what size DNA fragment should be targeted would allow the forensic biologist to begin analysis on skeletal material with the greatest chance of producing results, reducing both the time and resources spent on analysis of aged skeletal remains.

In this study, mtDNA was isolated and amplified from a series of skeletons found in an abandoned cemetery in Pittsburgh, Pennsylvania. The cemetery was utilized by Swiss-German immigrants from 1833 to 1861, after which it was eventually built over and subsequently uncovered during an Interstate expansion project in 1987. Over 700 graves were found, and all remains were analyzed anthropologically. The level of weathering was assessed for whole skeletons, and later for individual bones, to determine if either or both would be beneficial for predicting PCR success and mtDNA quality. Skeletons were graded on a 0 to 5 scale, with 5 being the most weathered, representing bone that crumbled easily. Multiple bone types from skeletons at five out of six stages (1 – 5) were tested genetically. These same sets of bones were regraded on a 1 to 4 scale based on individual bone weathering. Maximum mtDNA amplification size was assessed using primers that produced amplicons of 107 bp, 220 bp 329 bp, and 402 bp.

The analysis of this material allowed researchers to determine statistically what influence skeletal and/or bone weathering conditions have on successful mtDNA analysis, as well as what role the type of bone plays. Variables such as the sex and age of the deceased were also included. By using these types of objective comparisons of bone condition and type, and individual age and sex, the forensic biologist should be able to better predict the likelihood of successfully amplifying mtDNA from weathered bone, and devise strategies for targeting amplicon length. This then, would increase the productivity and efficiency of DNA analysis of skeletal material.

MtDNA, Bone Degradation, Skeletal Remains

B128 Validation of the Roche Linear Array Mitochondrial DNA HVI/HVII Region-Sequence Typing Kit

David R. Fisher, BS, Jason C. Kolowski, MS, Paul Goncharoff, PhD, Mechthild Prinz, PhD, Howard Baum, PhD, and Robert Shaler, PhD, Office of Chief Medical Examiner, 520 First Avenue, New York, NY 10016*

After attending this presentation, attendees will learn that the Roche Linear Array Mitochondrial DNA HVI/HVII Region-Sequence Typing Kit is validated for use as a screening method in forensic casework.

This presentation will impact the forensic community and/or humanity by demonstrating the use of the Roche Linear Array mtDNA sequence typing kit that will decrease casework turnaround time by quickly screening for exclusions, thereby allowing the analyst to focus on more probative samples.

Mitochondrial DNA (mtDNA) typing is a useful tool in the forensic biology laboratory due to the high mtDNA copy number per cell, high degree of polymorphism, and maternal inheritance. MtDNA typing is often successful in yielding profiles in cases where there is an insufficient amount or quality of DNA for nuclear STR DNA testing. While direct DNA sequencing is commonly used to determine mtDNA sequence variation, the Linear Array assay is a more simple and rapid method (e.g. the procedure can be done in about 2 hours versus several days for DNA sequencing) that can be used as a screening technique in mtDNA casework.

This presentation will demonstrate that the Roche Linear Array strips are a specific, sensitive, and robust method for the detection of sequence variation in hypervariable regions I and II (HVI/HVII) of the mtDNA control region. During the course of the validation for the new mtDNA laboratory at the NYC Office of Chief Medical Examiner, several different studies were performed on the Linear Array strips to meet the current SWGDAM guidelines for DNA analysis.

Sensitivity studies revealed that the most favorable banding and intensity patterns were achieved with approximately 75ng of amplified DNA. Mixture studies revealed that minor components could be seen at a 50:1 ratio, indicating that the array is highly sensitive. Non-probative samples from different tissue types, including, hair, muscle, and bone, were also typed with the Linear Array strips and were found to be in agreement with typing results from direct DNA sequencing. Typing of all laboratory staff was also performed to maintain an in-house database to rule out possible contamination concerns. Lastly, decontamination procedures, such as cleansing gloves in bleach, were employed to minimize the number of failed negative controls.

mtDNA, Linear Array, Validation

B129 How Well Can Race be Predicted From mtDNA?

Mark D. Leney, PhD, Joint POW/MIA Accounting Command, Central Identification Laboratory, 310 Worchester, Hickam Air Force Base, HI 96853*

After attending this presentation, attendees will learn a technique to predict likely self-identified race from an unknown mtDNA profile and to attach statistical weight to such an attribution

This presentation will impact the forensic community and/or humanity by allowing explicit calculation of the likely race of an unknown from mtDNA. While not as accurate as nuclear DNA based techniques designed to estimate biological ancestry this will work to provide additional information for a biological profile of a unknown person where nuclear DNA cannot be recovered and could augment nuclear DNA based techniques by flagging the likely race of the mother of an unknown contributor of mixed ancestry.

While mitochondrial DNA (mtDNA) in forensic contexts has generally been used to support or refute identification hypotheses, it also contains information that permits inference of the race of an unknown person contributing the mtDNA profile. The mtDNA population database was compiled to provide the forensic community with frequency estimates for mtDNA hypervariable region (mtDNA HVR) profiles observed in evidence-to-reference matches for a specific population of interest. However, the database can also be used to find the frequencies of matching or closely related mtDNA HVR profiles of unknown origin in several different ethnic/racial sub-samples. As the majority of all profiles in the mtDNA population database are themselves unique within the database, it is no surprise that most evidentiary profiles are also observed zero or one times in the database. While such a low frequency is adequate for establishing the relative rarity of the profile in question, it is not informative of probable racial/ethnic origin of the contributor. Nevertheless, as most individuals are only distinguished by a few polymorphisms in the mtDNA HVR from multiple individuals in the database, the pool of closely related individuals is a much richer source of information for estimation of probable ancestry.

Attendees will learn how a simple likelihood ratio can be constructed from the probability of observing closely related profiles to an unknown evidence profile in a specific racial or ethnic sub-group and the probability of observing equally related profiles in the rest of the database. Attendees will then observe that by calculating such a ratio for each racial or ethnic sub-group of interest for all possible degrees of profile relatedness it is possible to determine the peak likelihood ratio for racial or ethnic sub-group attribution. This peak represents the balance between idiosyncratic polymorphic differences that are a result of recent within-lineage mutations and older polymorphic differences that are a result of shared common ancestry. The height of the peak indicates the statistical weight of the racial or ethnic attribution. The attendees will also be able to review validation studies conducted on profiles drawn at random from the mtDNA population database and from unrelated but known mtDNA HVR profiles.

Neither race nor ethnicity is an absolute biological category but each does contain a biological component. This shared genetic heritage is what allows this technique to work. However, the mtDNA population database is based on self-identified race and ethnicity and thus various other factors act to degrade the power and accuracy of the technique. The main factors are cultural biases in the reporting or recording of single racial or ethnic categories (when many people are actually of mixed ancestry) coupled with the solely matrilineal nature of mtDNA inheritance. These factors will be reviewed and their impact on careful and proper interpretation of results will be discussed.

Additionally the applicability of the technique depends on adequate sampling of the populations in question by the database used. The presentation will briefly cover the diversity in the published database, indicating where the database is adequate and where it falls short, giving examples from casework to indicate potential pitfalls in interpretation when a profile from an underrepresented population is analyzed.

This technique offers a novel method for placing an explicit statistical value on inference of racial or ethnic group from an mtDNA profile. This could provide a useful lead in building a biological profile of an unknown contributor where only mtDNA was recoverable (as is often the case where conventional nuclear DNA testing fails). Furthermore it could be used in conjunction with the recently developed techniques that estimate biological ancestry from nuclear DNA markers; for example in a person of mixed ancestry, the use of this technique could provide a likely estimate of the self-identified race of the unknown contributor's mother. At the Joint POW/MIA Accounting Command it is hoped that the technique will assist case resolution for long-term cold cases by highlighting those fragmentary remains that are likely to be unidentified American casualties and those that are likely to derive from indigenous Asian combatants and civilians from the battlefields of Korea and Vietnam.

Race, Ancestry, Mitochondrial DNA

B130 A Modified Hair Extraction Technique for Mitochondrial DNA Analysis

Jason C. Kolowski, MS, Paul Goncharoff, PhD, Metchild Prinz, PhD, and Robert Shaler, PhD, Department of Forensic Biology, Office of the Chief Medical Examiner, 520 1st Avenue, New York, NY 10016*

After attending this presentation, attendees will learn about a modified technique for the processing of evidentiary hairs for use in mitochondrial DNA testing, including, but not limited to, the documentation, handling, washing, and extraction technique employed by the mitochondrial DNA laboratory at the Office of Chief Medical Examiner in New York City.

This presentation will impact the forensic community and/or humanity by demonstrating the evidentiary value of hair, whether collected from a crime scene, taken from a body at autopsy, or lifted from evidence in the laboratory, cannot be underestimated. An improved way to process hair evidence for mitochondrial DNA testing will be useful in forensic casework.

In the course of implementing a mitochondrial DNA laboratory for the Office of Chief Medical Examiner in New York City, a validation study on hair extraction was performed to ensure the proper handling and processing of evidentiary hairs in forensic casework. One of the goals was to improve the enzymatic digestion technique and to eliminate the high cost and time-consuming process of manually grinding hairs, which is also a possible source of contamination. To ensure the cleanliness of the hair, a technique of cleaning the hair was developed in which the evidentiary hairs were immobilized on a moist membrane following sonication in a detergent. The membrane, being liquid permeable, allowed the hair to be washed with a variety of reagents and dried in open air without risking the loss of the sample. An enzymatic digestion technique was modified and optimized using regular laboratory-grade reagents, resulting in the complete digestion of a standard 2 cm cutting of a hair shaft in under a half-hour, in nearly all of the samples tested. A variety of studies were carried out on the quality of obtaining viable sequence data from previously mounted hairs, as well as a sensitivity study on the necessary length of the hair prior to enzymatic digestions. Several studies on chemically treated/dyed hair were carried out as well. The enzymatic digestion technique was successful in obtaining mitochondrial DNA from all types of hair, regardless of the mountant or fixative, regardless of chemical alteration or dyes, and from as little as 2 mm of hair shaft. A high success rate was observed in obtaining high-quality mitochondrial sequence data from all of the hair extracts (regardless of complete digestion of the hair shaft), initially using Linear Array strips from Roche Applied Science, and confirmed by DNA sequencing and 3100 analysis.

The forensic documentation of the hairs, prior to the processing for extraction, was done on a stereomicroscope from Mideo Systems Inc., allowing for the rapid identification, measurement, and photography of the hair, including the region of interest that would be submitted for the extraction of mitochondrial DNA. Furthermore, the use of dead-air hoods from Labconco and the strict adherence to a conservative decontamination policy in a dedicated pre-amplified room served to reduce the overall effects of contamination and sample loss that are common when dealing with mitochondrial DNA analysis and evidentiary hairs.

Mitochondrial DNA, Hair, Extraction

B131 A Human Mitochondrial DNA Database Derived From Casework at Mitotyping Technologies

Terry Melton, PhD, and Kimberlyn Nelson, PhD, Mitotyping Technologies, 2565 Park Center Boulevard, Suite 200, State College, PA 16801*

After attending this presentation, attendees will know about the diversity and distribution of mitochondrial DNA control region sequences observed in a caseworking forensic mitochondrial DNA laboratory.

This presentation will impact the forensic community and/or humanity by demonstrating Forensic mitochondrial DNA analysis is being applied more broadly and frequently. However, forensic mtDNA practitioners rarely present DNA sequence data that they are gathering, and studies on the mtDNA variation present in North America are few. The data presented here will build the scientific understanding of all practitioners, and enhance the application of this type of DNA testing.

Between January 1999 and June 2004, Mitotyping Technologies collected 854 human mitochondrial DNA sequences for an internal database. Sequences were complete hypervariable region 1 and hypervariable region 2 nucleotide sequences encompassing positions 15998-16400 and 30-407, respectively. A total of at least 783 nucleotides were available for each sequence. Identical sequences within a case (indicating that a match had been obtained between two or more samples within a case) were included only one time in the database. Therefore the samples are assumed to be randomly collected convenience samples derived from both questioned and known samples (blood, bone, hair, saliva, and other tissues) from most of the 50 United States, Canada, and the Caribbean. In most cases, an ethnic/biogeographical identity for the sequence (African/African American, Asian, Caucasian/European, Hispanic, and Native American) could be assigned based on either haplogroup-specific polymorphisms or information submitted with the samples.

The sequences were analyzed for sequence diversity, average number of nucleotide differences, haplogroup identity, and length heteroplasmy. These variables were examined at an overall level, within classically defined mtDNA haplogroups, and by state/geographic region. The results were compared to previously published studies on mitochondrial DNA diversity in the continental U.S. and internationally.

Overall, 72% (N=614) of the sequences could be classified as historically or biogeographically European while 17% (N=146) could be classified as historically or biogeographically African. Asian-, Hispanic-, Native American-type or unclassifiable sequences comprised the remainder of the sample. The electropherograms of unclassifiable sequences were re-examined for ambiguities or errors and were determined to be correct, indicating that the inability to classify these sequences was likely due to back mutations that have erased haplogroup-specific polymorphisms.

Diversity among the Europe-derived sequences was 0.995, with an average number of nucleotide differences of 8.2. Haplogroups H, I, J, K, T, U, V, W, and X were represented in this group, with diversity values ranging from 0.916 (V) to 1.0 (W, X). The average number of nucleotide differences within these European haplogroups ranged from 2.7 (V) to 7.9 (U). Haplogroup H members, the most frequently observed group in all published studies of European populations to date, comprised 38.4% of the European samples, and had a diversity value of 0.973 and an average number of nucleotide differences of 3.5. The "common" H1 haplotype (263A?G, 315.1insC) was observed at frequencies of 3.7% in the database overall and 5.7% within all European-derived sequences.

Among sequences determined to be historically or biogeographically African, diversity was close to 1.0 (0.999), indicating that nearly every sequence was unique in the database. The average number of nucleotide differences among these sequences was 15.1. Haplogroup L1 comprised 28% of the African-origin sequences, haplogroup L2 comprised 20% of these sequences, and haplogroup L3 comprised 36% of these sequences. Individuals from subgroups L1a, L1b, L1c, L2a, L2b, L2c, L2d, L3b, L3d, L3e, and L3f were represented from these three haplogroups. Diversity within the subgroups was uniformly high (above 0.977) with the exception of subgroup L1a (0.917).

Mitochondrial DNA, mtDNA Sequence Database, Criminalistics

B132 The FBI's Regional Mitochondrial DNA Laboratory Program

Alice R. Isenberg, PhD, FBI Laboratory, 2501 Investigation Parkway, Quantico, VA 22135*

Aattending this presentation, the forensic community will be introduced to the four regional mitochondrial DNA laboratories funded by the FBI to which they may submit cases for analysis at no-cost.

This presentation will impact the forensic community and/or humanity by providing a better understanding of the possibilty for increased throughput of mitochondrial DNA casework at no cost through the FBI's four regional mitochondrial DNA laboratories which will be accepting casework in late 2005.

This presentation will familiarize the audience with a new program initiated by the FBI to increase the availability of no-cost mitochondrial DNA analyses to the law enforcement community. The FBI's fiscal year 2003 budget included $4,000,000 to establish and operate four regional mitochondrial DNA (mtDNA) laboratories. The Congressional authorization requires the FBI Laboratory to provide technical management and quality assurance for regional labs and the regional labs to conduct mtDNA analysis for both forensic casework and missing persons. Competitive procurement began in June of 2003 at a briefing with about 35 state and local crime labs attending or requesting materials. Twelve applications were received in mid-July and cooperative agreements were awarded in September 2003 to the Arizona Department of Public Safety Central Crime Laboratory in Phoenix, AZ, the Connecticut Forensic Science Laboratory (Department of Public Safety) in Meriden, CT, the Minnesota Bureau of Criminal Apprehension Forensic Science Laboratory in St. Paul, MN, and the New Jersey State Police Laboratory in Hamilton, NJ. All four regional mtDNA labs are state-wide, full-service crime labs accredited by ASCLD/LAB in biology and trace evidence and have established forensic nuclear DNA and CODIS/NDIS programs. Under the cooperative agreements, the FBI will train and equip regional laboratories and authorize mtDNA cases to be analyzed according to the Quality Assurance Standards and Scientific Working Group on DNA Analysis Methods (SWGDAM) Guidelines for mtDNA Nucleotide Sequence Interpretation Guidelines. The regional laboratories will provide facilities, employees, and supervision to conduct mtDNA casework, with the FBI reimbursing direct expenses, including salaries and benefits for up to nine employees, space renovation required for mtDNA operations, equipment and maintenance, supplies, training, and travel. When the regional labs are operational, cases will be directed to them and they will be responsible for performing analysis, reporting results, and testifying, if necessary. Fully operational regional labs will have the capacity to examine 120 cases per year, and the regional lab will retain 25% of this capacity for internal allocation. The remaining 75% will be allocated by the FBI for the regional lab's service

area. The current status of the program and procedures for submission of cases will be discussed. The regional mitochondrial DNA program will more than double the nation's capacity for no-cost forensic mtDNA casework when fully operational in September 2005.

Mitochondrial DNA, Regional Laboratories, FBI Laboratory

B133 Beyond Laci Peterson: Using DNA Analysis to Identify Missing Persons

John C. Tonkyn, PhD, California Department of Justice/Missing Persons DNA Program, 1001 West Cutting Boulevard, Suite 110, Richmond, CA 94804*

The goal of this presentation is to present to the forensic community the development and implementation of a statewide program designed to utilize DNA analysis to solve cases of missing and unidentified persons. The challenges, both technical and administrative, will be described. The need for a nationally coordinated effort will also be discussed.

This presentation will impact the forensic community and/or humanity by providing an understanding of the methodology of identifying persons using DNA, but an appreciation for the need for wider implementation of similar programs.

The identification of human remains is one of the primary duties of coroners and medical examiners, and is a critical aspect of homicide investigation when the body is not readily identified. In addition to odontology, fingerprints and anthropology, DNA analysis is a highly discriminating tool that is available to identify remains, provided that there is a corresponding reference sample available, either from biologically-related family members or from the missing person themselves (i.e., baby tooth). However, DNA analysis is expensive and body ID is a low priority for most crime labs, so this tool remains vastly underused.

The goal of this presentation is to describe the implementation of a statewide program that is successfully providing investigators with the identity of human remains through a concerted effort involving the state crime lab, the state missing person clearinghouse, coroners, medical examiners and local law enforcement. The California Missing Persons DNA Program was created in 2001 with the express purpose of using DNA databases of both unidentified human remains and reference samples for missing person (either swabs from relatives or items from the missing person) to make identifications. Model collection kits have been devised for the collection of oral swabs from family members of missing persons, and for the collection of human remains. Training, in the form of instructional videos and written publications, has been developed. Outreach has involved the identification of "high risk" missing person cases and unidentified person cases reported to the state clearinghouse, and coordination with coroners and law enforcement investigators for the collection of appropriate samples. Short Tandem Repeat DNA profiles, as well as mitochondrial DNA sequencing data are entered into local databases as well as the new "CODISmp," which has been developed specifically for use with missing and unidentified person DNA profiles. As most analyses involve comparison between remains and a relative of the missing person, kinship analysis is required for comparison of nuclear DNA profiles.

While all states participate in CODIS, the primary categories of samples entered are convicted offender and forensic unknown. Few labs routinely enter profiles from missing or unidentified persons, and fewer still have dedicated resources to this task. It is one of the goals of this presentation to provide a model for other states to consider when implementing a program for the purpose of identifying human remains. Because of the movement of individuals and families between states, a certain percentage of cases either will not be analyzed or compared after analysis. A national program of all states entering both STR and mitochondrial DNA into NDIS is required, similar to the highly successful convicted offender/forensic unknown model.

Several dozen identifications have been made to date. Technical improvements in typing human remains will be discussed. These include the following: 1) Improved methods for DNA extraction, 2) qPCR methods that simultaneously quantify the amount of both nuclear and mitochondrial DNA, and 3) the use of a duplex PCR reaction for the simultaneous amplification of both HV1 and HV2 regions of mitochondrial DNA (thereby conserving sample which contains little DNA to begin with). Finally, several successful cases will be described that highlight the issues and technologies describe above.

Missing Person, Mitochondrial DNA, Unidentified Person

B134 Optimization of Mini Plex Primer Sets for STR Testing of DNA Extracts From Bone Samples 10 – 13 Years Postmortem

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The goal of this presentation is to describe some of the PCR optimizations that have been performed on a number of reduced amplicon primer sets for amplification of DNA from 10 – 13 year postmortem skeletal remains. The work presented here will be useful for anyone performing DNA STR testing of bone sample.

The goal of this presentation is to describe some of the PCR optimizations that have been performed on a number of reduced amplicon primer sets for amplification of DNA from 10 – 13 year postmortem skeletal remains.

The International Commission on Missing persons has developed a DNA led identification system for identification of victims of the conflicts resulting during the breakup of the former Yugoslavia. As a first step in the identification effort bone samples were taken from whole skeletons and tested using a silica-based extraction method and the Promega PowerPlex® 16 system. With the PP16 system results were obtained in approximately 85% of the samples tested. The 15% that were considered failures, during the first phase, had between 0 and 11 loci amplified with most of the failed loci being the longer PCR products.

To better understand why these samples were failing STR analysis extracts were assessed using the Applied Biosystems Quantifiler™ Human DNA quantification system. Most of the samples displayed relatively low amounts of DNA (<10 pg/µl) and/or the presence of PCR inhibitors. The results of both the quantification as well as the allelic drop outs in the longer loci indicate that the DNA in these extracts may be degraded to the point where commercially available STR kits are not effective.

In an attempt to get more STR data out of the DNA extracts, that failed the initial phase of this testing, the possibility of using reduced amplicon primer sets has been investigated. Initially a concordance study was performed to ensure that the alleles amplified by the new primer sets would reflect the same alleles designated by the PP16 system and the Applied Biosystems AMPF/STR® SeFiler™ kits. Reduced amplicon primer sets were also optimized for amplification of DNA isolated from a number of bone samples. The optimizations tested include modifications to the PCR buffer, Mg++, and different *taq* enzymes.

The results of the optimizations will be presented and compared to optimizations of the PP16 and SeFiler kits. Additionally the effectiveness of the mini primer sets for STR testing of DNA extracts from bone samples will be discussed in detail.

STR, DNA, Mini Plex

B135 A Duplex Real-Time qPCR Assay for the Quantification of Human Nuclear and Mitochondrial DNA in Forensic Samples: Implications for Quantifying DNA in Degraded Samples

Mark D. Timken, PhD, Katie Swango, PhD, Cristian Orrego, PhD, and Martin R. Buoncristiani, MPH, California Department of Justice, Jan Bashinski DNA Laboratory, 1001 West Cutting Boulevard, Suite 110, Richmond, CA 94804*

After attending this presentation, attendees will learn the advantages of using a new duplex qPCR protocol for quantifying nuclear and mitochondrial DNA in forensic sample; the implications of using qPCR versus slot blot quantification methods for successfully genotyping degraded DNA.

This presentation will impact the forensic community and/or humanity by providing a new tool for DNA quantification in forensic samples; to describe quantification differences, especially for samples containing degraded DNA that can be expected when moving from slot blot to qPCR quantitation methods.

This report describes selected results from validation of a duplex real-time qPCR assay that has been developed for the quantification of human nuclear and mitochondrial DNA in forensic samples. This assay was designed to be of general utility for forensic DNA quantifications, but to be particularly useful for the post-extraction analysis of samples that contain degraded DNA. Such samples, though not uncommon in standard casework evidence, are often encountered in evidences from mass disasters, mass graves, and missing persons' cases. Presently, the initial decision as to how to proceed with analysis of such samples, either by nuclear STR or mitochondrial typing, is commonly based on a slot blot quantification approach that (1) has been reported to underestimate the quantity of nuclear DNA in degraded samples and in samples that contain high levels of microbial contamination, (2) provides no information about the quality (fragment length) of the quantified nuclear DNA, and (3) provides no direct information about the quantity of human mitochondrial DNA in the sample. Due to these quantification deficiencies, the actual forensic analysis of challenging samples often proceeds first by obtaining inadequate STR typing results, and then by using any remaining extracted DNA in an attempt to obtain mitochondrial typing results, the latter analysis typically attempted without any direct knowledge of the presence (or absence) of human mitochondrial genome in the DNA extract. The efficiency and quality of this analysis procedure can be improved substantially by obtaining reliable estimates of the amounts of human nuclear and mitochondrial DNA in these samples. Based on such estimates, an optimal analytical approach can be selected at the outset, leading directly to optimal genotyping or haplotyping results and to a concomitant savings in time, in labor, in reagent/kit costs and of extracted DNA.

In the duplex nuclear-mitochondrial qPCR assay developed, the authors quantify a nuclear target sequence that spans the repeat region of the primate-specific *TH01* STR locus, a locus that has been used widely for forensic applications. This target sequence is of direct interest for quantification, considering that a primary reason for quantifying human nuclear DNA in forensic samples is to determine the amount of extract to amplify in a commercial multiplex STR PCR kit. For degraded samples, quantification of the relatively long *TH01* target (~170-190bp) leads to improved STR typing results, compared to typing results based on quantification by slot blot hybridization. For the mitochondrial portion of the duplex qPCR assay, the authors quantify a short target (69bp) in the mitochondrial *ND1* gene. This selection provides a sensitive means for determining the presence of human mitochondrial DNA, degraded or not, in forensic samples. Although the presentation will focus mainly on quantification and analysis of samples containing degraded DNA, the authors will also briefly describe other results from validation work, including studies of precision, reproducibility, sensitivity, species specificity, and applications to casework-type samples.

qPCR, Duplex, Degraded DNA

B136 Significance of Detecting Foreign Sources of DNA Under Fingernails

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The goal of this presentation is to provide the forensic community with a better foundation on which to base opinions with respect to DNA fingernail evidence in casework.

This presentation will impact the forensic community and/or humanity by providing the forensic community with data to validate their opinion regarding DNA evidence from fingernail samples in courts of law.

Scientists at the Centre of Forensic Sciences (CFS) routinely examine DNA results from fingernail scrapings and clippings in casework. Fingernails are useful in forensic science as they can often be used to generate a DNA profile from the donor and any additional sources. Foreign DNA beneath the fingernails can arise due to the transfer of skin cells or body fluids as a result of intimate physical contact. While the ability to detect foreign DNA profiles from fingernails has been demonstrated, their evidentiary significance is afforded little attention in the literature.

Fingernail related items are submitted to the CFS for DNA testing in one of two ways: scrapings or clippings. If the debris underneath the fingernails has been scraped with a wooden applicator stick prior to submission to the laboratory, then all of the scraped debris and the end of the stick are subjected to DNA analysis. In cases where clippings have been provided, the undersides of the fingernails are swabbed at the laboratory prior to DNA analysis. Special attention is given to fingernail clippings with blood staining; for these samples the blood, usually originating from the fingernail donor, is swabbed separately from the remainder of the underside of the fingernails. Experience is that this approach aids in the detection of foreign DNA by separating out samples likely to contain very high amounts of the donor's DNA.

A study performed at the CFS, involving staff of the laboratory and students from a local University, was undertaken to determine the prevalence of foreign DNA underneath the fingernails of individuals who share work or household environments. A total of 39 participants provided 78 samples (from the left and right hands) for DNA analysis by scraping under their fingernails with a wooden applicator stick. Of these samples, only 12% yielded a second source of DNA. When these were further categorized into samples where a significant foreign DNA profile was detected (DNA results for at least 4 STR loci) then the number dropped to only 4%. Further investigation determined that the foreign source of DNA could not be attributed to fellow members of the household or work environment, unless intimate physical contact had occurred. These results suggested that casual contact between individuals is not likely to result in the deposition of a second source of DNA beneath the fingernails.

The CFS maintains a database to track DNA results from fingernail related items in casework. Since February 2003 the data from 95 cases have been analyzed (a total of 187 samples). Homicides (67%) and sexual assaults (26%) comprised the majority of cases with fingernail related items. The majority (76%) of samples were submitted as clippings, while 22% were submitted as fingernail scrapings, and 2% contained both clippings and scrapings. Of the samples from fingernail clippings, 34% yielded a foreign source of DNA, while 58% contained only DNA from the fingernail donor, and 8% yielded insufficient or no DNA for analysis. Of the samples of fingernail scrapings, 29% yielded a foreign source of DNA, 40% contained only the fingernail donor's DNA, and 31% yielded insufficient or no DNA for analysis.

The results indicate that the likelihood of detecting a foreign source of DNA on fingernail clippings is greater than in scrapings. This may be a result of the CFS method of sampling any blood separately on clippings to prevent the "swamping out" of a foreign source of DNA with the donor's DNA during PCR. The data also suggest that fingernail samples can yield useful investigative information when the case history warrants their examination. However in casework, fingernail evidence is only examined if the case history suggests an expectation of finding a foreign source of DNA. Therefore one would expect a much higher prevalence of foreign DNA relative to the controlled study.

Additional experimental data regarding both the prevalence and persistence of foreign DNA profiles beneath fingernails under a variety of conditions will be presented. It is expected that this data and research will provide the forensic community with a strong foundation on which to base opinion evidence in courts of law pertaining to the relevance of fingernail findings in casework.

Fingernail Clippings, Fingernail Scrapings, DNA

B137 Development of a Human-Specific Real Time PCR Assay for Simultaneous Quantitation of Total Genomic and Male DNA

Katie M. Horsman, MS, University of Virginia, Department of Chemistry, McCormick Road, Charlottesville, VA 22901; Jeffrey A. Hickey, MS, Margaret A. Terrill, MSFS, and Robin W. Cotton, PhD, Orchid Cellmark, 20271 Goldenrod Lane, Germantown, MD 20876; James P. Landers, PhD, University of Virginia, Departments of Chemistry and Pathology, McCormick Road, Charlottesville, VA 22901; and Lewis O. Maddox, PhD, Orchid Cellmark, 20271 Goldenrod Lane, Germantown, MD 20876*

The goal of this presentation is to describe the development and validation of a duplex real time PCR method for simultaneous determination of total genomic and male DNA concentrations in a forensic sample.

This presentation will impact the forensic community and/or humanity by demonstrating the real-time PCR assay which was developed for simultaneous quantitation of total genomic and male DNA should be utilized in forensic DNA analysis as a replacement to slot-blot quantitation. Increased sensitivity, decreased analysis time, specific quantitation of male and total genomic DNA make the assay superior to the slot-blot assay. In addition, the multiplex assay results in time and cost savings when compared to the ABI Quantifiler kits.

Historically, the slot-blot method has been used to quantitate human DNA in forensic samples. However, the slot blot method is labor intensive, subjective in interpretation, and not highly amenable to automation, which has led to the development of new methods for quantitating human DNA. Current research[1,2] has focused on the use of Real-Time PCR as a more accurate, more sensitive, and less labor intensive method. Real time PCR has the capability of absolute quantitation based upon measurement of the increase in fluorescence signal with each cycle and comparison to a standard curve. A number of detection chemistries are currently available including SYBR® Green detection, fluorogenic probes, and molecular beacon technology. Fluorogenic probe chemistry was utilized in this study, with spectrally distinguishable reporter dyes for each target sequence.

With the growing capabilities for discrimination based upon Y-chromosome STR typing, the need to quantitate the male contribution to a sample is becoming increasingly evident. Commercial kits (Applied Biosystems) for human DNA and Y-chromosome DNA quantitation with real-time quantitative PCR are available in singleplex reactions. However, multiplex PCR has the advantage of consuming half of the DNA as compared to the commercial kit in addition to reducing the cost of the analysis. Therefore, a multiplex real time PCR assay has been developed for simultaneous quantitation of both the total human genomic DNA concentration as well as the male DNA component. Primer/probe sets were designed using the Primer Express® (Applied Biosystems) software. For total human genomic DNA quantitation, the amplicon is a 63bp fragment of the TPOX locus. The Y-chromosome amplicon is a 70bp fragment of the sex-determining region (SRY) of the Y-chromosome. Both primer sequences were determined to be human (or higher-primate) specific with a BLAST search as well as tested experimentally with common DNA sources including yeast, *E Coli*, and mouse.

The lower limit of quantitation was determined to be approximately 10 pg for total genomic DNA and approximately 20 pg for male DNA. The upper limit of the quantitation was set at 50 ng, which is appropriate for typical casework samples. This linear range for the real time PCR quantitation is significantly larger than that of the 125 pg to 10 ng range of the slot-blot assay. In direct comparison to a modified QuantiBlot® (Applied Biosystems) assay followed by BioImage® analysis, the average relative error of the multiplex assay was comparable to the slot-blot assay. The average percent error was 11.6% for total genomic DNA and 12.1% for male DNA, compared to 12.8% for the total genomic DNA quantitation by slot blot. The slot-blot analysis is unable to specifically detect the concentration of male DNA in a mixture. A mixture-challenge study indicated the quantitation of 25 pg male DNA was accurate in mixtures of up to 1:5000 male:female DNA. Additional validation experiments included optimization of Mg^{2+} concentration, comparison of quantitation accuracy to the Quantifiler™ and Quantifiler™ Y kits, and assay reproducibility.

References:
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2. Richard ML, Frappier RH, Newman JC. Developmental Validation of a Real-Time Quantitative PCR Assay for Automated Quantification of Human DNA. J Forensic Sci. 2003; 48(5): 1041-6.

DNA Quantitation, Real-Time PCR, Slot Blot

B138 Application of Real Time qPCR Multiplex Results to Downstream Decision Making in Samples Containing Mixtures of Male and Female DNA

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The goal of this presentation is to describe the results of Real Time PCR quantitation of male/female mixtures and the effect of this data on decision making at the point of PCR amplification for STR loci.

This presentation will impact the forensic community and/or humanity by providing data from a real time qPCR multiplex for simultaneous quantitation of total genomic and male DNA which can be used to improve amplification decisions. This will assist analysts in determining which DNA samples are likely to provide useful information when amplified for autosomal STR and/or YSTR loci.

The availability of real time PCR (qPCR) methods capable of determining total genomic and male DNA in forensic samples has changed and improved the decision making process for STR testing. Other quantitation methods, such as the slot blot, do not provide information regarding the relative amounts of male versus total genomic DNA and are much less sensitive than real time PCR. Knowledge of the male DNA concentration can be used to determine if the sample should be amplified with autosomal and/or Y specific STR loci.

In this study, a real time qPCR multiplex capable of detecting male and total genomic DNA in one reaction was used. This assay utilizes

Taqman® probe chemistry and contains a primer/probe set for the TPOX locus and a primer/probe set for the sex-determining region of the Y chromosome. The information gleaned from validation of this real-time multiplex was used in concert with validation data from ABI Profiler Plus™, COfiler™, and Promega PowerPlex Y® testing systems to make decisions regarding the most effective approach for sample analysis.

Experiments were designed with the purpose of determining if real time results are reliable predictors of both Y STR and autosomal STR amplification results. For this study, several dilution series of male/female mixtures were quantified for total genomic and male DNA using the real time multiplex. After quantitation, all of the samples were amplified using the PowerPlex Y® kit and a subset was amplified using the Profiler Plus kit as well. The PowerPlex Y® amplifications were based on the male specific qPCR results, whereas the Profiler Plus amplifications were based on the total genomic DNA qPCR results. The samples were then analyzed using an ABI Prism 310 Genetic Analyzer.

The results showed that the real time qPCR multiplex used in these experiments provides valuable quantitation data for both total genomic and male DNA in mixed samples. The real time qPCR results for the male/female dilution series confirmed that this assay detects male DNA in a wide variety of male/female DNA mixtures. The lower range of detection is approximately 12.5pg of male DNA in a 1:5000 male:female mixture. For both PowerPlex Y® and Profiler Plus™, the amplifications were successful using the real time qPCR data to calculate the volume to be added to the PCR reactions. When run on the ABI Prism 310, the amplifications resulted in peaks heights within the laboratory's analysis parameters. Additionally, the real time data proved to be a good indicator of the ratio of male to female DNA. The Profiler Plus peak height ratios for the male/female mixtures were reasonably consistent with the male to total DNA ratios calculated from the qPCR data. These results were also similar to the known male/female ratios in the actual dilutions.

From these data and data from the previous validations of Profiler Plus™, COfiler™, and PowerPlex Y®, it is possible to draw important conclusions regarding mixed samples prior to STR amplification. Because this assay can accurately detect male DNA in the presence of overwhelming amounts of female DNA, it is possible to decide how much sample to use for PowerPlex Y® amplifications. In addition, since the assay can reasonably determine the ratio of male to female DNA in a mixed sample, it is possible to reasonably deduce which samples will result in a useful secondary male profile when amplified for Profiler Plus™.

DNA Quantitation, Real-Time PCR, Y STRs

B139 Development of Human and Human Male DNA Quantitation Systems Using a Novel, Fluorescent, Two-Primer Real-Time PCR Method

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The goal of this presentation is to present information on a new approach to DNA quantitation.

This presentation will impact the forensic community and/or humanity by demonstrating a new commercial alternative for real-time PCR.

Heavily multiplexed Short Tandem Repeat (STR) analysis has become the dominant technology in DNA-based human identification. Although highly informative, these assays require a defined range of template quantity to produce optimal results. Additionally, resources can be conserved with accurate assessment of DNA quality and assessment of minimum quantity.

Currently, many practitioners observe either high levels of false negative results (due to lack of sensitivity) or subjective conclusions (due to visual comparison of band intensities) based on common hybridization-based methodologies. Amplification-based methods for quantitation provide a high level of sensitivity while real-time methods can deliver a dynamic range that often exceeds end point assays. A numerical output also increases the objectivity of the data interpretation.

A real-time PCR method has been developed for the quantitation of total human and human male DNA in purified samples using the specificity of interaction between two modified nucleotides to achieve quantitative PCR analysis. One of the PCR primers includes a modified nucleotide (iso-dC) adjacent to a fluorescent label on the 5′ end. The second PCR primer is unlabeled. The reaction mix includes deoxynucleotides and iso-dGTP, which has been modified to include dabcyl quencher. The only nucleotide incorporated at the position complimentary to iso-dCTP is dabcyl iso-dGTP. The incorporation of the dabcyl iso-dGTP adjacent to the fluorescent dye results in a reduction in signal that allows quantitation during amplification. Associated analysis software has been developed to visualize amplification data from various instrument platforms, plot standard curves and calculate DNA concentrations of unknowns. Relative to other real-time approaches, this methodology provides specificity through the use of fluorescently-labeled primers compared to DNA binding dyes and simplicity compared to probe-based quantitative PCR approaches. Data will be presented demonstrating the performance of assays using human autosomal (total human) and human Y-chromosome (male human) targets for quantitation.

Forensic Science, DNA Quantitation, Real-Time PCR

B140 Utility of Quantifiler™ Y in Resolving Difficult Forensic Cases

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The goal of this presentation is to demonstrate to the forensic community the usefulness of Quantifiler™ Y in forensic casework.

This presentation will impact the forensic community and/or humanity by demonstrating the usefulness of Quantifiler™ Y in forensic casework.

Quantitation of human male DNA and obtaining interpretable male profile are major obstacles during the analysis of a mixture sample containing male and female DNA. Availability of Quantifiler™ Y for quantitation of human male DNA and Y-STR multiplex systems for amplification of short tandem repeat loci on the Y-chromosome (Y-STRs) enables one to overcome these obstacles. It is possible to quantitate male DNA and obtain an exclusive profile of male DNA in a sample containing mixtures of male and female DNA using Quantifiler™ Y and Y-STR multiplex systems, respectively. Scientific Working Group on DNA Analysis Methods (SWGDAM) has identified a set of eleven loci namely DYS19, DYS385a/b, DYS389I, DYS389II, DYS390, DYS391, DYS392, DYS393, DYS438, and DYS439 for forensic analysis.

Quantifiler™ Y human male DNA quantitation kit was validated for forensic DNA analysis using the 7500 Sequence Detection System. Analysis for Y-STRs was performed using the Y-PLEX™ 12 system. A combination of Quantifiler™ Y and Y-PLEX™ 12 was used to obtain male profiles in the analysis of 10 forensic cases. Sensitivity of the Quantifiler™ Y on the 7500 Sequence Detection System in the laboratory was 44.5 pg of human male DNA. Quantitation of male DNA by Quantifiler™ Y is based on real time PCR and hence provides scalable information about the quantifiable human male DNA. This approach enables one to obtain male profile from evidence samples. Of the 15 cases investigated, 4 evidence samples provided complete profiles, 2 evidence samples provided partial profiles, and 4 evidence samples provided inconclusive results. Data and strategies used for amplification of evidence samples from these difficult forensic cases will be presented.

Quantifiler™ Y, Y-PLEX 12, Forensic Casework

B141 We're Not Gonna Take It! Girls Fight Back Against Attackers (Case Studies)

Noelle J. Umback, PhD, Louis M. Serico, BS, Ana T. Fernandez, BS, and Mary Quigg, BS, New York City Office of Chief Medical Examiner, Department of Forensic Biology, 520 First Avenue, New York, NY 10016*

The goal of this presentation is to present several interesting case studies where in each case, DNA from the assailant was obtained after the victim fought back. To date, CODIS has solved two of these cases.

This presentation will impact the forensic community and/or humanity by demonstrating that semen on body swabs need not be the only target for DNA analysis in rape cases. Women who defend themselves during an attack help forensic laboratories by giving them more chances to obtain male profiles from the available evidence.

Several recent male-on-female assault cases received for DNA analysis by the New York City OCME Forensic Biology Department have generated CODIS-eligible profiles. Three are from blood, one is from skin cells, and one is from semen. These were all "stranger" rape or attempted rape cases, in different NYC boroughs.

The first case of the "pattern" was a home-invasion in which a stranger entered the bedroom of a middle-aged woman during the night, and chased her around her room several minutes in her nightgown. The sexual assault kit was negative, as expected because the attacker never got the chance to complete the rape. She managed to hit him over the head with a chair, drawing blood. Stains on the chest area of her nightgown matched a crime-scene sample collected from the bedroom. The blood proved to be male and was uploaded into CODIS. To date, no hits have surfaced.

Another home invader got more than he bargained for when his rape victim managed to get a knife and stab him. No sexual assault kit was collected. There was one semen stain on a washcloth, which yielded no DNA. There were bloodstains on several items from in and around the home, most of which matched the victim. However, drops of blood collected from a nearby sidewalk gave a clean male profile, which was uploaded into CODIS. It hit a convicted offender immediately, making Special Victims Unit detectives very happy, as this crime was one of a string (although the first with DNA evidence) of violent attacks. The suspect was apprehended within 24 hours.

A teenage girl was grabbed from behind in the elevator of her own building by a man who told her he had a gun, and pulled her pants down. The attack was recorded by a security camera but the picture was too blurry to be of much assistance in identifying the man. During the struggle in which she was injured as well, she managed to pull the much-larger perpetrator down the stairs with her, knocking off his eyeglasses; and eventually escape into her apartment. Male DNA from the eyeglasses, as well as bloodstains in the case, gave a full CODIS profile; to date this case is unsolved.

A woman walking home late on a winter night was grabbed from behind and dragged into a nearby park by a man with a gun. Following completion of the forced sexual activity, the victim kicked him in the groin and sprayed him with pepper spray. Detectives collected a semen sample from the scene which yielded a full CODIS profile. This case has not yet been solved.

Last but not least, a woman fended off a rapist in Central Park by twisting the attacker's penis in her hand when he put it near her face. Meanwhile her dog bit him hard enough to draw blood, which left a stain on her clothing. The male DNA from this bloodstain hit a convicted offender sample in CODIS in the next search after its upload. At the time he was free on parole.

Self-Defense, CODIS, Sexual Assault

B142 Developmental Validation of a New 17-Y-STR Multiplex System: The AmpF*l*STR® Yfiler™ PCR Amplification Kit

Lori K. Hennessy, PhD, Julio J. Mulero, PhD, Chien-Wei Chang, PhD, Robert L. Green, BS, Yixin Li, PhD, Rixun Fang, PhD, Lisa Calandro, MPH, and Cherisse Boland, BS, Applied Biosystems, 850 Lincoln Centre Drive, Foster City, CA 94404*

After attending this presentation, attendees will learn about the validation of a new Y-STR muliplex PCR assay.

This presentation will impact the forensic community and/or humanity by providing a new tool available for DNA testing of the Y chromosome.

The goal of this presentation is to summarize the results of the developmental validations studies for the AmpF*l*STR® Yfiler™ PCR Amplification Kit. This kit was developed in accordance with the guidelines of the forensic community, as defined by SWGDAM and the DNA Advisory Board's (DAB) Quality Assurance Standards.

Analysis of DNA sequence variation on the Y chromosome has become an increasingly important method in forensic casework, especially in sexual assault samples where there is a relatively small amount of male DNA and a large amount of female DNA. A multiplex PCR amplification system targeting Y-specific loci can simplify interpretation of complex male/female mixtures and yield a high degree of confidence that only the male contributor(s) is being analyzed.

The authors have developed and validated a 17-locus Y-STR multiplex system that has a higher discriminatory capacity than the European minimal haplotype. The Y-STR multiplex includes all the loci in the "European minimal haplotypes;" DYS19, DYS385, DYS389I, DYS389II, DYS390, DYS391, DYS392, DYS393, the SWGDAM recommended Y-STR loci; DYS438, DYS439, and six highly polymorphic loci; DYS437, DYS448, DYS456, DYS458, DYS635 (Y GATA C4), and Y GATA H4. By incorporating the automated 5-dye DNA fragment analysis technology and non-nucleotide linkers small amplicon sizes (100bp-326bp) can be maintained and ensure no overlap between allele ranges. 6-FAM™ labeled primers detects DYS456, DYS389I/II, and DYS390. VIC® labeled primers detects DYS458, DYS19, and DYS385 a/b. NED™ labeled primers detect DYS393, DYS391, DYS439, DYS635, (Y GATA C4), and DYS392. PET® labeled primers detect Y GATA H4, DYS437, DYS438, and DYS448. The fifth dye, LIZ® is used to label the GeneScan-500 Size Standard. All loci are co-amplified simultaneously in a single tube and analyzed in a single capillary injection. The Yfiler™ kit includes an extensive allelic ladder containing the most common 137 variants observed at each locus.

To test the sensitivity of the multiplex male DNA was serially diluted from 4 ng to 31 pg. Complete male profiles above a 50-rfu threshold were reproducibly obtained at 125 pg. Partial to complete profiles could also be obtained at 62.5 and 31 pg. Testing a panel of domestic and farm animals, bacterial species, and female DNA, the kit demonstrated primate and male specificity. No cross reactivity was seen with the various animal or bacterial species and no reproducible peaks above 50-rfu were detected in the presence of 500 ng of female DNA. Complete male profiles were reproducibly obtained at 1000:1 female to male mixtures and the minor contributor was reproducibly distinguishable in male-to-male mixture ratios of up to 10:1. Haplotype concordance was 100% when tested with the NIST standard SRM#2395 and 600 population samples. A database for this new 17 Y-STR multiplex has been created for determining haplotype frequency using population samples from North American, European and Asian population groups. The data are accessible via the internet for haplotype searches.

Results demonstrate that the AmpF*l*STR® Yfiler™ PCR Amplification Kit is a sensitive, valid, and robust multiplex system for Y chromosome STR analysis. The system can be used in conjunction with Applied Biosystems Thermal Cyclers, and ABI PRISM® Genetic Analyzers, and provides the forensic scientist with a complete set of tools for Y chromosome analysis.

Multiplex PCR, Y Chromosome, STR

B143 Development of a Haplotype Database for the AmpF*l*STR® Yfiler™ PCR Amplification Kit

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Attendees will receive an overview of the development of a haplotype population database for the AmpF*l*STR® Yfiler™ PCR Ampliification Kit and the web-based tool for searching the haplotype database.

This presentation will impact the forensic community and/or humanity by informing the forensic community of a new tool for the analysis of haplotypes obtained using the Yfiler™ PCR Amplification Kit.

This presentation will discuss the development of a haplotype population database for the AmpF*l*STR® Yfiler™ PCR Amplification kit. Attendees of the presentation will be provided with an overview of a web-based tool for searching the haplotype database. Statistical analyses of the population database and the detection of microvariants will be discussed.

Analysis of sexual assault evidence using currently available autosomal amplification and typing systems is complicated by the inability to obtain male DNA profiles in the context of high quantities of female DNA.

As a result, sexual assault evidence containing low numbers of spermatozoa or semen from azoospermic or vasectomized males may not be analyzed and, if analyzed, often does not yield male DNA profiles. Analysis of male-specific DNA markers can provide evidence profiles that may have probative or exculpatory value in such cases. Y STR analysis has proven to be a valuable tool for recovering information from evidence samples containing marginal amounts of male DNA. Due to the genetically linked structure of Y STR haplotypes, estimation of population frequencies for a particular haplotype requires analysis of population database samples using the complete set of markers used to analyze the forensic evidence sample. The AmpF*l*STR® Yfiler™ PCR Amplification kit may also be utilized for paternity analysis in situations involving male offspring, providing an additional tool for discrimination that will complement autosomal STR analysis.

The AmpF*l*STR® Yfiler™ PCR Amplification kit features 17 male-specific DNA markers located on the Y chromosome. A small range of amplicon sizes, from 100-326 base pairs, has been achieved by labeling the amplified products with four fluorescent dyes, including 6-FAM™, VIC®, NED™, and PET®. The selected markers include the European minimal haplotype consisting of DYS19, DYS389I/II, DYS390, DYS391, DY6S392, DYS393 and DYS385a/b, the additional SWGDAM recommended loci, DYS438 and DYS439, as well as six additional loci, DYS437, DYS448, DYS456, DYS458, DYS635 (Y GATA C4), and Y GATA H4. The added loci significantly increase the discrimination potential of the Y haplotype. A haplotype database was developed in order to provide a useful tool for estimating Y haplotype frequencies in a variety of ethnic groups.

Population samples from North American, European and Asian population groups were analyzed by various test site laboratories and compiled on the basis of ethnic group. The data are accessible via the Internet for haplotype searches. Features of the search tool include the ability to input evidence profiles both singly and in batches via automatic upload from Genotyper® software files. The tool is also compatible with data generated using GeneMapper® *ID* v3.2 software. A manual input mode allows entry of microvariant data resulting in the capability for all profiles to be searched and reported. Search outputs provide estimated frequencies for individual ethnic groups as well as for all population samples. Any haplotype matches to the forensic unknown will also be shown. As is the case for mitochondrial DNA, haplotype frequencies are estimated by counting the number of times the haplotype is seen in various populations. Therefore it is desirable to increase the size of the haplotype database where possible. Periodic updates to the database will reflect the ongoing analysis of additional population samples.

Y STRs, Haplotype, Database

B144 The Amelogenin Sex Test: The Missing Y?

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The goal of this presentation is to present the forensic community rare and interesting failures in the amelogenin sex test and to recommend alternative Y-locus (i.e., SRY) marker be routinely included in any sex test to avoid mistyping and for gender confirmation. In addition, more p-arm Y-STRs should be included in Y-STRs multiplex design to accommodate potentialy q-arm Y-chromosome deleted males.

The amelogenin sex test is well established as the marker of choice for sex determination in forensic DNA typing work. This sex test is included in commercially available DNA typing kits. This presentation will impact the forensic community and/or humanity by highlighting two interesting cases that demonstrate the failure of the amelogenin sex test. Alternative Y-locus (i.e., SRY) marker should be routinely included in any sex test to avoid mistyping and for gender confirmation. In addition, more p-arm Y-STRs should be included in Y-STRs multiplex design to accommodate potentialy q-arm Y-chromosome deleted males.

The oral presentation will highlight two interesting cases that demonstrate the failure of the amelogenin sex test:

Case I: a male convicted offender was typed as "asexual" by AmpF*l*STR® Identiflier™ DNA typing kit.

Case II: a paternity test involving a family of 4 persons, where one of the 2 brothers showed a female genotype by AmpF*l*STR® Profiler Plus™.

In both cases, the cause of gender mis-identification using the commercial available amelogenin sex test found in the DNA typing kit was resolved using alternative amelogenin primers, sex determining region on the Y chromosome (*SRY)* primers, and Reliagene Y-Plex™ 12.

In the first case, during routine DNA Database typing analysis, an amelogenin null male was encountered. Both amelogenin specific X and Y alleles was missing from his DNA profile, obtained using the AmpF*l*STR® Identiflier™ DNA typing kit. Alternative amelogenin primers, which amplifies the X allele at 212 bp, and Y allele at 218 bp was used to verify the gender. Amplification using the alternative amelogenin primers, showed the presence of only the X allele. This indicates a point mutation at the primer binding position at the amelogenin X allele, which account for the failure in typing for the amelogenin X allele using the Identifiler™ DNA typing kit. However, the amelogenin Y allele still remain missing. The SRY gene amplification gave a positive result, which is the correct sex test result. Using the Reliagene Y-Plex™ 12 DNA typing kit, a complete Y-halpotype DNA profile was obtained. Results therefore, suggest that a deletion of the amelogenin gene must have occurred along the Y chromosome. In addition, a point mutation of the primer-binding site of the X allele used in the Identifiler™ DNA typing kit caused the total failure of the amelognin sex test, resulting in a null allele profile for the amelogenin locus.

In the second case, a family of four, which includes the tested parents and their two sons, were genotyped using the AmpF*l*STR® Profiler Plus™ DNA typing kit and their biological parentage relationship was established. Gender determination using the amelogenin sex test available in the DNA typing kit was correct for all, except for the older son, whose Y allele was missing from his DNA profile. Alternative amelogenin primers fail to amplify the Y specific allele as well. However, with *SRY* typing, the older brother was correct for his gender. Reliagene Y-Plex™ 12 was then used to determine the Y-STRs profiles of the biological father and his two sons. The Y-STRs haplotype of the biological father and his younger son was found to be both complete and consistent with one another. For the older

son, only the Y-chromosomal STR marker DYS393 and the X allele of the amelogenin locus were typed. The DYS393 allele was found to be consistent with that of his father and younger brother. The results, therefore indicate that a deletion polymorphism possibly, spanning a major part of the Y-chromosome from Yp11.31 on the short arm up to Yq11.221 on the long arm has occurred. This deletion event, would explain his missing Y allele from the amelogenin maker using the Profiler Plus™ DNA typing kit. In addition, the inclusion of more Y-STRs on the p-arm of the Y chromosome for e.g. DYS453, DYS446 and DYS456 in Y-STRs multiplex design should be considered. In this way, Y chromosome with deleted q-arm can still allow discriminating Y-STRs information to be obtained.

Amelogenin, Gender Identification, Y-STRs

B145 Genotyping of Nuclear Loci From Telogenic Hair Shafts Using mini-STRs

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After attending this presentation, attendees will learn an approach to increasing the successful typing of nuclear DNA from telogenic hair samples using miniSTRs for both CODIS and non-CODIS markers will be described.

This presentation will impact the forensic community and/or humanity by demonstrating how the successful typing of even a small number of nuclear loci from shed hairs can greatly increase the forensic discrimination of the sample compared to mtDNA testing alone, where a significant number of common types are present in the population.

Forensic DNA analysts often perform short tandem repeat (STR) typing on highly degraded biological material and then turn to mitochondrial DNA (mtDNA) testing, which is less variable but more likely to obtain a result due to higher copy numbers in cells, if many or all of the STRs fail. MtDNA typing of hair shafts is a particularly important application as shed hairs are commonly found as sources of evidence. Currently, forensic hair comparisons of evidentiary and reference specimens are based upon a set of morphological characteristics. These analyses tend to be subjective, relying on the experience and judgment of the examiner.[1]

A number of studies have demonstrated that successful analysis of degraded DNA specimens from mass disasters or forensic evidence improves with smaller sized polymerase chain reaction (PCR) products.[2] By moving PCR primers closer to the STR repeat region, it is possible to obtain fully concordant results to the commercial kits while improving successful analysis of degraded DNA with smaller PCR products or miniSTRs[2]. However, many of the CODIS core loci have large allele ranges (e.g., D21S11 and FGA) that make it impossible to create small PCR products. The authors are also going beyond the CODIS core loci and examining a battery of new potential STR loci that can be made less than 100 bp in size and would therefore be helpful in testing highly degraded DNA samples.[3]

Methods and Materials: Hairs were digested using either a standard micro-tissue grinding protocol or a complete digestion protocol.[4] DNA template was purified with phenol/chloroform/water followed by microcon concentration or via binding/elution using a Qiagen column. PCR reactions using STR miniplex markers of CODIS markers (TH01, FGA, D18S51, D16S539) along with the D2S1338 marker and Amelogenin were evaluated. An additional miniplex containing non-CODIS markers (D10S1248, D14S1434, and D22S1045) was also evaluated.

Summary of Results: A set of two miniSTR multiplexes containing CODIS and non-CODIS markers have been evaluated for their ability to genotype degraded DNA. A number of the miniSTR markers were used to successfully type nuclear DNA from hairs belonging to multiple individuals.

Conclusions: The selection of STR loci that have a narrow allele range (e.g., less than 50 bp) and can be made smaller than 100 bp works well with degraded DNA samples. The successful typing of even a small number of nuclear loci from shed hairs can greatly increase the forensic discrimination of the sample compared to mtDNA testing alone, where a significant number of common types are present in the population.

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Short Tandem Repeat DNA Typing, Degraded DNA, Reduced Size PCR Products

B146 Optimized Extraction of Nuclear DNA From Hair Shafts: Part 2

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After attending this presentation, attendees will learn a method to extract nuclear DNA from hair shafts (without roots) on both head and pubic hairs

Traditionally, it is known that nuclear DNA from hair shafts is minimal to non-existent in the absence of a root or adhering epithelial cells. This method proves that nuclear DNA can be obtained from hair shafts. This method can be implemented in forensic DNA labs equipped mainly for STR DNA testing. It can also be used in labs also online for forensic mtDNA testing to use in conjunction with the STR profile to increase the statistics on the profile obtained whether it be for use in criminal cases or for missing persons. The profile or profiles can then be uploaded to CODIS.

This research initially began as work to test hair samples recovered from the World Trade Center Disaster and the hair samples received as references provided by the families as well as direct reference hair samples from the victims. The experiments during Part 1 explored decontamination methods, application of various enzymes for digestion, enzyme concentrations, different volumes of incubation buffer, amplification strategies, and varied run parameters on the ABI Prism 3100 Genetic Analyzer. Part 2 focuses on comparing two modified extraction protocols using Promega's DNA IQ versus a direct lysis extraction.

Head and pubic hairs were collected. The hairs were cut to ensure that no roots were present. If the hairs were not cut, they were examined macroscopically and microscopically to ensure that no roots were present. The hairs were washed using 5% Terg-a-zyme, 0.9% NaCl solution, and 100% ethyl alcohol and air dried overnight. The dried head hair was milled into a powder using the Spex Certi-Prep Freezer Mill and measured out in 20mg amounts. The pubic hairs were washed in the same way and each cut to 2.5 cm in length. The pubic hairs were pooled together to 12.5 cm and 25 cm lengths. The hairs were then incubated in 1.8 mg/ml Proteinase K, 0.25M DTT, 0.5% SDS, and DNA IQ incubation buffer containing 10mM Tris (pH 8.0), 100mM NaCl, and 50mM EDTA overnight at 56°C. The volume of incubation buffer varied depending on the type of hair sample-milled hair or pubic hair strands. For the milled head hair, the supernatant was taken and divided evenly between the optimized DNA IQ and direct lysis

extraction. For DNA IQ, the recommended amount of Resin was used followed by a Microcon 100 cleanup. For the direct lysis extraction, the extract was purified through either a Bio-Rad Micro Bio-Spin Chromatography or a Centri-Sep column followed by a Microcon 100 clean-up.

The amount of DNA was quantified using a real-time PCR *Alu*-based assay (Nicklas and Buel). Attempts at quantifying the amount of nuclear DNA were initially done using the slot-blot method (Quantiblot). As expected, no DNA was detected since the sensitivity of Quantiblot is insufficient to less than 150 picograms. The use of the real-time technology is advantageous for quantifying the low level amount of nuclear DNA in the hair shaft extraction, to detect if melanin is inhibiting amplification, to check the "success" of the positive and negative controls, and also to predict the success of STR amplification.

Results from head hair and pubic hair are compared as well as the differences in the amount of DNA recovered from blond, brown, and black colored hairs. Initial results for 20 mg of milled head hair show that naturally blond hair yields a stronger signal in real-time PCR than brown or black colored hairs for both extraction methods. This further proves that melanin can act as a PCR inhibitor. Comparing the two extraction methods, the optimized DNA IQ protocol is generally more successful at "capturing" about three times more the amount of DNA than by using the direct lysis method. Initial STR data based on Promega's PowerPlex® 16 show the expected amount of DNA degradation with drop out of the larger loci.

Future work will discuss the results of the testing on pubic hair strands, additional STR results using PowerPlex®16, and the viability of the extract and success for mtDNA sequencing.

Hair Shafts, Extraction, Nuclear DNA

B147 Evaluation and Quantification of Nuclear DNA From Human Telogen Hair

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After attending this presentation, attendees will be familiar with the procedures utilized in the extraction, quantification and amplification of nuclear DNA from single telogen hairs.

This presentation will impact the forensic community and/or humanity by providing information on the practicality of extracting and amplifying nuclear DNA from human telogen hair.

This paper presents data on the extraction and quantification of nuclear DNA from naturally shed hairs such as those that would be present at crime scenes. Additional goals of this project are: to determine the significance of exogenous DNA on hair; to evaluate method for the removal of exogenous DNA from the hair; and to evaluate the state of degradation of the DNA using real time PCR. The quantified DNA was amplified using small amplicon STR kits (Miniplexes) and a commercial STR typing kit.

Many experiments have been published on the extraction and amplification of DNA from hair. While some success has been reported for amplification of DNA from hair, accurate quantification of the extracted DNA has been a problem. Before the use of real time PCR for quantification, DNA analysts have relied on methods which lack the sensitivity required to detect the minute amounts of DNA found in hair. Therefore, information on the actual amount of nuclear DNA that can be recovered from hair is scarce. The use of real time PCR for quantification allows for detection of DNA in the picogram range, and this method is suitable for a study of the amount of DNA that can be recovered from telogen hairs. In order to ensure that the DNA quantified comes from within the hair, methods that can remove exogenous DNA must be utilized. The use of differential extraction is a method that allows removal of epithelial cells from the surface of hair, and also allows for the evaluation of the impact of exogenous DNA through quantification of the recovered DNA and evaluation of contamination by amplification of the exogenous DNA.

Direct evaluation of the state of degradation of DNA can normally be accomplished through agarose gel separation and ethidium bromide staining. However, this method required microgram amounts of DNA. When only picogram or nanogram amounts are recovered, real time PCR can be used to determine the number of small and large fragments through amplification with different primers. Comparison of the amounts of large and small fragments will indicate if degradation is present in the sample.

When DNA recovered from hair is degraded, success of amplification of the DNA using multiplex kits with large amplicons can be limited. Instead, Miniplex kits specifically designed for use with degraded DNA can be used as an alternative for such samples.

In this project, DNA was extracted from telogen hairs (3 cm in length) from numerous volunteers. Eight to nine hairs from each individual were extracted using a published protocol consisting of a calcium based extraction buffer system with DTT, phenol chloroform separation, and Microcon® YM-30 filtration. The extracted DNA was quantified by real time PCR using the Corbett Rotor-Gene 3000, a 124 base pair *Alu* amplicon, and SYBR Green I dye. In order to evaluate the amount of exogenous DNA contamination, a differential extraction buffer without DTT was used to remove epithelial cell DNA, and the DNA removed was extracted, quantified, and amplified with the Miniplex kits. Samples with the highest concentrations were concentrated further using Microcon® filters. The concentrated extracts were quantified with two different sized *Alu* primers (124 and 280 base pairs) and the quantification results were compared to determine the state of degradation of the extracted DNA. The concentrated extracts were then amplified with the Miniplex kits, and the results of the quantification were compared to the profiles to determine the effect of the degradation on genotyping.

The amount of DNA recovered from hair using this method varies greatly, with a range of 1-90 pg/□L. The amount of exogenous DNA present in hair also varies, and the exogenous DNA appears to have little contamination from outside sources. DNA recovered from hair does show degradation upon evaluation by real time PCR, but the DNA can be successfully amplified using reduced size STRs.

Nuclear DNA, Telogen Hair, Real Time PCR Quantification

B148 Applications of Visible and Near Infrared Chemical Imaging to the Analysis of Forensic Evidence

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Attendees will gain an understanding of chemical imaging and the general application of this new technology in the field of forensic science.

With technology continuously evolving, it is important to explore new developments that may prove to be superior to techniques currently in use in forensic laboratories. This presentation will impact the forensic community and/or humanity by demonstrating how chemical imaging offers a higher discriminating power and greater sensitivity compared to conventional digital imaging.

This oral presentation will describe the theory of chemical imaging and demonstrate how this emerging technology has enormous potential in the forensic analysis of materials when compared to traditional digital imaging techniques.

Chemical imaging combines molecular spectroscopy and digital imaging, providing both spatial and spectral information of materials. Light intensity is detected as a function of wavelength as in spectroscopy, and is also detected as a function of location as in conventional imaging to form a data set. The three-dimensional data set has a fully resolved image at each individual wavelength and a full spectrum at each individual pixel. Valuable information can then be extracted from the large data sets through the utilization of specialized software designed for chemometric and image analysis. Common processing tools include zero offset, normalization and principal components analysis.

This promising technology has a wide variety of applications in many scientific and industrial fields, one of which is in forensic science. Chemical imaging offers many advantages for forensic science applications. Over a short analysis time, information on morphology, composition, structure and concentration can be obtained and displayed side-by-side. It is also a non-destructive technique that utilizes well-accepted microscopy and spectroscopy methods, with little or no sample preparation required.

The liquid crystal tunable filter (LCTF), the basis of the chemical imaging instruments considered here, is extremely advantageous as it replaces the often numerous detection filters needed. The LCTF is able to perform analysis with less than 1 nm increments, which greatly increases the sensitivity capabilities of the analysis. The VIS/NIR ChemImage 'Condor' Macroscopic Chemical Imaging system, as used in this research, consists of an electro-optical tunable filter system with a charged couple device (CCD) camera on a macroscopic platform. The total spectral range of the VIS/NIR Condor is from 400 nm to 1100 nm.

This research project is focused on establishing the potential for the use of the VIS/NIR Condor for forensic evidence analysis with special focus on the analysis of inks on questioned documents. Over 110 pens have been sampled (specifically blue and black ballpoint and roller-ball pens). Chemical imaging analysis using the VIS/NIR Condor was conducted on inks deposited on white paper. Resulting data sets were then processed using the software to distinguish between the different inks. Traditional optical techniques currently in use for ink analysis were used to obtain comparison data.

Other avenues of research include firearm propellant analysis, latent fingerprint detection, and textile fiber comparison. Unfired and fired firearm propellant was examined using the VIS/NIR Condor with the objective of determining if fluorescence can be used for the detection and identification of propellant grains. Latent fingerprints on porous and non-porous surfaces were examined before and after common reagent treatment to establish if additional ridge detail could be detected using the chemical imaging system. Red and black textile fibers were examined in transmittance, reflectance and fluorescence mode to ascertain if Chemical Imaging produced superior discriminating powers compared to traditional techniques.

All evidence types examined produced extremely promising results. The chemical imaging technology was able to distinguish a greater number of inks and fibers. Propellant grains on a target could be traced to the brand that was used in the shooting. The VIS/NIR Condor proved to be an advantage when examining latent fingerprints, especially weak marks or marks on surfaces that produce highly luminescent backgrounds. Untreated latent fingermark ridge detail could also be detected in some cases.

This is an ongoing research project that will be expanded to include a range of evidence categories to fully validate the technology. Initial results show that chemical imaging has great potential in the analysis of forensic evidence including questioned documents, firearm propellants, fingerprint detection and textile fibers.

Chemical Imaging, Ink Analysis, Trace Evidence

B149 Combinatorial Optimization of the Extraction of Dyes From Textile Fibers

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The goal of this presentation is to report the development of automated procedures for the extraction of dyes from textile fibers and analysis of dye extracts by spectroscopic methods for possible adaptation to forensic casework.

This presentation will impact the forensic community and/or humanity by demonstrating how optimization of extraction conditions can provide the analyst with the maximum amount of dye, possibly providing additional discrimination between forensic fiber evidence.

This presentation will report the use of a Beckman-Coulter BioMek® 2000 laboratory automation workstation to systematically investigate a combinatorial approach to the development of micro-scale extraction techniques for a broad range of dye classes from a range of textile fiber types. The laboratory workstation was programmed to extract dyes from small fiber samples. The resulting extracts were used to quantitatively determine the extraction efficiencies of different extraction solvents. Details of the programming and extraction technology will be presented along with experimental results, conclusions, and potential impact on forensic science.

Use of an automated workstation to extract dyes from fibers presents several advantages. Both speed of analyses and sample throughput are drastically increased versus manual extraction. In addition, the automated workstation gives the ability to program combinatorial experiments for the determination of the solvent mixtures that will provide the most efficient extraction conditions possible for a given fiber-dye interaction. Extraction efficiencies were quantitatively determined via designed combinatorial experiments and generation of surface response models.

Knowledge of the chemistry of fibers and fiber dyes is important to developing extraction techniques. Depending on the chemistries of the dye-fiber interaction, dyes may be loosely associated with fibers (e.g., direct dyes), bound by salt linkages (e.g., acid dyes), covalently bound to the fiber (e.g., reactive dyes), or simply dispersed as finely divided pigments in the fiber (e.g., disperse dyes). Dyes may also be applied during melt spinning of thermoplastic fibers (e.g., pigment coloration of nylon, polyolefins and polyester) or adhered to the fiber surface with adhesives (e.g., pigment dyeing of bedding and apparel fabrics).

The following fiber/dye combinations have been successfully extracted using automated extraction techniques: acid dyes on nylon, basic dyes on acrylic, direct, vat, or reactive dyes on cotton, and disperse dyes on polyester. Acid dyes usually contain sulfonic or carboxylic acid groups that form salt linkages to the nylon. Basic dyes on acrylics, also called cationic dyes, contain basic groups that form salt linkages to the acrylic. Cotton is usually dyed using direct, vat, or reactive dyes. Direct dyes form hydrogen bonds with the cellulose, and usually contain sulfonic or carboxylic acid groups, rendering them soluble in water. Vat dyes, which are usually quinone structures, are reduced to their water-soluble leuco form for application to the fibers, and re-oxidized to form insoluble pigments to improve wash fastness. Reactive dyes contain functional groups that form covalent bonds to the cellulosic hydroxyl groups. Lastly, disperse dyes on polyester are finely divided organic pigments dispersed throughout the fiber.

Dyes were extracted from fibers using the automated workstation, and loaded into a 96-well plate system. In this 96-well plate system, each well contains a 500-□L glass insert. A Teflon liner was placed between the glass inserts and a plastic lid to minimize evaporation of the extraction solvent during high-temperature extractions. To further minimize evaporation of solvents during extraction, the assembled plate was clamped in an alu-

minum press to improve the seal between the Teflon liner and the glass inserts. Extracted dyes were analyzed by capillary electrophoresis (CE) with a PACE-MDQ CE system using diode array detection. Optimization of extraction conditions provides the analyst with the maximum amount of dye, possibly providing additional discrimination between forensic fiber evidence.

Textile Fibers, Dyes, Automated Extraction

B150 Capillary Electrophoresis/Diode Array Detection/Mass Spectrometry for the Forensic Analysis of Fiber Dyes

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The goal of this presentation is to determine the usefulness of capillary electrophoresis-diode array detection-mass spectrometry (CE-DAD-MS) on extracted fiber dyes for forensic fiber discrimination.

This presentation will impact the forensic community and/or humanity by demonstrating CE-DAD-MS of extracted fiber dyes represents a supplement to microscopy and microspectrophotometry for the forensic discrimination of fibers.

Fiber evidence is frequently used in forensic science to associate a suspect to a victim or crime scene. At times "questioned" fibers are collected from the crime scene and "known" fibers are collected from suspects for comparison. Evidence fibers are collected through a combination of picking, scraping, vacuuming, and sometimes taping clothing and areas of the crime scene. They are often mounted in a mounting material on microscope slides for comparison and storage. Once the fibers have been collected, questioned and known fibers are compared using a series of microscopic techniques to determine whether or not the fibers could have come from the same source. The first of these methods is often polarized light microscopy (PLM). Using PLM, the generic fiber type (polyester, acrylic, nylon, cotton, *etc*.) is determined, and color, fiber cross-sectional shape and fiber thickness are compared. This analysis is often followed by fluorescence microscopy and UV-Vis and fluorescence microspectrophotometry. If spectra of the known and questioned fibers are consistent, the hypothesis that the fibers originate from a common source should not be rejected. Additional discrimination may be achieved by extraction of the fibers dyes followed by chromatographic analysis. CE-DAD-MS was chosen as the analysis technique following extraction because of its high sensitivity and selectivity.

Fiber dyes were extracted using a Beckman-Coulter Biomek 2000 liquid sample-handling robot. Extracted dyes were analyzed using a Beckman-Coulter P/ACE MDQ capillary electrophoresis system coupled to a Micromass Q-TOF micro mass spectrometer. An external fiber optic light source with a xenon lamp was used as the light source for the diode array detector to enable simultaneous DAD and MS detection. This setup provides an improved signal to noise ratio in the visible region and a better agreement between peaks in the DAD and MS electropherograms.

CE-DAD of small molecules has often employed sodium acetate or phosphate buffers with cationic surfactants or cyclodextrins as buffer additives. However, because of the requirements of the electrospray ionization process, non-volatile buffers and buffer additives should be avoided in CE-MS. CE-DAD-MS methods for the analysis of cationic dyes from acrylics, direct, vat, and reactive dyes from cotton, acid dyes from nylons, and disperse dyes from polyester were developed.

Overall, CE-DAD-MS of extracted fiber dyes represents an alternative approach for the forensic discrimination of fibers. However, because of the comparatively high cost and time requirements of CE/MS, extraction and further analysis may only be considered if additional discrimination is needed after forensic microspectroscopy and microspectrophotometry has been conducted.

Discrimination of Fiber Dyes, Capillary Electrophoresis, Mass Spectrometry

B151 UV-Visible and Fluorescence Microspectrophotometry for the Forensic Analysis of Fluorescent Brighteners on Textile Fibers

Stephen L. Morgan, PhD, Alexander A. Nieuwland, PhD, Elizabeth M. Enlow, BS, and James E. Hendrix, PhD, University of South Carolina, Department of Chemistry And Biochemistry, 631 Sumter Street, Columbia, SC 29208; and Edward G. Bartick, PhD, FBI Laboratory, Coutnerterrorism and Forensic Science Research Unit, FBI Academy, Quantico, VA 22135*

The goal of this presentation is to determine the usefulness of UV-Vis and fluorescence microspectrophotometry of fluorescent brighteners on fibers for forensic fiber discrimination.

This presentation will impact the forensic community and/or humanity by demonstrating how fluorescent brighteners can be important for discriminating among seemingly similar white fibers. The absorbance and fluorescence of fluorescent brighteners on acrylic, cotton, nylon and polyester fibers can be detected and differentiated in Permount without significant interference from absorbance or fluorescence from the mounting material. C Different fluorescent brighteners from the same chemical subclass (e.g., pyrazolines) showed similar spectra that could also be differentiated.

Fiber evidence is frequently used in forensic science to associate a suspect to a victim or crime scene. "Questioned" fibers are collected from the crime scene and "known" fibers are collected from the suspect. Evidence fibers are collected through a combination of picking, scraping, vacuuming, and sometimes taping clothing and areas of the crime scene and are mounted in a mounting material on microscope slides for comparison and storage. Once the fibers have been collected, questioned and known fibers are compared using a series of microscopic techniques to determine whether or not the fibers could have come from the same source. The first of these methods is often polarized light microscopy (PLM). Using PLM, the generic fiber type (polyester, acrylic, nylon, cotton, etc.) is determined, and color, fiber cross-sectional shape and fiber thickness are compared. This analysis is often followed by fluorescence microscopy, and UV-Vis and fluorescence microspectrophotometry. If spectra of the known and questioned fibers match, the hypothesis that the fibers originate from a common source should not be rejected.

Many fibers not only contain dyes that absorb visible light (400-700 nm), but also optical brighteners, which absorb ultra-violet light (around 360 nm) and re-emit light as fluorescence within the visible spectrum (around 440 nm). These fluorescent dyes mask "yellowness" and can make fabrics appear "whiter than white." Most of the attention in the analytical literature has been focused on fluorescent brighteners from detergents, with little attention being paid to fluorescent brighteners applied by the textile dyer. Fluorescent brighteners are often the only dyes present on white fibers. They are added to the melt during manufacture of staple polyester for blending with cotton. Textile dyers add fluorescent brighteners to impart whiteness to woven and knit products. Everyone who launders his/her clothing also adds fluorescent brighteners because they are in almost every brand of laundry detergent.

Fluorescent brighteners can therefore be important for discriminating among seemingly similar fibers. For this paper, nine different fluorescent brighteners from six different chemical subclasses were compared: one coumarin, two distyrylbiphenyls, one heterocycle, two pyrazolines, two

stilbenes, and one thiophene oxazole. One objective of this study was to determine whether Permount®, a popular mounting medium for UV/vis spectrophotometric characterization, would result in loss of discriminatory spectral data for fibers dyed with fluorescent brighteners. To answer this question, slides of polyester, acrylic and nylon 6 fibers, with and without fluorescent brightener, were prepared using Permount® and glycerin as mounting media on glass and quartz. Additionally, the possibility of discriminating between seemingly similar white fibers with different fluorescent brighteners based on their UV-Vis and fluorescence spectra was assessed.

The absorbance and fluorescence of fluorescent brighteners on acrylic, cotton, nylon and polyester fibers can be detected in Permount® without significant interference from absorbance or fluorescence from the mounting material. Comparison of fluorescence spectra by visual analysis and multivariate data analysis showed that fluorescence microspectroscopy could differentiate between all 9 different fluorescent brighteners used in this study. Different fluorescent brighteners from the same chemical subclass (e.g., pyrazolines) showed similar spectra that could nevertheless still be differentiated. In the case of cotton and nylon, fluorescent brighteners from detergents may increase the discrimination. Fluorescent brighteners contained in the detergent tested, however, did not show substantivity for polyester and acrylic fibers.

Overall, UV-Vis and UV-fluorescence microspectroscopy using Permount® is a viable approach for forensic discrimination of white fibers. For best results, forensic investigators should use as thin a layer of Permount® as possible, and routinely take the 365 nm excitation fluorescence spectra of white fibers that show an absorbance peak around 360 nm. Further discrimination may be achieved by extraction of fluorescent brighteners from fibers dyes followed by chromatographic analysis.

Fibers, Fluorescent Brighteners, UV-Vis/Fluorescence Microspectrophotometry

B152 Forensic Discrimination of Dyed Textile Fibers Using UV-Vis and Fluorescence Microspectrophotometry

Stephen L. Morgan, PhD, Alexander A. Nieuwland, PhD, Christopher R. Mubarak, PhD, James E. Hendrix, PhD, Elizabeth M. Enlow, BS, and Bryan J. Vasser, University of South Carolina, Department of Chemistry and Biochemistry, 631 Sumter Street, Columbia, SC 29208; and Edward G. Bartick, PhD, FBI Laboratory, Counterterrorism and Forensic Science Research Unit, FBI Academy, Quantico, VA 22135*

The goal of this presentation is to evaluate the relative discriminating power of visible, UV/visible, and UV/fluorescence spectrophotometry for the characterization of dyed textile fibers.

This presentation will impact the forensic community and/or humanity by demonstrating how UV/Vis and fluorescence microspectrophotometry are valuable tools for the discrimination of fibers, in particular for discrimination of fibers of similar color but different dye composition. The fibers and associated spectra in the database are a useful tool for fiber comparisons in casework and in quality control and training of analysts.

Fibers are ubiquitously found as trace evidence in crimes of personal contact, such as homicide, assault, sexual offenses, and hit-and-run accidents. Ultraviolet-visible (UV-VIS), and fluorescence microspectrophotometry (MSP) offers direct, relatively inexpensive, and informative means of characterizing dyed textile fibers. Research in the use of UV-VIS and fluorescence MSP has multiple objectives: improving the forensic discrimination of fibers by defining protocols for the most discriminating approaches, validating data analysis methods, and providing a tested database of spectra from dyed and undyed textile fibers.

Fiber samples for forensic microspectrophotometry are typically mounted in a mounting medium (or mountant). The mountant must not chemically react with the dyed fiber, be relatively easy to use, adhere and harden rapidly for permanent storage (if desired), have high optical clarity with no formation of bubbles or crystals, have a refractive index near 1.5 for performing polarized light microscopy (PLM), be soluble in a non-toxic solvent to facilitate recovery of the fiber from the medium, be colorless, be non-fluorescent, not yellow or shrink with age, and be inexpensive. While no mountant possesses all of these ideal properties, a suitable mountant must have most of these characteristics, and of particular importance is that it must not react with the textile fiber. The authors have evaluated three different mounting media (glycerin, Norland Optical Adhesive 65, and Permount®) for the forensic discrimination of fibers by UV-VIS and UV/fluorescence. Subject to a few working recommendations, it has been found that Permount® to be a suitable mountant for analyses.

A physical database containing over 500 dyed and undyed textile fibers has been developed with contributions from textile companies in the southeastern United States. All fibers have been characterized by polarized light microscopy, UV/Visible, and fluorescence microspectroscopy. A total of 25,000 UV-vis and fluorescence spectra have been acquired. Visual comparisons among the fiber spectra from the database have been supplemented by multivariate statistical analysis to confirm the statistical validity of discrimination observed.

Overall, UV/Vis and fluorescence microspectrophotometry are valuable tools for the discrimination of fibers, in particular for discrimination of fibers of similar color but different dye composition. The fibers and associated spectra in the database are a useful tool for fiber comparisons in casework and in quality control and training of analysts. Recommendations will be made for approaches which produce the most discriminating data to ensure that the limited time and resources available in forensic laboratories are most efficiently applied.

Fibers, UV-Visible Microspectrophotometry, Fluorescence

B153 A Study of Fabric Frequency

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Attendees will learn an example of fiber content and frequency distribution among college students over time.

The majority of reported victims and offenders of sexual assault are college aged, with the rape victimization highest among 16 – 19-year-olds. In 2002, nearly 4,000 sexual assaults were reported on college campuses nationwide. These crimes involve considerable contact between the perpetrator and the victim, allowing fibers to provide information about the crime scene as well as the vehicle used to transport a victim. This presentation will impact the forensic community and/or humanity by demonstrating data from the current project that helps to answer questions such as which fibers are more prevalent than others? Which fibers are rare? Are these fibers rare, or just not as common within this particular population? Population studies provide forensic scientists with a basis for understanding and interpreting the evidence they analyze, especially as it varies across geography, culture, and economic status.

This paper will present the work done at West Virginia University to determine the relative frequencies of fiber types and content in a college-aged cohort over time. The research was conducted throughout the month of April 2004. On a voluntary basis, 60 students were asked to describe their clothing three days a week. A variety of garment types (i.e., shirt, sweater, t-shirt, jeans, pants, etc.) were available to choose from when examining up to two top garments and one bottom garment. This excluded outer garments, such as jackets, coats, or slickers. Using the Kelly system, primary, secondary, and tertiary colors of each garment in addition to the modifiers light and dark were recorded. The students were asked to record the fiber type and respective percentage of each garment as reflected on the garment label(s).

This data was compiled to observe the totality of each garment type, primary, secondary, and tertiary colors, and fiber type and percentage. Out of the 619 #1 upper garments, 347 were t-shirts; 541 or 87.4% stated cotton as the primary fiber type. Polyester and acrylic were the two other major fiber types with 6.0% and 2.4%, respectively. Color distribution was more even with the most frequent being white throughout primary, secondary, and tertiary colors. The #2 upper garments were also primarily t-shirts at 126 out of the 244 total shirts observed. The fabric distribution was nearly the same as upper garment #1, with cotton being the most prevalent followed by polyester and acrylic including a high frequency of white shirts. The bottom garments showed 398 out of the 620 were blue jeans, or denim. Primary fiber types show that cotton was 93.3% of the total fiber type among bottom garments. Polyester comes in next with 4.2% of the total primary fiber type. Blue was the most prevalent primary color of all bottom garments.

White cotton is the primary fabric type among the sampled group of college students; white cotton is often noted for its lack of specificity in fiber examinations. Excluding white cotton, polyester and acrylic in a variety of colors are the most prevalent. The frequency of fibers such as acetate, linen, and lyocel are non-existent in upper garments. Linen does not seem to be popular among the college students sampled. Fashion plays a large role in the fiber and fabric choices of this demographic and this influences the potential evidence available to forensic scientists whose casework involves college students in a temperate climate.

Fiber Analysis, Fabric Content, Fiber Distribution

B154 The Instrumental Analysis of the Volatile Organic Compounds Present in Human Scent by SPME-GC/MS and the Evaluation of Scent Preservation Methods

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Attendee will learn about the commonalities and the differences in human scent profiles across different individuals.

This presentation will impact the forensic community and/or humanity by demonstrating the variability of human scent profiles and allowing for the better utilization of human scent evidence as an investigative tool in criminal cases.

Human scent evidence and scent identification canines have become more commonly used by the law enforcement community for investigative purposes in recent years. Canines, *Canis lupus* var. *familiaris*, have demonstrated the ability to discriminate between individuals based on their odor. For these identifications to be valid, the hypothesis about human scent is that each person has a unique odor that is stable over time. Scientific research into the ability of canines to distinguish between individuals based on their scent supports this theory. The research presented here also supports the hypothesis of the uniqueness of human scent. Solid Phase Microextraction Gas Chromatography Mass Spectrometry (SPME-GC/MS) has proven to be a viable method for the extraction, separation, and identification of the volatile compounds which comprise human scent and various types of compounds have been identified, such as organic fatty acids, alcohols, aldehydes, and ketones

The majority of the scientific research into human odor has been conducted on sweat collected from the axillary (armpit) area and the feet by the cosmetics industry. The production of human odor is a complicated process which has yet to be fully understood. A number of factors make the axillary region a good odor producing area in the human body: (1) the contents of the apocrine gland secretions may serve as bacterial substrates; (2) moisture is available from the eccrine glands; (3) there is a resident population of bacteria to transform non-odorous substances to odorous substances; and (4) the presence of axillary hair may aid in the dispersion of the odor. The human body has 2-4 million sweat glands distributed over its surface. Sweating is the process of releasing a fluid secretion on the body's surface in an effort to control temperature. The human axillary (armpit) region is the area of the body where the largest collection of sweat glands in both size and number are located. Apocrine, eccrine, and sebaceous glands, which are the major glands responsible for the secretion of "sweat," are all present in the axillary region of the body.

Forensically, odor collected from the hand is also of great interest. The use of detector dogs for "human scent lineups" has been utilized in European countries, including the Netherlands, Poland, Russia, Belgium, Germany, Denmark, and Hungary for decades. A "human scent lineup" is an identification based on a canine matching the human scent collected from a crime scene to a possible suspect. The process for conducting a "human scent line-up" in the Netherlands begins when scent evidence is collected at a crime scene, packaged, and preserved. When a suspect is taken into custody he or she may be asked to submit to a "human scent lineup." The suspect then holds a metal bar in his hands for a period of time, and this metal bar is collected. This metal bar from the suspect along with metal bars that have been held by other individuals and collected at random throughout the population are set up in a sterile room, where the law enforcement certified canine is then exposed to the scent evidence, and allowed to work the line-up of hand scented metal bars independently. Scent identification indicates an association between the suspect and the scent evidence. Canines performing "human scent line-ups" are utilizing hand odor for their distinctions between individuals.

This paper discusses the use of SPME-GC/MS for the analysis of scent samples collected from both the hand and armpit region of individuals differing in age, sex, and race. The stability and reproducibility of an individual scent profile over time for the purpose of creating a baseline for human odor will also be discussed. The common compounds determined between individuals and their relative ratios across individuals will be presented along with some compounds that are uncommon. The analysis of scent samples collected from identical twins living under the same environmental conditions and different environmental conditions will also be presented and compared.

Various collection techniques for axillary scent and hand odor samples will be discussed as well as the stability of these samples when stored at room temperature. Sampling methods and mediums are also being investigated in an attempt to optimize the recovery and storage of human scent from forensic specimens. Different absorber types, including both sterile gauze and King's Cotton, which is used by the Dutch National Police for human scent collection, have been evaluated based on their ability to collect human scent. Persistence/dissipation studies of human scent using SPME-GC/MS will also be presented evaluating variables such as light (UV, VIS) and temperature effects.

Human Scent, Odor Profiles, SPME-GC/MS

B155 Identification of the Metal Residues on the Death Related to the High Voltage Spark Region by SEM-EDS

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Attendees will learn an easy method for SEM-EDS data from the area of metallic particles which were originated from the evaporating conductor contaminate the skin the arc-burns related to the high voltage.

This presentation will impact the forensic community and/or humanity by demonstrating how SEM-EDS data from the area of metallic particles which were originated from the evaporating conductor can contaminate the skin the arc-burns related to the high voltage.

High voltage electric energy wires, transformers, and the devices which run with this kind of electricity, may cause serious damage and death. It is the goal of this presentation to demonstrate this to those in forensic medicine by showing the conductive evaporated metallic particles existing on the arc-burn of the corpse using the scanning electron microscope-energy dispersive spectroscopy (SEM-EDS).

It was reported to authorities that somebody who entered a transformer building in Istanbul without permission died of an arc which was formed by the high voltage within the building. The autopsy was performed in the Morgue Department of Council of Forensic Medicine, Ministry of Justice. During the autopsy, samples were collected using double-sided adhesive coated stubs from the surface of the skin lesions, which was the result of the high voltage arc, by stub. The removed samples were examined by SEM-EDS technique. The results were evaluated to determine the origin of death.

It was concluded that the SEM-EDS data from the area of metallic particles originated from the evaporating conductor. Contaminating the skin, arc-burns resulting from the high voltage, are important combined with other close examinations to identify the cause and mechanism of death.

Electrical Arc Burnt, Scanning Electron Microscopy-Energy Dispersive Spectroscopy, Metallic Particle

B156 Development of a Method to Produce Lead Particle Patterns

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Attendees will learn how to make reproducible lead oxide particle patterns of know amounts of lead oxide on various substrates.

This presentation will impact the forensic community and/or humanity by assisting individuals interested developing improved methods of visualizing lead particle patterns and recovering GSR particles.

This research involves the development of a simple procedure to produce lead particle patterns on paper or cloth that resemble those used to estimate muzzle to target firing distances. Forensic examiners have long used the patterns produced on the target by lead particles and burned and partially burned smokeless powder particles to estimate the distance between the muzzle of a firearm and the object through which the bullet passed. Test patterns for evaluation of method variations were produced by firing a weapon from different distances into a piece of filter paper or cloth. This usually requires a trip to a firing range and produces rather variable patterns due to inconsistencies in the amount of smoke and lead produce by a weapon from shot to shot. In addition, it would be convenient to be able to measure the efficiency of various gunshot residue (GSR) recovery techniques. To be able to do valid comparisons it is necessary to be able to control the amount of lead deposited on the substrate. This is virtually impossible when producing patterns in the normal way at a firing range.

The authors have tried to develop a laboratory method for producing patterns of fine lead oxide particles, similar to muzzle to target patterns, on paper and cloth substrates. One can purchase very fine lead oxide powders in the size range of GSR particles[1]. Suspending these particles in water, similar to the molybdenum sulfite suspensions used for the fingerprint reagent "small particle reagent"[2], followed by delivering a known volume of the solution to the target would allow the delivery of a known amount of lead oxide to the target. A simple squirt gun can be used to produce fairly tight patterns similar to those produced at several inches by most firearms. To produce more diffuse patterns, similar to those observed from shots of one foot or greater distances, a simple spray bottle can be used. By weighing the squirt gun or spray bottle before and after a "squirt" one can calculate the amount of liquid delivered to the target. By knowing the concentration of the lead oxide in the suspension one can calculate the amount of lead being delivered to the target. Using varying concentrations of lead oxide in the suspension allows control of the amount delivered over a fairly large range.

Three different substrates were used- filter paper, Whatman 3MM, Electrophoresis blotting pads S&S and white cotton cloth. It was found that using an inexpensive squirt gun fairly reproducible patterns could be generated by firing vertically down from a range of three to five feet. Using a spray bottle a more diffuse pattern could be made spraying from six inches to twelve inches in a horizontal direction. The patterns were visualized using the standard two step-sodium rhodizinate method[3]. As expected the diameter of the pattern increased as the distance increased. Similar patterns over a number of shots were reproduced. The patterns produced at the same distances on all three substrates were very similar in appearance.

By weighing the squirt gun filled with distilled water it was determined that it deliver 0.40 g of water quite reproducibly. A lead stock solution containing 15g of lead oxide in 500 ml. of water was prepared. It was found that the patterns produced with this solution were too concentrated to resemble gunshot patterns. A working solution was prepared by diluting ten ml. of the stock solution to one hundred ml. This working solution was used to obtain patterns as indicated above and the patterns were visualized with sodium rhodizinate.

This technique produced quite reproducible looking patterns the spread and intensity of which could be conveniently varied as indicated above.

1. Alfa Aesar Research Chemicals Iron Oxide -325 Mesh Powder
2. *Advances in Fingerprint Technology*, H.C. Lee & R.E. Geansslen, 2nd Ed., CRC Press, Chapter 4 p 113-4
3. M.R. Bartsh, H.J. Korbus, & K.P. Wainwrght, *J. Forensic Sciences* 1996;41: 1046-1051

GSR, Sodium Rhodizinate, Muzzle-Target Distance

B157 Lead Isotopes in Gunshot Residues

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The goal of this presentation is to inform the forensic community about the possible usefulness of using lead isotope ratio analysis in specific cases.

Different from the absolute concentration of an element or element/element ratios, radiogenic isotopic ratios from elements like lead or strontium are not sensitive to production or manufacturing processes and provided that no additional radiogenic isotope is added, the isotopic signature from the source material is retained. Due to geological processes on geological time scales most raw materials have developed identifiable isotopic fingerprints. Especially the lead isotopes are unique because the combination of three radiogenic isotopes (^{206}Pb, ^{207}Pb and ^{208}Pb) and one stable isotope (^{204}Pb) allow the construction of several different isotope ratio scatter diagrams which permit a very sensitive and discriminative assessment of the possible different sources of the lead.

In a recent case the clothes of a murder suspect contained elevated traces of lead, possibly from GSR from a shooting incident. The defense argued that the lead contamination had been caused by exposure in a technical workshop. Additionally the evidence material had been kept under suboptimal conditions for several years that could not exclude contamination. Preliminary trace element analysis indicated elevated concentrations of several metals including lead.

In this study the authors compared the lead isotopic composition of two GSR sheets from the murder victim with fifteen samples taken from a pullover of the suspect. The samples from the pullover were taken from the front and the back and the two sleeves in order to evaluate any focus of possible lead contamination from the GSR.

This study showed that three different sources contributed to the lead found on the pullover but that none of these three sources agreed with the composition of the GSR found on the sheets.

Lead Isotopes, Gunshot Residues, Isotope Analysis

B158 The FBI Laboratory's Response to Recommendations Regarding Comparative Bullet Lead Analysis

Diana M. Wright, PhD, and Marc A. LeBeau, MS, FBI Laboratory, Chemistry Unit, Room 4220, Quantico, VA 22135*

Attendees will learn the FBI Laboratory's response to recommendations regarding the analysis, assessment, and significance of comparative bullet lead examinations, which were offered in an independent report by the National Research Council of the National Academies.

This presentation will impact the forensic community and/or humanity by informing the forensic community of the FBI Laboratory's response to recommendations set forth in a report by the National Research Council of the National Academies regarding comparative bullet lead analysis and its interpretation.

Comparative bullet lead analysis is the physical and chemical examination of lead bullets, fragments, or shot pellets. It is a non-routine examination, in that, it is only performed on damaged specimens that are unsuitable for direct comparison by a firearms examiner or in the absence of a firearm for comparative projectile testing. The FBI Laboratory has provided this examination for over 35 years in support of local and federal investigations involving recovered ammunition.

Throughout the history of this examination, challenges have been raised in court as to its validity, scientific merit, and probative value. As each criticism has been raised, the FBI Laboratory has sought to address these concerns through the use of publications and presentations at scientific meetings. Not all of the challenges, however, have concerned the scientific method employed. Questions regarding the significance of the examinations have consistently been posed to courts, which have chosen to allow the jury to decide the issue. Periodically, more comprehensive *Daubert* and *Frye* challenges have also been presented to the court regarding this examination. Comparative bullet lead analysis has successfully withstood each of these challenges.

The FBI Laboratory has always welcomed constructive assessments of its scientific practices. The Scientific Working Group (SWG) program has been an excellent forum to allow for spirited scientific discussions that ultimately result in consensus documents to serve as sample protocols for the community. Unfortunately, comparative bullet lead analysis is an examination that is non-routine or non-existent in the FBI Laboratory's peer organizations at both the state and federal level. Trace element analysis, in general, is still fairly non-routine for most laboratories. The necessary consumption of a portion of the evidence, the cost to purchase and maintain the requisite equipment, and the challenges associated with deriving a meaningful conclusion from the quantitative analysis of the composition of a mass– produced, man-made entity have all contributed to a lack of other laboratories embracing the technology.

To provide an impartial assessment of the comparative bullet lead procedure, statistical analysis and subsequent testimonial assertions, the FBI Laboratory commissioned a study by the National Research Council of the National Academies as a means of addressing the challenges to this examination. The intent of this study was to obtain guidance as to what improvements might be necessary to continue to produce quality results that could be appropriately presented to a non-technical audience. To that end, the FBI Laboratory also requested that the NRC consider appropriate language to convey the bullet manufacturing process, chemical analysis, statistical assessments, and interpretative conclusions to a jury in a manner that was both thorough and concise.

This presentation will summarize the committee's recommendations to the FBI Laboratory. The recommendations cover a very broad range of topics including: the analytical protocol, the number of elements analyzed, quality control and proficiency testing measures, statistical recommendations for interpretation of the results, report wording, testimony language, and the use of phrases that the NRC committee developed to describe some of the concepts presented to a jury during direct testimony. The FBI Laboratory's response to each suggestion will be described after presentation of the specific recommendation.

Bullet Lead Analysis, NRC Recommendations, Comparative Examinations

B159 Using LA-ICP-MS at the Netherlands Forensic Institute

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Attendees will learn the discrimination potential of LA-ICP-MS for the elemental analysis of different types of materials of forensic interest.

This presentation will impact the forensic community and/or humanity by demonstrating the discrimination potential of LA-ICP-MS in the analysis of chemical composition of some materials of forensic interest that cannot be discriminated using traditional methods.

Trace evidence is widely recognized for its associative value. Sometimes recovered samples associated with a suspect and samples associated with a known source are compared to each other based on the physical properties as well as their chemical composition. The choice of methods to characterise and compare trace evidence depends on, among other factors, the accessibility of the proper instrumentation (i.e., sensi-

tivity, discrimination potential), the cost of the analysis including analysis time and the characteristics of the evidence (such as size and physical state). However, when there is control on the variation of physical properties in materials of the same kind, the discrimination potential of the methods used to measure such properties decreases. In many of those cases, elemental analysis has demonstrated to have a great value when used for the characterisation of such materials. In addition, if the sample is small, more sensitive methods are needed to measure reliably the elemental composition, in particular at trace levels. In recent years, different research laboratories and international networks have made an effort to develop and validate analytical methods with better sensitivity, precision and reproducibility.

At the Netherlands Forensic Institute, different analytical methods have been optimised and validated for the elemental analysis of materials of forensic interest by LA-ICP-MS. Two of these materials, glass and pigment-based ink on paper, have been selected for this presentation. There are many studies demonstrating the value of elemental analysis of glass by different techniques. On the other hand, the need for non-traditional methods for the examination of documents produced with inkjet printers (e.g., threatening letters, contracts, and invoices) has increased only recently with the shifting from dye-based inks to pigment-based inks. Inks belonging to the latter type, are more robust when exposed to light and more resistant to solvents in contact with the paper, thus, not bleeding as much as inks of the former type. However, pigment-based inks are not soluble and therefore, not easily separated by traditional methods such as TLC and HPLC. The improved quality in the manufacturing of printers makes the differentiation among them based on physical characteristics more difficult, whether from the same manufacturer or from different ones.

The technique, LA-ICP-MS, combines the sensitivity and precision of ICP-MS with the advantages of laser ablation sampling. With the use of LA-ICP-MS there is no need for laborious and lengthy digestion procedures with dangerous chemicals. In addition, the common analytical interferences that are increased by the presence of solvents are minimised using laser sampling, improving the detection limits of some potentially discriminating elements. The amount of material ablated for the complete analysis is very small (~fg), allowing the analysis (including replicates) of very small samples. The destruction is minimal with craters in the order of 10^{-8} m^2, in contrast to the solution approach where the whole sample to be analysed is irreversibly digested. The system at the NFI is an ICP-MS (Perkin Elmer ELAN DRC plus) in combination with a 3 mJ- 213 nm-laser ablation system (New Wave UP-213).

The standard reference materials (SRMs) NIST 612 and 1830 were used for the development and validation of a quantitative method for glass analysis. This method has been used to analyse glass samples collected by the police from different locations within the Netherlands. In addition, the traditional analyses such as the refractive index measurements and the less sensitive semi-quantitative µXRF measurements were carried out on all the samples. The methods, the selection of the matching criteria and the results of the comparisons of the samples using elemental concentrations and refractive index (measured with GRIM II) will be discussed. Finally, the development and validation and application of a semi quantitative method for the analysis of pigment-based inkjet inks will be also discussed.

LA-ICP-MS, Elemental Analysis, Trace

B160 Characterization of Trace Elements in Gunshot Residue of Lead Free Primers Winchester, Winclean, and Remington

Zachariah Oommen, MSc, PhD, Scott Pierce, and Odister Kisha, Albany State University, 504 College Drive, Albany, GA 31705*

Attendees will gain a comparative understanding of the gunshot residue particles produced during firing bullets having lead free primers manufactured by Winchester, Winclaen, and Remington.

This presentation will impact the forensic community and/or humanity by demonstrating a systematic analysis, of gun shot residue (GSR) from primers and ammunitions in the area surrounding bullets holes and from the shooter's hand. This is a very important tool to determine the shooting distance, types, of the primer and ammunitions to the forensic scientist.

A comparative study of the gunshot residue particles produced during firing bullets having lead free primers manufactured by Winchester, Winclaen, and Remington were performed. Morphology and composition were analyzed using scanning electron microscope equipped with energy dispersive x-ray.

The effect of lead pollution caused by the use of bullets and primers containing lead is one of the greatest problems facing the law enforcement and the military. Therefore attempts have been in progress to eliminate lead based primer mixtures and bullets. The recent development of lead free ammunition and bullets represent a new challenge for ballistic specialists and forensic scientist. Much research work has been carried out and published on lead based GSR but, only very few research studies have been reported in the analysis gunshot residues produced from lead free primers during firing.

In this context this research is a study of the topography, morphology, and composition of the residues deposited during firing using lead free primers and ammunitions. Attempts have also been given to detect and estimate the amount of various constituents in the given ammunition and also to correlate the results to forensic examination.

Test firing, collection of gunshot residues, and subsequent analysis were carried out at the Forensic Science Laboratory of the Albany State University. A specially made bullet trap filled with polymer fibers was employed for live firing. The firearms used in this study were a Springfield Armory 0.45 caliber (model 1911) and a Beretta 9mm Parabellum (model 92 FS.CaC). Two types of ammunition, 9 mm and 45 ACP, used in this study were manufactured by Winchester (Win Clean) and Remington. Firing distance and the area surrounding the target are the two parameters used in the collection of gun shot residues. A total of 60 rounds were fired in this study. Imaging and compositional analysis were performed on a Cam Scan 44 scanning electron microscope equipped with energy dispersive x- ray detector.

Spherical and Non-spherical particles with size in the range 3- 30 □m are studied for intensity, distribution and composition of gun shot residue particles. Intensity and distribution are studied as a function of shooting distance and collection areas. Number of particles on the shooter's hand is high, compared to those collected from different areas of the target. The elements identified from the GSR particles of Winchester Winclean primers are Potassium, Calcium, Aluminum, Chlorine, Sodium, Copper, Zinc, and Silicon where as Remington constitutes Copper, Zinc, Magnesium, Chlorine, and Silicon. Composition variations are based on the size and shape of the GSR particles. Nonspherical and large particles always composed of more than three elements. Small and spherical particle contains either one or two elements. Attempts have been made to distinguish between Remington and Winchester Winclean GSR particles in terms of composition and morphology.

Both types of GSR particles contain Copper and Zinc alone or in combination with other respective elements. This is because of the brass plated cartridge or the brass firing pin. Lead and barium is also found in both types due to use of previously fired gun. Morphology and size do not show any differences in their intensity or distribution. Characteristic GSR particles having spherical, spherical with dimples, oval, and irregular shapes are common in both types.

Gun Shot Residue, Scanning Electron Microscope, Lead Free Primers

B161 Detection of Recent Handling of Firearms

Joseph Almog, PhD, The Hebrew University, Casali Institute of Applied Chemistry, Jerusalem, 91904, Israel; Yaniv Avissar, MSc, The Hebrew University, Analytical Chemistry Department, Jerusalem, 91904, Israel; Assaf Sagiv, MSc, The Hebrew University, School of Pharmacy, Jerusalem, 95744, Israel; and Daniel Mandler, PhD, The Hebrew University, Analytical Chemistry Department, Jerusalem, 91904, Israel*

Attendees will learn how to detect recent handling of firearms by a simple and sensitive color test. The reasons for differences between various individuals in the quality of the marks developed on their palms.

This presentation will impact the forensic community and/or humanity by increasing the number of serious crimes, which are resolved by scientific techniques.

Several physiological and environmental factors that affect the outcome of the Ferrotrace technique have been thoroughly studied. Consequently, two improvements, which greatly enhance sensitivity, have been suggested.

Handling of a gun results in the formation of invisible impressions, caused by transfer of iron traces to the skin surface. Visualization of these impressions is possible by spraying the palms with a solution of 3-(2-pyridyl)-5,6-diphenyl-1,2,4-triazine (PDT), which forms a magenta complex with iron(II) residues.

Quantitative data are reported for the first time on the amounts of iron transferred to the hand upon holding a firearm. Iron levels between 21–315 ng/cm2 were found on volunteers' palms after a single holding of a handgun. Determination of the iron traces was accomplished spectrophotometrically using PDT as a chelating agent. The transfer of iron from firearms to the palm was found to be, by and large, a chemical (dissolution) rather than mechanical dislodgement. The prime factor that determines the amount of iron transferred from the firearm to the hand is the moisture level on the palm. More factors, however, are involved in this process. Three time-dependent factors have been studied with relation to their effect on the developed mark: the gripping duration of the weapon; the time that elapses from the moment of contact; and the rate of iron dissolution in aqueous solutions containing sweat components in physiological concentrations.

It was found that the amounts of iron transferred to the palm depend on both, the gripping period and the levels of palmar moisture. Thus, only a few seconds of gripping were required for good marks to develop (corresponding to 80 $ng \cdot cm^{-2}$ of iron) on highly-moistured hands ("good acceptors"). Much longer gripping periods were necessary for marks of similar intensity to develop on relatively dry hands ("poor acceptors"). Experiments aimed at studying the effect of sweat components on metallic iron dissolution were carried out in aqueous solutions. It was found that chloride ions in physiological concentrations remarkably enhanced the dissolution, while L-serine, the major amino acid in palmar sweat, had a detrimental effect on this process. These findings are likely to be of importance in courts of law, as well as in the war against terrorism and serious crime.

Two modifications, which have been suggested – splitting the development process into two subsequent steps, and exposing the hand to water vapor – greatly improve the sensitivity of the method.

Several cases that were resolved by the Ferrotrace reagent will be demonstrated.

Forensic Science, Firearms, PDT

B162 A Portable X-Ray Fluorescence Instrument for Forensic Investigations

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After attending this presentation, attendees will understand the critical design features and operational parameters of a new, portable x-ray instrument for assisting in the recognition of trace evidence for crime scene and forensic laboratory applications.

This presentation will impact the forensic community and/or humanity by describing the development of a portable x-ray fluorescence instrument; demonstrating the operational performance of the instrument for trace residua of forensic importance, including (but not limited to) primer residue, blood, and semen in a simulated crime scene; and discussing the future use of this instrument at crime scenes or in the laboratory to develop investigative leads by assisting in the recognition and recovery of such trace evidence through elemental analysis.

A rugged x-ray fluorescence (XRF) instrument has been designed to investigate trace element content in and on evidence at crime scenes. The initial focus is to identify possible materials of interest such as gunshot residue and bodily fluids, but it has broad capability for general XRF applications. The instrument was designed to be part of a system to aid crime scene investigation and transmit the data to locations requiring it. This portable instrument was designed to meet the constraints of weight, battery operation, and ruggedness. Some special design features, however, were needed to achieve detection of microgram quantities of the trace elements of interest.

This instrument is part of a Teleforensics program jointly funded by NIJ and NASA. This collaboration seeks to develop cost-effective instrumentation based on technology developed for the space program to benefit crime scene investigation, and to develop advanced instrumentation for planetary missions for NASA. A critical factor at crime scenes is the collection of evidence for analysis at forensic laboratories. The friable nature of evidence requires rapid recognition, to avoid losing the probative information contained therein. Some evidence is invisible to normal investigation techniques, either because it involves trace quantities not visible to any investigation technique, or because it is covered or hidden from view. Many types of potential evidence can be indicated by crime scene detection through *in situ* trace element analysis.

Data is shown that supports possible use of a portable XRF instrument through detection of gunshot residue, blood (through the detection of the iron in hemoglobin), and semen (through the detection of zinc protoporphorin). To detect the low levels of trace element concentrations, advanced technology has been incorporated including the unique x-ray generator and a recently developed Shottky cadmium telluride x-ray detector. The design of the internal structure of the instrument is a critical component for minimizing the background due to coherent scattering. This design was necessary to ensure that the instrument could measure microgram quantities of elements of interest. It was also necessary to select the x-ray tube anode material to ensure that the tube's x-ray line production does not interfere with the detection of elements of forensic interest.

A key feature for the efficient and reliable operation of the instrument is spectral analysis software that can adapt to changing backgrounds and arbitrary elemental content. The results are incorporated in a database that was originally developed for planetary missions. In addition, it is now

understood that the application of historically-derived XRF data loaded into a relational database representing data relationships between items of interest and background matrices is just as important in forensic applications as has been recognized for planetary missions. Discussion of the use of such relational databases to assist in data recognition and recovery, and those data related to forensic trace evidence either available or researched to date, will also be included.

The authors have also helped develop a Monte Carlo code for modeling the interaction of x-rays from any inputted source and the secondary particles that they produce as they interact with any type of material. This code can simulate the x-ray fluorescence produced by a variety of forensic materials (e.g., blood, semen, gunshot residue).

Finally, results of experiments to date characterize the expected performance of the instrument for detecting trace element concentrations that are useful for investigating crime scenes and in laboratory applications.

Teleforensics, Trace Recognition & Recovery, Portable X-Ray Fluorescence

B163 Evaluation of SNPs as Tools in Human Identity Testing

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After attending this presentation, attendees will learn the utility of single nucleotide polymorphisms (SNPs) as human identity markers. The attendee will learn about different classes of SNP markers, typing technologies, and how SNPs compare with STR markers.

This presentation will impact the forensic community and/or humanity by reporting on the utility of SNP markers to the DNA testing community. SNP markers can provide valuable complementary roles in human identity testing. The typing of coding region mtSNPs and small autosomal panels of SNPs for typing degraded DNA are two examples of where SNPs can benefit the forensic community.

SNPs have the potential to play a helpful role in human identification testing. The small PCR amplicon sizes associated with SNP typing technologies make SNPs attractive for typing degraded DNA or other low copy number situations. SNP can be useful in combination with STRs for resolving complex paternity issues (e.g., incest), identifying victims of mass disasters where insufficient family references are available and possibly inferring population of origin. SNPs located in the coding region of the mitochondrial genome have been used to separate common HV1/HV2 mitotypes thereby extending the power of mtDNA testing (1,2). SNPs located on the Y chromosome have been evaluated for ethnicity prediction and individual sample discrimination (3).

Various SNP typing platforms exist, but at this time there is not a universally agreed upon platform for SNPs and human identity testing. Currently researchers are typing SNPs with multiplex allele specific primer extension (ASPE) reactions. The assay is comprised of an initial step of PCR followed by primer extension and subsequent fragment separation and detection by capillary electrophoresis. ASPE multiplex panels can routinely type 6-12 SNPs in a single tube and have reported to go as high as 35 SNP markers.

Important considerations for SNP markers are the larger number required to equal the discriminatory power compared to traditional STRs, their inability to resolve complex mixtures, issues related to databasing new loci, and the availability of a standard analysis platform. However, in appropriate situations SNPs can be useful as a supplementary tool complementary to STR markers.

Methods and Materials: A total of 70 bi-allelic (C/T) SNP markers have been typed for 189 U.S. samples. Amplifications were performed in 6-plex panels. Amplicons between 59 –108 base pairs were generated. The SNP markers were typed using multiplex ASPE assays and capillary electrophoresis. An 11-plex ASPE assay for typing coding region SNPs that helps resolve the most common Caucasian mitotype was developed and run on samples previously screened by Roche linear arrays for a common HV1/HV2 mitotype. Multiplex assays consisting of 3 ASPE multiplexes and 5 commercial hybridization multiplexes were used for typing 50 Y-SNPs. The 50 Y-SNPs were typed for 229 U.S. African American and Caucasian samples.

Summary of Results: Novel multiplex SNP assays have been developed for typing various classes of SNP markers on U.S. population samples. Subset panels of the 70 autosomal SNP markers have been used to successfully type DNA from shed human hairs. Results for mtSNPs and Y-SNPs allow for an evaluation of the practical utility of various SNP markers in a human identity context. Samples typed by commercial and novel multiplex STR panels allow for a direct comparison of SNP and STR markers.

Conclusions: Practical and inherent characteristics of SNP markers will prevent them from replacing traditional STR typing methods. However, SNP markers can provide valuable complementary roles in human identity testing. The typing of coding region mtSNPs and small autosomal panels of SNPs for typing degraded DNA are two excellent examples of where SNPs can benefit the forensic community.

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3. Vallone, P.M. and Butler, J.M. (2004) Y-SNP typing of U.S. African American and Caucasian samples using allele-specific hybridization and primer extension. *J. Forensic Sci.* 49(4): 723-732.

Single Nucleotide Polymorphism, Multiplex PCR, Degraded DNA

B164 Allele Drop Out at Locus D5S818 Caused by a Single Nucleotide Polymorphism at a Primer Binding Site

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After attending this presentation, attendees will understand the reason for the loss of allele D5S818*10 when using PowerPlex®16 kit, approaches to overcome this and similar problems, and the impact and consequences for data bases.

This presentation will impact the forensic community and/or humanity by providing the forensic community with the knowledge of the nature and the frequency of a primer binding site mutation and its impact on multiplex PCR analyses. Moreover, information is provided how to overcome the problem of allele drop out in general.

The goal of this presentation is to clarify the reason for loss of allele *10 at locus D5S818 when using PowerPlex® 16 kit.

Outcome: The authors present data about a single nucleotide polymorphism (SNP) at STR locus D5S818 including association of the mutant with the STR allele *10 and strategies to overcome the problem of allele drop out.

Three SNPs were localized in close proximity to the D5S818 STR region at positions –13 (C/T), +4 (G/T) and +36 (T/C). The reverse primer

for amplification of this locus in the PowerPlex® 16 kit binds in the region of the +36T/C SNP. In order to investigate allele frequencies of the +36T/C SNP the authors established an allele-specific PCR method using sequence-specific primers (PCR-SSP). The PCR-SSP method was used for genotyping 288 samples from a DNA archive of blood donors from Southwest Germany. Four of the samples revealed a heterozygous genotype of the +36T/C SNP, thus, the frequency of the +36C-allele was 0.69% in this population. According to the Hardy-Weinberg-Equilibrium the heterozygous +36T/C genotype occurred at a frequency of 1.4%, whereas the homozygous +36C/C type may be observed in 1:20,000 individuals only. Sequence analysis of the D5S818 locus in the 4 individuals with the heterozygous +36T/C genotype demonstrated a linkage of the +36C-allele with the STR allele *10 in all cases. In the multiplex STR-analysis using PowerPlex® 16 kit the samples showed homozygous phenotypes at locus D5S818. The same samples were investigated further using the same primers for amplification of the D5S818 locus but in monoplex PCR. The monoplex analysis revealed heterozygous genotypes for all samples with unambigous amplification of allele *10 in addition to other alleles. In order to solve the problem of allele drop out in multiplex STR analysis the authors investigated the use of a PCR primer containing a wobble base at the corresponding position of the +36T/C SNP. The standard reverse primer for amplification of the D5S818 locus was replaced by the wobble-base primer in the multiplex assay. DNA samples with known STR- and +36T/C SNP-types were analyzed by using the modified primer mix. The STR allele *10 could be clearly detected even in samples with a heterozygous +36T/C genotype, indicating that the wobble primer is suitable to overcome the problem of allele drop out. On the other hand the modified primer led to an increased background, i.e., higher numbers of unspecific amplification products. Modification of the PCR program should overcome this problem. In cases of a homozygous D5S818 phenotype the authors would suggest the use of one of the following strategies: 1) Decreasing the annealing temperature; 2) Retyping of the samples using D5S818 monoplex PCR; 3) Genotyping of the +36T/C SNP using the PCR-SSP approach; 4) Use of a D5S818 wobble-base primer in multiplex STR-analysis.

STR Locus D5S818, Aallele Drop Out, Single Nucleotide Polymorphism (SNP)

B165 Some Interesting Point Mutations and Deletions Found Through STR Allele Sequencing

Margaret C. Kline, MS, Michael D. Coble, PhD, Jill E. Appleby, BS, Richard Schoske, PhD, and John M. Butler, PhD, National Institute of Standards and Technology, 100 Bureau Drive, MS 8311, Building 227, Room B250, Gaithersburg, MD 20899-8311*

Attendees will learn a methodology for sequencing variant STR alleles will be described along with some interesting findings from samples producing allele dropout upon PCR amplification with various primer sets.

This presentation will impact the forensic community and/or humanity by enhancing the knowledge of the forensic community in regards to methodologies used to define the differences found in variant alleles.

Polymorphisms exist in the flanking regions of short tandem repeat (STR) loci that can cause allele dropout when they fall underneath PCR primer binding sites. The resulting "null alleles" are typically detected when concordance studies are performed using sets of PCR primers with different annealing positions (1,2). Some interesting deletions have been discovered in the flanking regions of D13S317 and VWA through concordance studies between miniSTR assays and commercial kits (3). In addition, several forensic laboratories have supplied samples possessing some novel variants that have been characterized. These STR typing and sequencing results will be discussed in the context of the growing number of more than 230 variant alleles reported and cataloged as part of the National Institute of Standards and Technology STRBase website: http://www.cstl.nist.gov/biotech/strbase/.

Methods and Materials: DNA sequencing primers lying outside of PCR amplification assay primer binding sites have been designed and tested for all 13 core STR loci used in the Combined DNA Index System (CODIS) as well as the D2S1338, D19S433, Penta D, and Penta E loci that are contained in commercial STR kits such as PowerPlex® 16, SGM Plus, and Identifiler. A variety of polyacrylamide gel electrophoresis conditions have been developed to separate closely spaced heterozygous alleles so that these alleles can be individually sequenced. Gel cutouts (individual alleles) are re-amplified prior to sequencing each allele. Variations in the individual alleles are determined by aligning their sequence to a reference sequence from GenBank. These alignments are assisted by the use of the software program Sequencher 4.1 (GeneCodes, Ann Arbor, MI).

Summary of Results: The novel sequencing primers developed encompass the primer binding regions of all known published primer sequences for loci included in commercial STR kits and thus enable an examination of polymorphisms giving rise to allele dropout upon PCR amplification.

Conclusions: Methodologies for DNA sequencing of STR alleles can aid in understanding the molecular basis for allele dropout due to point mutations or insertion/deletions in template DNA that disrupt PCR primer annealing. An increasing number of rare variant alleles are being discovered and information is being uncovered through DNA sequencing that can be helpful in assessing natural human variation and developing improved detection assays in the future.

References:

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Short Tandem Repeat DNA Typing, DNA Sequencing, Variant Allels

B166 Loss of Heterozygosity at Several Loci of the 13 CODIS Core STR Loci in a Patient Diagnosed With Cancer

Katherine E. Long, BS, Rick W. Staub, PhD, Judith I. Floyd, BS, and Robert C. Giles, PhD, Orchid Cellmark, 2600 Stemmons Freeway, Suite 133, Dallas, TX 75207*

After attending this presentation, attendees will have an increased awareness of the possibility of a complete or partial loss of heterozygosity in a single source sample at multiple locations in nuclear DNA as a result of deletions due to cancer.

This presentation will impact the forensic community and/or humanity by making scientists aware of the possibility of observing a loss of heterozygosity in a single source sample, which may be misidentified as a mixture when an inadequate number of loci are tested.

It has been documented that a loss of heterozygosity in one of the systems of the 13 CODIS core STR loci can occur due to actual autosomal rearrangements associated with cancer. It is also known that a loss of heterozygosity can be observed in poor quality DNA samples from paraffin embedded tissues resulting in stochastic effects during amplification. In this particular case, a loss of heterozygosity was seen at more than one locus in several specimens with some specimens exhibiting a loss of heterozygosity at up to four loci.

After a patient's untimely demise from cancer, slides used in the patient's diagnosis were submitted for DNA analysis via STR testing to ensure that the tissue on the slides was not contaminated by another patient's tissue during the preparation process for evaluation by a pathologist. The patient in this case had initially been diagnosed with non-Hodgkin's Lymphoma. After treatment with chemotherapy, the lymphoma was declared to be in remission. Approximately one year later, the patient was found to have a growth in one of his lungs. This tumor was subsequently diagnosed as being small cell carcinoma also known as oat cell carcinoma. While being treated for the lung tumor, the patient suffered a relapse of the non-Hodgkin's Lymphoma. Although it was noted that the lung tumor had begun to decrease in size the patient passed away a short time later. Upon autopsy, there was no indication of the lung tumor and the involved parties sent the paraffin blocks and related slides used to diagnose the small cell carcinoma to two private forensic DNA laboratories in order to determine the possibility of specimen mis-handling.

Peak imbalances observed in the samples tested from the patient led the first forensics laboratory performing testing to conclude that the samples were a mixture of the patient and another individual. However, none of the eight loci tested exhibited more than two alleles.

The second laboratory (Orchid Cellmark Dallas) then received three paraffin blocks and nine corresponding slides for testing and comparison with STR testing. Portions of the paraffin blocks and related slides were subjected to organic extraction via phenol chloroform and extracts were purified and concentrated using Microcon® centrifugal filter units. The extracts were quantitated and initially amplified using Applied Biosytem's Profiler Plus® Kit. At a later date, the samples were also amplified using Applied Biosystem's Cofiler® Kit.

After injection into Applied Biosystem's 310 Genetic Analyzer®, analysis was performed using Applied Biosysem's GeneScan® and Genotyper®. This analysis revealed severe peak imbalances in several specimens at D3S1358 (in both Profiler Plus® and Cofiler®), Amelogenin (in both Profiler Plus® and Cofiler®), D8S1179, D21S11, D5S818, D13S317, D7S820 (in Profiler Plus® only) and actual complete loss of heterozygosity at D5S818 and D13S317 in two samples. As seen in the data, the loss of heterozygosity was neither more prevalent in the smaller systems nor the larger systems. The peak imbalances varied from sample to sample inasmuch as there were not only differences in the percentages of peak RFU's, there were also discrepancies as to which systems revealed peak imbalances. Throughout all thirteen loci, no more than two alleles were observed.

Several months later, tissue slides prepared at autopsy were received and tested using methods identical to those used for the lung tissue slides. Although the autopsy slide tissue seemed to be more degraded than the lung tissue slides, the results obtained showed the same peak imbalances consistent with a loss of heterozygosity.

Heterozygosity, STR, Cancer

B167 Patterns of Allele Sharing in 13-Locus DNA Profiles of Siblings and Other Relatives

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After attending the presentation, the participants will gain an understanding of the usefulness and limitations of assessing whether similar DNA profiles may come from related individuals. Determining such relationships can be a valuable tool in conducting criminal investigations.

This presentation will impact the forensic community and/or humanity by demonstrating Identifying the likelihood that DNA profiles are from close relatives can be of great value to criminal investigations. This can aid investigators in identifying new suspects, and may result in faster apprehension of perpetrators of serious crime.

In criminal investigations involving DNA evidence, it can be useful to know if DNA profiles may have come from related individuals. Previous studies have shown that the profiles of siblings match at six of the thirteen CODIS loci, on average. Since matches at five or six loci are not uncommon in unrelated individuals, the authors would like to assess whether two similar profiles are the result of coincidence or biological relationship. Profiles from over one hundred sets of siblings were compared, along with other first and second-degree relatives. The average number of identical loci (both alleles shared) in full siblings was 4.7, with a range of 1 – 9. The average number of non-matching loci (neither allele shared) was 1.5, with a range of 0-5. These results were compared with a database of several hundred unrelated individuals, with primary focus on those unrelated profiles with were identical at four or more loci. The average number of non-matching loci in these pairs was approximately 4, with a range of 1-9. Thus, the number of non-matching loci is the best predictor of whether two similar profiles are more likely from siblings than from unrelated individuals. However, because there is substantial overlap in the ranges, caution should be used when assessing the possible biological relationship of persons with similar DNA profiles. Another factor that should be considered is the overall expected frequency of the 13-locus profile. One individual in the database showed a high degree of similarity with a large number of unrelated profiles, matching at seven loci in two separate instances. The overall expected frequency of this profile is approximately 1 in 1 trillion (FBI Popstats). While this exceeds the threshhold for declaring identity, it is considerably more common than the frequencies observed for most 13-locus profiles.

The results of this study have proved useful in several cases in the authors' jurisdiction. In one such case, a bottle was obtained from the trash of a possible suspect in a series of sexual assaults. A 9-locus DNA profile obtained from the bottle matched the semen profile at six loci and shared one allele at the three other loci, a strong indication that the DNA on the bottle came from a sibling of the perpetrator (the suspect shared the house with two brothers). Based on this information, surveillance was increased on the suspect and a DNA sample was obtained when the suspect blew his nose and discarded the tissue on the sidewalk. This sample matched the semen profile from the sexual assaults, leading to the arrest and conviction of the rapist.

DNA, STRs, Siblings

B168 Application of Multiple Displacement Whole Genome Amplification to Forensic DNA Analysis

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The goal of this presentation is to convey research findings evaluating the fidelity of whole genome amplification by multiple displacement amplification from DNA extracted from aged bloodstains.

This presentation will impact the forensic community and/or humanity by describing research on the forensic applicability of a technique which may allow forensic scientists to overcome the problem of limited sample sizes and open the door for many additional types of forensic DNA analysis that can be useful in the investigation of crime.

The recent completion of the human genome sequencing project has created many opportunities for further elucidation of human genetics. Such

advances continue to fuel the explosive growth of forensic DNA technology. The bottleneck in forensic science is that the quantity and condition of forensic evidence samples frequently limit the extent of analysis. Recent improvements in whole genome amplification may allow forensic scientists to overcome the problem of limited sample sizes and open the door for many additional types of forensic DNA analysis that can be useful in the investigation of crime.

Multiple displacement amplification (MDA) is a method of whole genome amplification (WGA) which is capable of providing large quantities of human genomic DNA from limited sample sources. It is a relatively new method which, although validated for various types of clinical samples (whole blood, cheek cells, etc.), has yet to be tested on the type of samples commonly encountered as forensic evidence. This research seeks to determine whether WGA/MDA is a suitable means of amplifying human genomic DNA from samples of a forensic nature. Current forensic DNA methods amplify targeted areas of the human genome in order to produce a genetic profile for the sample of interest. However, forensic evidence samples are frequently limited to that which is collected from a crime scene. A method that could accurately and representatively amplify the entire sample genome would provide sufficient DNA for multiple analyses and for archival storage. Minute samples could be amplified to ensure a sufficient quantity of DNA for both prosecution and defense teams to analyze. Amplification of the entire genome would also create sufficient DNA to analyze genomic loci that provide information useful in determining phenotypic characteristics of the unknown source of biological evidence from a crime scene.

This research will determine whether WGA/MDA can provide accurate STR profiles from DNA extracted from dried bloodstains. Blood will be drawn from anonymous donors for the preparation of control DNA and bloodstains. Control DNA will be extracted from fresh blood. Known volumes of blood will be stained onto a white cotton substrate, dried, and stored at room temperature. Stains will range in size based on the original volume of fresh blood used to stain the substrate: 1µl, 10 µl, and 50 µl. As an extraction control, the same volumes of blood will be aliquoted directly into microfuge tubes and stored under the same conditions as the blood-stained swatches. DNA will be extracted from the stains and extraction controls at various time points, ranging from Day Zero to 10 weeks, using Gentra's PureGene kit. Extracted DNA will be quantitated using PicoGreen fluorescence. DNA extracted from aged bloodstains and extraction controls will be amplified using Amersham's GenomiPhi Kit. Control DNA from the freshly drawn blood will also be amplified to compare the aged versus control DNA. The amplified DNA will be quantitated using PicoGreen fluorescence. The whole genome amplified DNA will then be analyzed for 7 of the 13 short tandem repeat (STR) loci required by the FBI for inclusion in the CODIS database system. The seven STR markers are D5S818, D13S317, D7S820, FGA, D3S1358, D21S11, and D18S51. Control DNA that has not been amplified via GenomiPhi will also be analyzed in these 7 loci. STR profiles from control DNA will be compared to the STR profiles obtained from the GenomiPhi amplified aged bloodstain samples to determine if the latter samples are capable of providing accurate DNA profiles.

Forensic DNA Analysis, Multiple Displacement Amplification, Whole Genome Amplification

B169 Degenerate Oligonucleotide-Primed PCR: 'Proofreading' a Method for Forensic DNA Analysis

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The goal of this research project is to provide the forensic DNA community with a Whole Genome Amplification (WGA) tool – Degenerate Oligonucleotide-Primed PCR (DOP-PCR) – that can readily increase the success rate of analysis of degraded, aged, or otherwise compromised biological evidence samples using existing conventional lab technologies and standard procedures for data analysis. This presentation will aim to build upon the data that was previously presented by showing improved amplification success using a dual-enzyme approach.

This presentation will impact the forensic community and/or humanity by allowing for an increased success rate for cases where a very low amount or unusable DNA was obtained from a crime scene, either through lack of evidence altogether or through severe degradation of samples. These samples can be analyzed by technicians without additional training or equipment, and with minimal additional costs to the labs.

Whole genome amplification techniques have been utilized in a number of molecular diagnostic areas, including embryonics, cancer biology, histopathology, and in a variety of studies on molecular diseases and genetic linkage. Degenerate Oligonucleotide-Primed PCR (DOP-PCR) is one such whole genome amplification technique which allows for low copy number DNA samples to be preamplified such that high quality, high yield DNA samples can be available for downstream forensic STR amplification and analysis. Thus far, standard DOP-PCR techniques have shown to sufficiently generate enough high yield, high molecular weight DNA for STR analysis by capillary electrophoresis. However, results show some preferential amplification and allele/locus drop out in these subsequent multiplex STR amplifications. By adding a proofreading enzyme (i.e., *Pyrococcus furiosus)* in a small ratio to the *Thermus aquaticus* enzyme currently used with DOP-PCR and increasing extension times during thermalcycling, longer-sized products should be achieved. This will greatly reduce the preferential amplification and allele/locus drop out seen in multiplex STR amplifications. Initially, input DNA amounts ranging from 0.25 nanograms to 7.5 picograms were tested in four DOP-PCR setups using either *Taq* enzyme with *Taq* buffer, *Pfu* enzyme with *Pfu* buffer, 16:1 *Taq*/*Pfu* enzyme combination in *Taq* buffer, or 16:1 *Taq/Pfu* enzyme with *Pfu* buffer in either 50ul or 100ul reaction volumes. All resulting DNA was visualized by agarose gel electrophoresis and human DNA was quantitated by the traditional Quantiblot method. Preliminary results indicate that while the standard DOP-PCR reaction (using *Taq* enzyme in *Taq* buffer) produced products with a size range of approximately 250bp to 2,000bp, the *Taq/Pfu* enzyme combination produced products with a size range of approximately 500bp to over 5,000bp. Additionally, preliminary data from the *Taq/Pfu* enzyme combination experiments indicate that input DNA amounts as low as 7.5 picograms (~2 cells) yielded enough DNA to be visualized on a 1% agarose gel, and DNA yields increased by several thousand-fold for samples with as low as 62 picograms input DNA. Further research will evaluate the ability of DOP-PCR products produced with the enzyme combination approach to generate a correct profile with distinct and balanced peaks at all multiplexed STR loci with minimal stochastic variation. In addition, other DOP-PCR enzyme combinations and WGA techniques will also be evaluated in a similar manner.

These research findings will impact the forensic DNA community by allowing for an increased success rate for cases where a very low amount or unusable DNA was obtained from a crime scene, either through lack of evidence altogether or through severe degradation of samples. These samples can be analyzed by technicians without additional training or equipment, and with minimal additional costs to the labs.

Whole Genome Amplification, DNA, STR Analysis

B170 Assessment and In Vitro Repair of Damaged DNA Templates

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Attendees will learn methods for the assessment and repair of damaged DNA templates derived from forensically relevant samples.

At the present time, little is known about the damage done to the DNA in biological stains exposed to various exogenous insults. This presentation will impact the forensic community and/or humanity by presenting the first comprehensive study of this damage at the molecular level and intoduce methods for the repair of the damaged DNA, facilitating the recovery of a genetic profile.

DNA extracted from biological stains is often intractable to analysis. This may due to a number of factors including a low copy number (LCN) of starting molecules, the presence of soluble inhibitors or damaged DNA templates. Remedies may be available to the forensic scientist to deal with LCN templates and soluble inhibitors but none presently exist for damaged DNA. In fact, knowledge of the biochemical nature and the extent of DNA damage in physiological stains is rudimentary at best. Also unknown is the point at which the damage inflicted upon a particular sample precludes the ability to obtain a genetic profile for purposes of identification. Therefore, the primary aims of this work were first ascertain the types of DNA damage encountered in forensically relevant stains, correlating the occurrence this damage with the partial or total loss of a genotype, and then to attempt the repair of the damage by means of *in vitro* DNA repair systems.

The initial focus of the work was the detection of damage caused by exogenous, environmental sources, including factors such as UV irradiation, heat, and humidity. By incorporating various lesion specific enzymes, a set of assays, both PCR and gel-based, have been developed which describe the type and extent of damage inflicted upon DNA, both in a hydrated and dehydrated state. Using these procedures, the major causes of damage have been identified and their effects on genetic profiling assessed.

Armed with this knowledge, the next focus was the repair of the damage by means of *in vitro* DNA systems. Efforts have been concentrated on base excision repair, single strand gap repair, and translesion synthesis assays. By modifying the assays and employing various combinations of the systems, a genetic profile has been obtained from previously intractable samples.

DNA Damage, In Vitro DNA Repair, Lesion Specific Endonucleases

B171 Age Determination: The Identification of Newborns Using Messenger RNA Profiling Analysis

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Attendees will learn a method to determine if a bloodstain originated from a newborn baby.

This presentation will impact the forensic community and/or humanity by demonstrating the development of a novel method, which can be incorporated into the forensic laboratory, to aid in investigations concerning bloodstains thought to originate from newborns.

It is now a matter of routine for the forensic scientist to obtain the genetic profile of an individual from DNA recovered from a biological stain deposited at a crime scene. Potential contributors of the stain must either be known to investigators (i.e., a developed suspect) or the questioned profile must be searched against a database of DNA profiles such as those maintained in the CODIS National DNA database. However, in those instances where there is no developed suspect as yet or there is no match with any database sample, the DNA profile *per se* presently provides no meaningful information to investigators, with the notable exception of gender determination.

To aid in these investigations another useful biometric that could provide important probative information is the age of an individual. For example, the ability to provide investigators with information as to whether a DNA donor is a newborn baby, an adolescent teenager or an elderly individual could be useful in certain cases, particularly those involving young children such as kidnapping or in providing additional intelligence during terrorist investigations. Currently no reliable validated molecular tests are available for age determination.

The lifecycle of humans comprises a number of developmentally recognized stages. As the human proceeds through these developmental stages, sub-sets of the 30-50 thousand human genes will be differentially expressed. Theoretically, and given sufficient knowledge of developmental genetics, a determination of the global gene expression profile could reveal constellations of genes whose expression is correlated with a specific age.

One example of how developmental regulation of gene expression can lead to the determination of age is by examining the ß-hemoglobin locus located on the short arm of chromosome 11 (11p15.5). This chromosomal region encodes five functional ß-like globin genes, ε, γ^G, γ^A, δ and ß, each with a specific pattern of highly regulated developmental gene expression. In the first weeks of neonatal development embryonic hemoglobin (ξ^2, ε^2) is produced by the yolk sac. Around twelve weeks of gestation embryonic hemoglobin synthesis decreases and the fetal liver, spleen, and bone marrow begin producing fetal hemoglobin (α^2, γ^2), which continues throughout fetal development. Shortly after birth fetal hemoglobin production decreases and the synthesis of adult hemoglobin (α^2, ß^2) rises and is the major form of hemoglobin present throughout life. Therefore, the development of an assay which selectively identifies an increased presence of fetal hemoglobin (γ chain) in a biological stain, would infer that the donor of the stain is a newborn baby.

Descrived here are two novel methods which assay the age related levels of variant forms of gamma hemoglobin (HBGv) present in bloodstains, with an increased level of expression being indicative of the newborn status of the individual. The first method is a duplex reverse transcription-polymerase chain reaction (RT-PCR) and allows for the determination of a newborn based on a present / absent gamma hemoglobin product, along with the presence of an internal control, the ribosomal protein S15. A second real-time-PCR (qPCR) assay, can distinguish between newborns and other age groups by evaluating the ΔC_t values (C^t S15 - C_t HBG) generated. A positive ΔC_t value would indicate that a bloodstain originated from a newborn; in contrast a negative ΔC_t value would be obtained with all other ages.

Age Determination, Identification of Newborns, Messenger RNA Profiling

B172 mRNA Profiling: Body Fluid Identification Using Multiplex Real-Time PCR

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Attendees will learn a novel means of identifying body fluids of forensic interest.

This presentation will impact the forensic community and/or humanity by demonstrating the mRNA based approach, such as the multiplex real-time PCR method described here, possibly allowing for the facile identification of body fluid stains and is one of many assay platforms that could conceivably supplant the battery of serological and biochemical tests currently employed in the forensic serology laboratory.

Conventional methods of body fluid identification use labor-intensive, technologically diverse techniques that are performed in a series, not parallel manner, and are costly in terms of time and sample. Furthermore, for some frequently encountered body fluids no confirmatory technique exists. There is no definitive test, for example, for the presence of saliva or vaginal secretions. In seeking to develop novel multiplex (i.e., parallel) analysis procedures for body fluid identification that are compatible with current DNA analysis procedures, The authors have chosen assays based upon messenger RNA (mRNA) since it is expressed in a tissue type specific manner. Terminally differentiated cells, such as blood lymphocytes, ejaculated spermatozoa, or epithelial cells lining the oral cavity, have a unique pattern of gene expression, which is evinced by the presence and relative abundance of specific mRNA species. If the type and abundance of mRNAs can be determined in a stain or tissue sample recovered at the crime scene, it would be possible to definitively identify the tissue or body fluid in question. Advantages of an mRNA-based approach, compared to conventional biochemical analysis, include greater specificity, simultaneous, and semi-automated analysis though a common assay format, improved timeliness, decreased sample consumption, and compatibility with DNA extraction methodologies.

It was previously reported that it is possible to isolate total RNA of sufficient quality and quantity from biological stains to enable subsequent detection of particular mRNA species using the reverse transcription-polymerase chain reaction (RT-PCR) technique and that has identified candidate sets of blood-, saliva-, semen-, vaginal secretions-, and menstrual blood-specific genes using a combination of literature and public database searches.

In the present work, the authors report the development of a set of multiplex real-time PCR assays for the definitive identification of blood, saliva, semen, vaginal secretions, and menstrual blood. Real-time PCR employs a 5' nuclease assay to detect specific amplimers and eliminates the need for post-PCR processing and gel electrophoresis. The real-time instrument is capable of multi-color detection, and so by using probes labeled with different reporter fluorophores, it is possible to develop multiplex assays for body fluid identification. Real-time PCR also has the ability to quantitate target sequences, which is important in establishing the tissue-specificity of a gene product, particularly when the relative abundance of a number of different mRNAs can demonstrate a unique or restricted pattern of expression.

Real-time PCR triplexes were developed that are composed of two body fluid-specific genes and one housekeeping gene and have been optimized for the detection of blood, saliva, semen, vaginal secretions, and menstrual blood as single or mixed stains. The methodology is based upon determining the delta C_t (ΔC_t) values generated using the C^t for the housekeeping gene (HSK) and the C_t for each of the body fluid-specific genes (BFG) (C_t HSK- C^t BFG). Depending upon the body fluid-specific gene being tested, a positive ΔC_t value would indicate the presence of a particular body fluid, while a negative ΔC_t value would indicate the absence of that body fluid.

An mRNA based approach, such as the multiplex real-time PCR method described above, could allow the facile identification of the tissue components present in a body fluid stain and is one of many assay platforms that conceivably could supplant the battery of serological and biochemical tests currently employed in the forensic serology laboratory.

mRNA Profiling, Multiplex Real-Time PCR, Body Fluid Identification

B173 Individualization of *Acer rubrum* Using Amplified Fragment Length Polymorphism

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Attendees will learn how the AFLP technique is a rapid, inexpensive, and efficient method that can be used to genotype DNA from botanical material. Within the closed set of samples used in this study, the AFLP profiles were species specific and unique.

AFLP is a rapid, cost-effective, simple, and robust method that can be used to genotype DNA of any origin and complexity. The technique can be used by forensic scientists to type DNA from nonhuman biological evidentiary material (plants, insects, and animals). This presentation will impact the forensic community and/or humanity by adding to the repertoire of techniques available to forensic scientists and increase the probative value of nonhuman DNA evidence.

Amplified fragment length polymorphism (AFLP) is a powerful method that combines techniques from classical hybridization-based and PCR-based genotyping strategies. AFLP was used to genotype leaf material from red maple trees, *Acer rubrum*, which are widely distributed throughout much of the United States and Canada. Duplicate samples from 40 *Acer rubrum* trees were collected from four different sites in central New Jersey. Samples from five additional species were collected for comparison. One set *Acer rubrum* samples was used to establish a DNA database. The second set of *Acer rubrum* samples and the comparison samples were analyzed and compared to the AFLP profiles in the database to determine the discriminative capacity of the technique.

The AFLP protocol was performed using components from the AFLP Core Reagent and Preamp Primer Mix I kits (Invitrogen, Rockville, MD). Genomic DNA was double-digested by two restriction endonucleases: *EcoRI* and *MseI*. The DNA fragments were ligated to *EcoRI* and *MseI* oligonucleotide adapters to generate primer binding sites. In this manner a select set of DNA fragments can be amplified without knowledge of the sequence. Two consecutive PCR reactions (preamplification and selective amplification) were performed. In the preamplification reaction DNA fragments were amplified using primers complementary to the adapters and adjacent restriction sites with one selective nucleotide at the 3' ends: *EcoRI* (5'-GACTGCGTACCAATTC**A**-3'; *MseI* (5'- GATGAGTCCTGAGTAA**C**-3'). During selective amplification the products of the preamplification reaction were amplified using a primer pair with three selective nucleotides at the 3' ends: *EcoRI* [5'- (dyeD4) GACTGCGTACCAATTC**ACT**-3', Proligo, Boulder, CO] labeled with the fluorophore (D4-WellRed, Beckman Coulter); *MseI* (5'- GATGAGTCCTGAGTAA**CAT**-3', Invitrogen). The primer design and amplification strategy ensured that only a subset of the EcoRI- MseI fragments was preferentially amplified.

The DNA fragments were separated by capillary electrophoresis using the CEQ 8000 DNA Fragment Analyzer. Data were analyzed using the CEQ 2000XL (Beckman Coulter) and Twin Peaks (authors, proprietary) software.

Within this closed set, AFLP profiles were species specific and unique. The individualization of plant matter will enable forensic scientists to derive more information from evidentiary material and to help link a suspect or a victim to a particular crime scene (source tree).

DNA, AFLP, *Acer rubrum*

B174 Extraction and Amplification of Nuclear DNA From Shed Dog Hairs

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Attendees will learn how to successfully extract and amplifly several highly variable canine microsatellites for unique identity testing from shed dog (*Canis familiaris*).

Upon completion of this research DNA profiles of unrelated dogs from different breed origin will be produced. This will not only provide verification of identity but will also display genetic diversity within inbred dogs. This presentation will impact the forensic community and/or humanity by providing a valuable asset to forensic science by opening new possibilities for linking suspects to crime scenes or victims.

Hypothesis: That it is possible to extract genomic DNA from shed dog hairs to facilitate the animal's identification, parentage verification, and possibly link suspects to crime scenes or victims. At present, very little effort has been made to extract nuclear DNA from dog's hair and in previous studies this has often been proven unsuccessful. This study, however, provides information on the retrieval of genomic DNA from shed dog hairs and has shown that though difficult it is indeed possible.

Text: DNA profiling of STR loci is now well established and extensively used for human identity testing such as identification of missing persons, investigation of crimes, cases of disputed paternity, investigation of mass disaster, and solving historic cases. However, the process of individual genetic identification has not been limited to human; attention has been paid to other organisms, including farm animals and pets. In addition to parentage verification and identification, nuclear and mitochondrial DNA profiling of animal samples (blood, saliva, tissues, and hairs) has contributed to homicide investigations and convictions.

Shed animal hair is one of the most common biological materials recovered during forensic evidence collection. Extraction and successful PCR amplification of DNA from recovered hair could provide powerful intelligence to aid criminal investigations. Previous studies have however, shown that shed hairs contain only minute amounts of undegraded DNA, therefore analysis of nuclear DNA is mostly unsuccessful. This paper however, presents results of genetic profiling of nuclear DNA extracted from naturally shed dog hairs. Experimentation with three different extraction methods was undertaken, a modified Chelex extraction method proved the most successful in extracting amplifiable nuclear DNA. Modifications of the Chelex extraction include pre-extraction preparation with proteinase K, incubations at 56°C and 100°C plus micro-concentration of the solution. The quantity of extracted nuclear DNA was shown to be adequate for PCR based typing at 3 loci. This study shows that nuclear DNA can reproducibly be obtained from shed dog hairs.

Dog Hair, DNA Extraction, DNA Profiling

Engineering Sciences

C1 Injury Pattern Analysis in Fatal Traffic Crash Investigation

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After attending this presentation, attendees will understand some principles of crash investigation, the necessary elements for the application of Injury Pattern Analysis, characteristic injury patterns of certain types of crashes, and an example of a practical application of Injury Pattern Analysis

This presentation will impact the forensic community and/or humanity by serving as a key aspect of fatal crash investigation as it can augment traditional means of investigation in a systematized format via interdisciplinary communication and collaboration.

Reconstruction of a fatal crash can be augmented, in certain circumstances, by information gleaned from the postmortem evaluation. Further improvement of the scope and accuracy of an investigation can result from evaluation of the injuries of crash survivors, taking into account the conformity of individual vehicle interiors as well as the movement of the occupants during the crash.

The term "Injury Pattern Analysis (IPA)" is proposed as a description of a fatal crash investigation technique that utilizes accident investigation, and reconstruction techniques, occupant kinematics, postmortem records, hospital and healthcare provider acute injury records, and other evidence as an adjunct to the investigation of homicides resulting from fatal crashes.

The authors present a case study in IPA as an example of the practical application of the technique. It is recommended that medicolegal death investigators become familiar with the principles of IPA.

Crash, Fatal, Investigation

C2 Numerical Models in Motor Vehicle Accident Reconstruction With Case Studies

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The goal of this presentation is to equip the attendee with an understanding of which collisions are suitable for numerical simulation techniques and some of the sensitive and insensitive input parameters used in the simulations.

This presentation will impact the forensic community and/or humanity by making the forensic community aware to highlight sensitive input parameters in commercial accident reconstruction simulation software and contrasts some of the available software. This presentation demonstrates that a variety of computer programs are capable of generating similar and accurate results.

Reconstruction of a motor vehicle accident using different computer software packages renders similar results if the packages are used appropriately. However, pre and post impact driver actions/reactions need to be interpreted with caution and can affect the results of the analysis.

High-speed collisions can be analyzed using several available tools, which are more directly applicable than for low speed collisions. This is due in part to the fact that much of accident reconstruction theory and available test data originated with test speeds in the 30-35 mph range. A brief overview of the types of tools available for reconstructing high-speed accidents is presented. Several popular computer programs employing these tools and the associated assumptions are utilized in case studies. A high-speed crash test in which one vehicle is driven into the side of a stationary vehicle and an actual "real world" left turning accident with two moving vehicles are used for illustration and comparison of the available methods and computer packages. Several computer programs, which are widely used for accident reconstruction, are used to reconstruct the collisions. The programs WinSlam© and EDCRASH™ are used to analyze the impacts from an energy standpoint. The programs PC Crash, EDSMAC4™, and DyMESH® simulate the impact and subsequent post-impact travel. The results of the various methods and their relationships to the known crash test parameters will be addressed. Additionally, some of the assumptions and inputs required by the tools are varied to illustrate their effects on the final results.

Some simulation programs are not always directly applicable to low velocity impacts. "Low velocity" impacts between motor vehicles is a somewhat arbitrary term that here will refer to collisions involving very little or no physical crushing of the vehicles. Low velocity collisions often cannot be adequately analyzed using some traditional high-speed numerical techniques.

Accident Reconstruction, Computer Modeling, Simulation Comparison

C3 Weakness in the Numerical Models Used in Accident Reconstruction Programs

John J Smith, MSEE, MSBMT, Raymond P. Smith and Associates, 43766 Buckskin Road, Parker, CO 80138*

After attending this presentation, attendees will understand the limitations of using computer programs in accident reconstruction.

This presentation will impact the forensic community and/or humanity by identifying the limitation of the computer programs allowing the forensic community to understand when the results provided are significant and when they have little value.

In the last several years, there has been an increasing usage of equations from various programs, like CRASH (Calspan Reconstruction of Accident Speeds on the Highway) and SMAC (Simulation Medel of Automobile Collisions), their derivatives, and other programs to determine pre impact and post impact velocities of vehicles. The use of equations from various programs, without regard for the underlying simplifying assumptions and checking routines, leads to errors and inaccuracies.

The underlying physics of accident reconstruction has been analyzed and compared to the assumption used in several programs. The first area addressed were those based on CRASH. The analysis was performed by comparing the simplifying assumptions in the programs to the actual values expected in collisions. Additionally the simplifying assumptions were checked for internal consistency. One area of particular concern was if the program violated a simplifying assumption required in the derivation of the equations necessary to develop the program. As an example, if the underlying equations used a simplifying assumption of homogeneity and then the program instructed the user to input values that established the surface was not homogeneous, this was identified as a potential problem. Finally, the computer-generated results of tests were compared with the actual speeds of the vehicles to determine if the program was accurate

A fundamental principle of mathematics is that for every unknown in a problem, a separate, independent equation must exist in order to arrive at a unique solution. In accident reconstruction the common unknowns of interest include: the mass of Vehicle 1, the mass of Vehicle 2, the initial speed of Vehicle 1, the initial speed of Vehicle 2, the final speed of Vehicle 1, the final speed of Vehicle 2, the approach angle of Vehicle 1, the approach angle of Vehicle 2, the departure angle of Vehicle 1 and the departure angle of Vehicle 2.

Less common, although often-critical variables include, tire forces, friction, steer angles, stiffness values, slope, surface material, and tire design.

In order to resolve the problem, equations are often solved simultaneously. Common fundamental equations used are conservation of linear momentum, conservation of angular momentum, conservation of energy, the principle of restitution, Newton's Laws of Motion, and the basic equations of motion. As the complexity of the problem increases, more equations are required to achieve a unique solution. As the number of variables and equations increase, the use of computers becomes more beneficial. This, in turn, explains the proliferation of programs available.

Even the use of computers does not relieve the investigator of the basic need of a separate equation for each variable. Compounding the problem is the use of quadratics, in some of the equations, since quadratics usually do not have a unique solution. For this reason, it is common to use simplifying assumptions and secondary equations such as those postulated in the work of Campbell or McHenry. Often these secondary equations are based on the same or additional assumptions.

As a result of the analysis it was determined that the numerical models used to predict the impact speed of vehicles have several limitations. The underlying simplifying assumptions used to derive the equations of the CRASH model in particular were found to have numerous problems. Among the critical assumptions identified in the derivation of the algorithm were several that were immediately violated by the program. These assumptions included that the vehicles act like a mass with a spring, the spring constant is constant, only plastic deformation occurs, the spring constants for both vehicles are equal, crush is symmetrical on both vehicles, the crush distance equals the acceleration distance and the system acts like a simple harmonic oscillator. Occasionally some of these assumptions are met, but it is rare that all are met and it is common that none are met. Typically, the program requires the operator to violate most, if not all of these assumptions.

In addition to the primary part of the program, the crush coefficients used are derived by a separate approach that uses many of the above assumptions and actually adds additional ones including the assumption that the vehicles are homogenous both vertically and horizontally.

The full-scale crash test run to validate the model actually showed that the results had no statistical significance. In some cases the program returns impossible answers. In other cases, the error associated with CRASH predictions has been observed to exceed 100%.

The use of CRASH, and its derivative programs, to reconstruct automobile collisions is valid only under certain conditions. The results obtained have limited statistically value. Anytime the programs are used, the assumptions should be checked for validity and how well the assumptions are met by the facts of the collision.

The approach used in this analysis has application in evaluating the reliability of any program used in accident reconstruction.

Computer Model, Accident Reconstruction, Crash

C4 Understanding Injury Potential in Low Damage Automobile Collisions

Peter Alexander, PhD, Raymond Smith & Associates, 43766 Buckskin Road, Parker, CO 80138*

The goal of this presentation is to provide further insight into correlation between vehicle damage and impact severity.

Observation of body damage coupled with frame deformation may provide criteria by which to judge impact speeds in situations where a visual examination of the vehicle shows little or no damage. This presentation will impact the forensic community and/or humanity by describing impact speed thresholds, which can prove helpful in understanding the injury severity in what otherwise, might appear to be a very low speed impact.

INTRODUCTION: Raymond Smith and Associates is sometimes confronted by cases in which a vehicle has been impacted by another vehicle, resulting in little or no visible damage. The driver of the target vehicle has sustained some fairly serious injuries, as determined by their physicians. How can the significant occupant injuries be reconciled with the apparent lack of significant vehicle damage? An approach has been developed, which demonstrates that in a number of these cases, despite the absence of obvious visible vehicle damage, the frame (or unibody) of the target vehicle was deformed by the force of the collision.

A number of recent cases involve collisions in which a vehicle's driver or passenger sustained significant head, neck, and back injuries. A physician diagnosed the injuries. The vehicle inspection often showed little to no obvious visible damage. Sometimes the bumper cover was scuffed, or there was a slight indentation in the bumper cover. Detailed body shop repair estimates for the vehicles, when available, showed either no damage or a need to replace only the bumper cover.

A reconstruction expert claimed that because the damage level was so low, the bullet vehicle impact speed was under 5 m.p.h. and the speed change of the injured party's target vehicle was less than 3 m.p.h. Thus it was unlikely that they would have been injured.

THE APPROACH: When examining the target vehicle, the author looked at the fit of the hood, the trunk lid, and the doors. The eye can easily see a distortion of less than 1 millimeter in the fit of these items. If the spacing between these components and the vehicle's body appeared to be uneven, a precision frame measurement was recommended. In every one of 14 recent cases, where visual evidence of external body distortion was observed, the precision frame measurement verified that the frame or unibody had been deformed beyond factory specifications. The 14 cases shown in Table 1, involved different vehicles impacted from the front, the rear, and the sides.

In most of the cases where this method was applied, the frame or unibody distortion was approximately 1 centimeter. This is not necessarily sufficient to cause difficulty steering, or uneven tire wear. It is, however, indicative of a very forceful impact at a speed far above the 5 m.p.h. cited by the other expert.

If no evidence of frame distortion was observed, removal of the bumper cover and disassembly of the bumper system often revealed deformation of the underlying bumper structure. Following the collision, in several cases, the bumper cover popped back out to its pre-impact position, masking the damage.

Frame deformations of ~1 centimeter are indicative of impact speeds in the range 15 to 25 m.p.h. This speed range can be identified because, in a number of cases where frame distortion was observed, the impact speed could be independently determined based on post impact movement of the vehicles involved. Bumper damage generally does not appear in vehicle-to-vehicle collisions below 8 to 10 m.p.h. Frame distortion is generally not seen below 12 to 15 m.p.h. At impact speeds in excess of 25 m.p.h. one would expect to see serious body damage to the vehicles.

The literature contains reports of numerical modeling efforts, which attempt to correlate the forces imposed on a vehicle, in a collision, with the expected deformation of the vehicle. At present, these models are still in their infancy, and are not capable of predicting the type of deformations, which are the subject of this paper. At some point it may be possible to determine the impact speed, which caused a particular frame deformation, using a finite element numerical modeling approach.

UNDERSTANDING INJURY POTENTIAL: The technical literature supports the view that there is no minimum or threshold vehicle impact speed (or speed change) required for occupant injury to occur. Logically, the higher the speed change, the greater the probability of injury. A portion of the impact energy is channeled into the vehicle's occupants. Injury to the occupants can occur as a result of the acceleration forces and from interaction between the occupant and the interior components of the vehicle, including the seat belt. Observation of body damage coupled with frame deformation may provide criteria by which to judge impact speeds in situations where a visual examination of the vehicle shows little or no damage. The impact speed vs. damage described can prove helpful in understanding the injury severity in what otherwise might appear to be a very low speed impact.

Table 1 FRAME/UNIBODY DEFORMATION CASE TABULATION

IMPACTED VEHICLE	IMPACT LOCATION	IMPACT SPEED (mph)	REPAIR $	DEFORMATION (mm)	INJURY
1992 Nissan Maxima	Left Side, L.F. Tire	25-35 Tire Involvement	4691	4	Lumbar, required spinal fusion
1995 Honda Accord	Left Front End	25-35 Tire Involvement	6805	6	No data
1997 Ford F150 PU	Right Rear	37-40	1954	7	Ruptured L5-S1
1994 Dodge Ram 1500 PU	Rear	15-25	3367	14	Herniation L5-S1
1992 Buick Le Sabre	Rear	>25	736	32	Stenosis at L3/4 , L4/5 and L5/S1
2000 Ford E250 Van	Front & Rear	Moderate	3839	5	Brain injury
1995 Ford Explorer 2WD	Rear	20-35	4031	18	Herniation L4/5 and L5/S1
1998 Toyota Corolla	Rear	15-25	422	6	Required spinal fusion
1992 Ford T.Bird	Rear End	20-25	5354	11	Herniated disk at L5
2002 Saab	Left side, front tire	20-35	-	38	Cracked teeth, back problems
1989 Ford Tempo	Rear	22	~500	11	Herniated disks C4-C5
1991 Chevrolet Blazer	Rear End**	20-35	2888	8	3 back surgeries: laminectomy, fusion
1998 GMC Suburban	Rear End	15-25	110	8	Closed head injury, cervical injuries
1999 Jeep Wrangler	Rear End	20-25	None	17	TMJ, Back injuries

Injury, Collision, Frame

C5 A Proposed Practice for the Correct Forensic Interrogation of Non-Volatile Memory Data in Evidentiary Vehicle Electronic Control Units

William Rosenbluth, MS, Automotive Systems Analysis, Inc., 12015 Canter Lane, Reston, VA 20191*

This presentation will impact the forensic community and/or humanity by discussing information on new forensic practices and procedures in a new and growing area of forensic technical investigation, electronic data recovery and documentation. It is important for the practicing forensic professional be familiar with proper procedures so that he or she can avoid pitfalls or errors that can jeopardize forensic findings and Court credibility, because existing practices and procedures often do not cover methods of electronic data recovery and documentation.

SYNOPSIS: This presentation discusses methods and considerations for the examination and interrogation of non-volatile memory data in evidentiary vehicle electronic control units (ECUs) that may have been involved in an event or incident that may be reasonably expected to be the subject of litigation. This practice is intended to become applicable when it is determined that examination or interpretation of such non-volatile memory data may produce probative evidence. These methods are being considered for a new *Practice for the Investigation of Non-Volatile Memory Data in Evidentiary Vehicle Electronic Control Units*, currently being considered by ASTM committee E30.05 on Forensic Engineering.

LEARNING OBJECTIVES: By observing the elements of this proposed protocol, the attendee will learn several methods for conducting an examination for the controlled interrogation of the data in a subject vehicle electronic control unit (ECU). Such data may be saved in ROM, EPROM, EEPROM[1] or flash-memory, all of which are non-volatile forms of memory. The retrieval of such data is commonly referred to as a download of information from the subject device[2].

A further objective of this proposed protocol is to retrieve any such data with the highest assurance of not changing or disturbing that data, either by erasure or overwriting. Such a download is referred to as a *forensically neutral*[3] download. A forensically neutral download can be accomplished with a load box/interface containing proper electrical loads and interfaces, or by using an exemplar vehicle for the same purpose. An example of a non- forensically neutral download is shown in Figure 1, and an example of a forensically neutral download is shown in Figure 2.

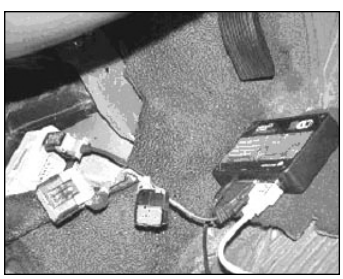

Figure 1

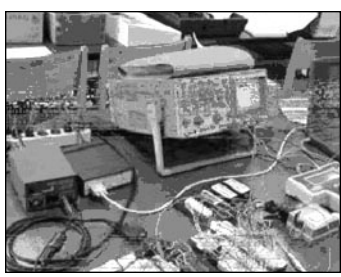

Figure 2

Certain commonly used commercial interrogating tools are not forensically neutral when used in a direct umbilical mode to interrogate SRS ECUs (i.e., a direct connection to the SRS ECU). In that mode, certain external fault codes will be added (or re-detected) because there is no provision for proper dummy-load resistors in the tool cabling. If the data of interest is not changed (e.g., crash data parameters), then a non-forensically-neutral interrogation may be acceptable. If certain fault codes are of

interest, then a non-forensically-neutral interrogation may not be acceptable. If a potential DTC data change is not acceptable, other test equipment, laboratory breadboards and/or the use of an exemplar vehicle can avoid this problem. In general, it is expected that the test conductor will have a proper test fixture, and a proper exemplar component to demonstrate that his/her test bed is forensically neutral.

If the subject component is considered as evidence in litigation, and the manufacturer or supplier of the subject ECU is, or may be, a party to that litigation, it shall be considered standard practice to give the opportunity of first (qualified, non-destructive, non-intrusive, non-altering) download to the manufacturer or supplier of the ECU, with all adverse parties observing. This does not apply to exploratory interrogations or analyses of ECU components, which may be considered exemplar components.

THEORY OF THE ANALYSIS: Electronic data within any ECU is an encoded representation of information, constants and variables used to govern the function of an electronic control unit, as well as to describe and document the version and level of such data. Such data are normally saved in a binary bit format. In order to create a concise representation of such data, it is usually represented by eight binary bit values, and these values are commonly represented as bytes of data, each byte having a specific memory address. Although most of the data referenced in this practice are saved in EEPROM, certain other data can be saved in ROM, EPROM or flash memory.

In general, the test conductor should perform two test series, with two devices under test (DUT). The first series should involve an exemplar device (to provide a baseline verification of the test fixture) and the second series should involve the subject ECU.

A. Power off test fixture (can include optional use of subject/exemplar vehicle as test fixture).
B. Select DUT.
C. Install DUT. DUT installation should include physical stability integrity if there is any chance that physical movement during the interrogation cycle will change the data within the DUT.
D. Power on test fixture with DUT installed. Observe MIL codes and other-indicator status. Visually record.
E. As appropriate, interrogate DUT with standard scan tool to observe scanner data (DTCs & PIDs). Save data as appropriate (photographically, computer data file, hardcopy, etc.)
F. Interrogate DUT with interrogation tool to download EEPROM and/or selected PID information (RAM, ROM, EAROM, EEPROM). Save data as appropriate (photographically, computer data file, hardcopy, etc.)
G. Re-interrogate with standard scan tool to record scanner data (DTCs & PIDs). Save data as appropriate (photographically, computer data file, hardcopy, etc.)
H. If no exceptions, power down and remove DUT.
I. Select next DUT as applicable and repeat steps 1-8. (For subject DUT, repeat EEPROM download procedure twice.)
J. End test operations.

[1] EEPROM = Electrically Erasable Programmable Read-Only Memory. EEPROM is made by using a special semiconductor construction that allows it to retain previously stored data even when the battery is disconnected. Flash-memory has similar characteristics to EEPROM, and that technology is also commonly used to save music or digital camera images in other commercial devices.

[2] Common usage identifies "download" as the process of interrogating an on-vehicle ECU and recording that data on an external diagnostic ECU (laptop computer), and that common usage is preserved herein. When requesting PID information that usage is reasonably applicable. However, strictly speaking, SAE J2190:4.23 identifies that the process of requesting the transfer of data from an on-vehicle ECU to an external ECU (Mode $35) is called an upload request, whereas the process of requesting the transfer of data from an external ECU to an on-vehicle ECU to an (Mode $34) is called an download request. Again, to avoid confusion, common usage is preserved herein.

[3] Not all electronic data interrogation processes are *forensically neutral*. A *forensically neutral* interrogation is one that will neither add or subtract error codes (DTCs) or crash data information from any ECU under interrogation. This applies to in-vehicle and bench top interrogation processes, including ECUs interrogated via direct umbilicals while still mounted in a vehicle. To be *forensically neutral*, such a unit must include provisions for actuator (squib, solenoid, etc.) dummy loads, sensor detection loads, MIL loads, serial feedback or for seatbelt switch status, so that any ECU undergoing such test-via-umbilical-interrogation will see only a correct operating environment during power-on and continuous loop checks.

Electronic Data Recorders, Forensic Neutrality, EDR Protocol

C6 The Need for Adequate Strength Seat Back Design - A Case Study

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After attending this presentation, attendees will understand an analysis of an automobile collision during which a rear seat occupant was ejected while wearing a 3-point lap and shoulder belt.

This presentation will impact the forensic community and/or humanity by demonstrating how an inadequate seat back design, while certified by federal safety standards, failed and resulted in catastrophic injuries

THEORY OF THE ANALYSIS: Seat back strength is essential in order to provide adequate protection and containment of occupants in passenger vehicles. Seat back failure as a result of rear-end collisions reduces the potential for occupant restraint and increases the risk of occupant ejection. Federal Motor Vehicle Safety Standard (FMVSS) 207 establishes the requirements for seat assemblies and their attachment hardware to minimize the possibility of component failure by occupant forces acting on them as a result of vehicle impact. However, real world rear-end impacts have shown that inadequate strength seat back designs can lead to lack of restraint and ejection of vehicle occupants.

COLLISION OVERVIEW: On the evening of October 6, 2002, a young male driver was operating his 2000 model year passenger vehicle at high-speed. Onboard were passengers in the right front seat and right rear seat. As the vehicle entered a downhill right-hand turn, the driver lost control and the vehicle began to yaw counter-clockwise. The vehicle veered left, crossing the opposing traffic lane, and struck a guardrail at the roadway edge. The initial guardrail strike was to the vehicle's right front corner. The principal direction of force (PDOF) of this impact was approximately 90 right of center. As a result of the right front impact, the vehicle continued to rotate counter-clockwise and struck the guardrail at the right rear corner. Rotating through this right rear corner impact, the rear of the vehicle then impacted a guardrail post. The impact to the right rear corner along with the rear guardrail post impact had a combined change in velocity of approximately 12.1m/s with a PDOF of 150 right of center. After separating from the guardrail, the vehicle continued to rotate counter-clockwise until it rolled to a stop on the shoulder.

FORENSIC ANALYSIS: Inspection of the seat belts revealed forensic evidence confirming that all three passengers were wearing their 3-point lap and shoulder belts at the time of impact. In addition, photographs taken by investigating officers show the right rear seat belt still fastened at the collision scene.

The right rear seat back was deformed due to occupant loading during the rear impact. In response to this impact and subsequent vehicle rotation, the right rear occupant ramped up the seat back, sliding under the seat belt, and was ejected through the rear hatchback window. The ejected occupant sustained fatal head injuries. The autopsy report revealed this occupant suffered an atlanto-occipital disarticulation, brainstem laceration and contusion, multiple skull fractures, and bilateral cerebral subdural and subarachnoid hemorrhage.

The subject vehicle rear seat back is a 50/50 split-back design such that either half can be independently unlatched and folded forward to increase cargo space. The latching mechanism for the left and right seat back panels are located outboard on the interior of the vehicle quarter panels. There is no restraining device or reinforcing structure at the centerline of the upper area of the seat back, except for a narrow fiberboard shelf behind the seat that conceals the rear cargo area when the hatchback is closed.

FMVSS 207 section 4.3.2.2 specifies the acceleration requirements for the restraining devices of hinged or folding seat backs of forward-facing seats. The section requires that once engaged, the device shall not release or fail when subjected to a horizontal acceleration of 20gs opposite to the direction the seat back folds. Section 5.1.2 of the standard specifies the testing procedure such that the horizontal force is applied through the CG of the seat back panel. The right rear seat back panel has a mass of approximately 4.5kg: therefore, at 20gs a total force of approximately 890N would be applied. Based on the location of the latching mechanism and hinge point of the seat back panel, the 890N-applied force would subject the latching mechanism to a force of approximately 672N and the hinge point to a force of approximately 218N.

A simple haversine analysis was used to determine the peak acceleration of the vehicle as a result of the rear impact. Assuming a collision pulse duration of 100ms, the resulting peak acceleration was approximately 24.6g. Medical records indicate the right rear occupant had a mass of 115kg, approximately 14 percent greater than the mass of a Hybrid III 95th percentile male test dummy. The mass and CG location of the individual torso and upper body components of a 95th percentile ATD were used to approximate the CG height of the effective mass of the right rear occupant. The effective mass, approximately 70% of the overall mass, is that portion of the occupant's mass that loaded the seat back panel in the rear impact. The CG height of the effective mass is approximately 30.5cm above the seat cushion surface. Based on this analysis, the potential peak force applied to the latching mechanism was approximately 9,200N, and the potential peak force applied to the hinge point was approximately 8,400N.

The potential peak forces applied to the latching mechanism and hinge point in the subject collision far exceeded the forces required by the seat back panel restraining devices to satisfy FMVSS 207. However, these calculated potential peak forces are not unlike those forces reasonably anticipated in real world collisions of this magnitude. Clearly, the seat back panel and its restraining devices were inadequately designed resulting in catastrophic failure in this unfortunate collision event.

CONCLUSION: Seat back yield strength is an important consideration in foldable rear seat back designs. Anticipated occupant loading forces resulting from real world collisions far exceed the static force requirements used to certify seat back designs. Inadequate strength restraining devices can lead to seat back failure and increase the risk of occupant ejection.

Seat Back Strength, FMVSS 207, Occupant Loading

C7 Go-Cart Fatality, Engineering Case Analysis

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The goal of this presentation is to present a typical product liability case which illustrates many aspects of engineering design for consumer products, and considers the special requirements and duty of care when the consumer market includes children.

This presentation will impact the forensic community and/or humanity by demonstrating the complete cycle of consumer product design, marketing, consumer injury (fatality), litigation, engineering investigation, trial, jury verdict, and government (CPSC) response to remedy the product by recall. All too often, the process is short circuited by settlements, without addressing the possible latent hazards in consumer products.

Summary/Outcome: This paper presents the findings of an investigation into the circumstances of a go-cart fatality. A 13-year-old girl was driving a go-cart when her long hair was caught in the rotating machinery behind the seat. The case (Woodburn v Manco) went to trial, and the plaintiff's verdict resulted in a recall of the go-carts. The presentation will include exhibits from the investigation and trial, with data and commentary. This typical product liability case illustrates many aspects of engineering design for consumer products, and considers the special requirements and duty of care when the consumer market includes children.

The young driver was presented the cart, her brother's, and instructed in its use. She was provided with her father's motorcycle helmet, and tucked her long braided hair into her T-shirt, and then proceeded to drive the go-cart in a completely fenced dirt corral. The tire tracks show regular large circles, about 75 feet in diameter in an unobstructed venue. Her brother, nearby, investigated when he heard the engine idling for a prolonged time.

Preliminary work included the examination of coroner's photos that were taken at twilight and included a cover over the victim. Photogrammetric techniques were used on an exemplar go-cart to determine the victim's actual position in the go-cart. An autopsy was not performed, and the cause of death was attributed to a neck fracture at C1-C2. Further photogrammetric studies helped determine the likely length of the victim's hair prior to the accident.

A key element of this case was to establish the likely seating position of the victim, and the range of positions that the foreseeable go-cart user population may assume. Exemplars of wigs were used in conjunction with a subject pool of young and older male and female drivers of varying statures. The wig enabled a study of the location of the long braided pigtail, both in a tucked-in location in the driver's T-shirt, and in the free position, dangling behind the go-cart seat.

A further study illustrated the foreseeability of long hair in the general population in both male and female drivers. The evidence presented showed that the go-cart industry and their component suppliers had a long-standing knowledge of prior scalping incidents involving long scarves, long hair, and other clothing. However, the testing by the manufacturer and remedial actions were cursory, incomplete, and ineffective. These included a recall based on a rear axle entanglement accident.

One of the consequences of the prior cases was the attempt by the manufacturer to warn the user by means of a label, and instructions. These Human Factors engineering related issues proved to be inadequate, given the well understood hierarchy of remedial engineering safety actions, namely that a warning is not an adequate resolution of a known hazard when a design change can eliminate the hazard. One of the engineering aspects of this case was the demonstration that a simple guard, at a nominal cost was sufficient to eliminate the nip point, the physical root cause of this fatality. Indeed, after this accident, the go-cart industry adopted a safety standard that incorporated just such a guard.

The accident itself was linked to the speed of the vehicle, largely unknown since there were no witnesses at the time. However, a simple analysis suggests that even at moderate to slow speed the entanglement occurred in fractions of a second. The neck fracture was thus almost instantaneous. An opposing expert argued that a proper fitting helmet would have somehow ameliorated the situation, while another offered the opinion that based on his questionnaires, the girl was operating the vehicle in an unsafe manner, and that her parents were negligent in letting her drive. This was part of the defense strategy to allocate blame to the plaintiffs, Idaho being a comparative fault State, wherein a 50% negligence finding negates any award in favor of the plaintiffs.

The verdict of the jury trial found in favor of the plaintiff's, but the defense succeeded in persuading the jury to find 50% contributory negligence thus negating the damage amount. On the basis of the verdict however, the Consumer Products safety Commission (CPSC) directed a product recall in August of 2000 for 91,000 Go-Carts manufactured by Manco Products Inc., of Fort Wayne, Ind. The jury verdict regarding the negligence was appealed to the Idaho State Supreme Court, but did not prevail.

Go-Cart, Human Factors, Anthropometry

C8 Momentum and Elastic-Plastic Vehicle Collisions: A *Daubert* Accuracy Analysis

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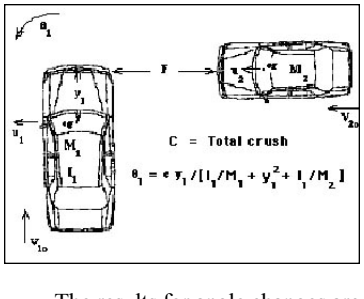
The goal of this presentation is to present to the forensic engineering community an analysis of the validity of a momentum and elastic-plastic model for vehicle collisions to examine the *Daubert* error requirement.

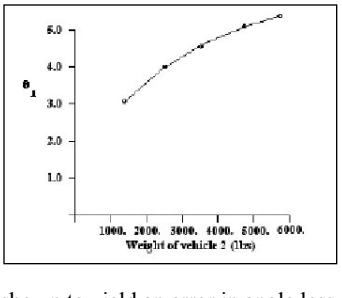
This presentation will impact the forensic community and/or humanity by examining the theory of three methods for predicting velocity in accident reconstruction. It makes clear that the method using pre- and post-impact motion in comparison with the highway witness marks is the most accurate. As such, it provides a means for guaranteeing the civil rights of defendants in criminal actions.

This paper will present an analysis of the right-angle impact between two 4-wheeled passenger vehicles that are defined by their dimensions, masses, moments of inertia, and vehicle crush. The equations of mechanics in impact are integrated using a Taylor's expansion of the impact force, proving that the error in the mean force is proportional to the time of impact if the first term in the series is defined by the impulse between the vehicles. The equations are also shown to be invariant with respect to the impulse on first integration.

The second integration to yield the displacements at impact is shown to have meaning only if measurable crush is found on the vehicles. By using an elastic-plastic model for crush and demonstrating that the elastic motion is dominated by the plastic crush, closed-form expressions are derived for both the *time-of-impact* and the *mean force of impact*.

The error analysis for the *Daubert* requirement on accuracy continues with the developments from the equations of mechanics. By using the *time-of-impact* derived from the crush, the angular changes of a target vehicle of 4105 lbs (1866 kg), moment of inertia of 2285 lb sec ft^2, and bullet vehicles between 1500 lbs (682 kg) and 6000 lbs (2727 kg), shown in the figure below, were found.





The results for angle changes are shown to yield an error in angle less than 5^o that produces a cosine of 0.996 and a sin of 0.087. This proof demonstrates that impulsive motion theory can be used to study pre- and post-impact motion, validating the requirement of *Daubert* on knowledge of error.

By using a standard ASTM tensile test for a body part of an American car, the theory of plasticity is shown to closely approximate a perfectly plastic steel model, at least for moderate strains near the yield point. The error induced by ignoring *strain hardening* is estimated and the resulting errors in approach and departure velocities are determined for the common pair of vehicles in the example.

Finally, the *chaos* in crash testing of vehicles to determine the coefficients of crush is examined relative to the requirements of *Daubert*. In this study, the literature has been searched to examine multiple crash tests of identical vehicles in identical crashes. The *theory of chaos* is shown to apply to these crash tests because the deformation of the vehicle in crush is dependent on small changes in the initial conditions of the crash in both the structural geometry and in the angles of approach. *Chaos* appears in the results because these small changes in initial conditions cause disproportionately large changes in the folding patterns of the vehicle panels and beam supports. As is predicted by the *theory of chaos*, derived crush coefficients have considerable variation. Even with a large sample size, there can be no guarantee that a given crash will follow one family of crush parameters over another. It would seem that the *finite element method* would yield the best results, assuming that the vehicle is available so that the crush sequence can be defined and measured. This makes the analysis a deterministic model.

The closure of the paper describes the validation of the theory of the basic equations of mechanics through the study of impulse-momentum. It cautions the accident reconstructionist to make sure that predictions for the motions of the vehicle come from both the *witness marks* on the highway (using photogrammetry) as well as any crush and momentum simulation attempted. Of particular concern is the use of such impact models to determine speed when it is known that *chaos* is present in the crash tests from which crush data are determined. The authors' conclusion is that it is better to use the equations of dynamics to study the highway *witness marks* than to depend on v calculations of a chaotic system.

Impact, Momentum, Chaos

C9 How Prevalent are Defective Automobile Air Bags?

Peter K. Alexander, PhD, PE, Raymond Smith & Associates, 43766 Buckskin Road, Parker, CO 80138*

The goal of this presentation is to address questions regarding the reliability of automobile air bags.

This presentation will impact the forensic community and/or humanity by answering questions regarding the reliability of automobile air bags.

INTRODUCTION: The automobile air bag is just one part in a complex electronic and mechanical system designed to inflate the air bag at the proper moment. Air bag malfunctions can manifest themselves in four ways. The air bag can deploy for no reason, the air bag can deploy early or late, the air bag can inflate only partially when full inflation is called for, or the air bag can fail to deploy when it should have. This paper addresses only the last issue.

Raymond Smith and Associates is currently working on 4 separate cases in which air bags failed to deploy. A reconstruction of the collisions showed that in all these cases, the air bags should have deployed. This surprisingly large number of failure to deploy cases raises the following question. Are there a large number of defective air bag systems in the current vehicle population?

CRITERIA FOR AIR BAG DEPLOYMENT: In general the air bag should deploy in a frontal or side impact if the speed change induced by the crash is between at least 15 m.p.h. The air bag should never deploy at a speed change of less than 9 m.p.h.

The speed change required for deployment with some of the newer two stage airbags and smart air bag systems that identify whether the occupant is small and sitting close to the air bag, can be higher.

CRITERIA FOR AIR BAG NON DEPLOYMENT TO MANIFEST ITSELF: Three things have to happen before an air bag non-deployment event will come to public attention.

1) The air bag system must be faulty
2) An accident must take place, where deployment should have occurred but did not
3) An injury sufficient to raise the visibility level of the failure, occurred

The air bag system contains sensors, a microprocessor, the air bag charge, the air bag, and a significant quantity of electronic circuitry. Due to the complexity of the system, there can be a large number of reasons for the air bag not to deploy when it should have deployed. Among the reasons the system might fail to deploy are the items that follow:

- An open circuit or communication failure within the system
- A short circuit within the system
- Sensor drift or improper sensor calibration
- Voltage drift in the power circuitry
- Software malfunction
- A microprocessor malfunction
- A faulty air bag charge
- Environmental issues, such as moisture or contaminant intrusion during production or while in use
- Poor system maintenance (an error code is displayed, indicating a problem, but no repair is performed)

THE MAGNITUDE OF THE PROBLEM: A sense of the seriousness of the air bag failure to deploy problem can be gained from examination of the National Highway Traffic Safety Administration's National Accident Sampling System Data. Every year the U.S. Government examines, analyzes, and documents key elements of a sampling of U.S. vehicle crashes. Most years the sampling contains data from 4,200 to 4,400 crashes.

Selecting from the NASS database one and two vehicle crashes, which involved frontal impacts resulting in a speed change in excess of 15 m.p.h. produced the data shown in Table 1. This vehicle speed change should have caused the air bags, in air bag equipped vehicles, to deploy.

Table 1 Air Bag Deployment and Non Deployment Collisions for 2 Injury Levels

YEAR -Injury Severity	COLLISIONS WHERE AIR BAG DEPLOYED**	COLLISIONS WHERE AIR BAG SHOULD HAVE DEPLOYED BUT DID NOT	% OF COLLISIONS WHERE AIR BAG SHOULD HAVE DEPLOYED BUT DID NOT
1998			
All Injuries	335	8	2
Serious Injury *	115	1	0.8
1999			
All Injuries	362	20	5
Serious Injury	131	5	4
2000			
All Injuries	397	24	6
Serious Injury	143	2	1
2001			
All Injuries	383	17	4
Serious Injury	118	4	3
2002			
All Injuries	457	24	5
Serious Injury	173	6	3

* Serious Injury is defined on the Abbreviated Injury Scale (AIS) as 3 to 5. An AIS 1 injury is relatively minor. AIS 5 injuries are fatal.
** Air bag deployed as a result of the collision

The table shows that, averaged over the 5-year period 1998-2002, the air bags did not deploy when they should have in 4% of the frontal crashes involving all injury levels. The non-deployment rate was 2% for crashes involving serious injury (AIS level 3 to 5).

It should be noted that the NASS statistics only document injuries that are apparent at the time of the accident. In many cases the seriousness of an injury may not be recognized for hours or days after an accident. Other serious injuries may not be well represented in the NASS database because the AIS scale was designed to categorize life-threatening injuries. On this scale the loss of an eye rates as an AIS 2 injury.

As "smart" air bag systems are introduced, a rise in the non-deployment figures due to an increase in the sophistication and complexity of the air bag systems may be seen.

If the nationwide percentage of vehicles with air bags that have the potential to fail to deploy was 4%, it would suggest that among the 170 million vehicles on the road today, there are millions of defective air bag systems, which will not deploy when needed. This poses a potentially significant risk to the public.

Air Bag, Automobile, Non-Deployment

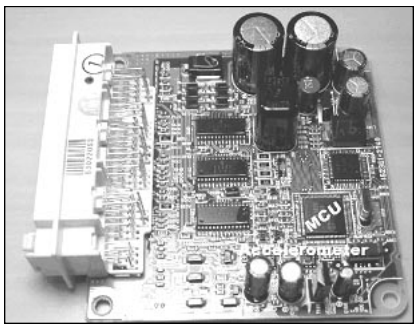
C10 A Method for Evaluating the Reliability of EDR Crash Data and Considerations of Consistency Between EDR Crash Data and Post-Accident Artifacts

William Rosenbluth, MS, Automotive Systems Analysis, Inc., 12015 Canter Lane, Reston, VA 20191*

By describing these efforts and methodology, the attendee will learn the methods of characterizing crash sensor sensitivity. These methods include an introduction to the identification and analysis of public accelerometer specifications and to public micro controller specifications as can be identified from a teardown analysis of the EDR series to be investigated. This analysis is illustrated with an algebraic derivation of EDR unit data sensitivity using binary and hexadecimal arithmetic. Lastly, the process to derive a cumulative velocity loss from a hexadecimal crash record will be shown for an example.

This presentation will impact the forensic community and/or humanity by teaching the attendee to de-mystify the subject of black box data and black box data analysis by seeing practical examples of technical analysis. This will allow the attendees to extend their existing forensic skills, abilities and professionalism by applying them to an area scientific investigation where pre-2000 skills are often inadequate.

SYNOPSIS: This analysis illustrates a method of evaluating the reliability crash record data in Event Data Recorder (EDR) and includes a discussion of the consistency of EDR data with the physically reconstructed evidence after a collision. The method described illustrates an engineering analysis to determine the calibration of an electronic crash sensor, and then requires using series of calibrated acceleration pulses impinged on an exemplar electronic crash sensor to document its response to known input pulses. These steps allow the investigator to derive a calibration transfer function for the raw EDR data versus a known calibrated acceleration input. Once the relationship between the saved EDR data and the external calibrated acceleration pulse is known, the subject electronic crash record could be evaluated for consistency with the physically documented reconstruction evidence.



LEARNING OBJECTIVES: By describing these efforts and methodology, the attendee will learn the methods of characterizing crash sensor sensitivity. These methods include an introduction to the identification and analysis of public accelerometer specifications and to public micro controller specifications as can be identified from a teardown analysis of the EDR series to be investigated. This analysis is illustrated with an algebraic derivation of EDR unit data sensitivity using binary and

hexadecimal arithmetic. Lastly, the process to derive a cumulative velocity loss from a hexadecimal crash record will be shown for an example.

THEORY OF THE ANALYSIS: The steps required to accomplish this analysis had to focus on several problems:

Retrieving the Crash-Related Data The first problem to be solved was to develop the ability to read the crash-related data inside the appropriate event data recorder (EDR). This required a study of SAE and ISO guidelines and specifications for vehicle networks, and a verification of which particular sub-specification applied in the instant case. This was done using several vehicle network analysis tools as a network traffic monitor for manufacturer/aftermarket scanner equipment doing similar or partial interrogations. In general, the retrieval development process had to include:

A. Interrogation of the target EDR so as to obtain the desired electronic information [e.g., EEPROM/Flash-memory hexadecimal data]. This information is often enclosed within interrogation commands and responses, not part of the actual desired information.

B. Parsing is the next step. Parsing is the process of extracting the desired electronic information from within the undesired interrogation commands and responses.

C. Formatting, the next step is the process of assembling the parsed data into a structured format so that it can be easily read and interpreted. This often involves adding address identifiers and spaces between data elements.

D. Translation is the fourth step, is the process of performing an evaluation of the address-identified data elements into meaningful engineering units. Data element translation is usually accomplished in accordance with a standard specification such as SAE J2178-2, SLOT instructions [scaling, limits, offset and transfer function guidelines]. Meaningful engineering units allow the investigator to report such parameter facts as acceleration, timing, seatbelt usage, instantaneous velocity change, cumulative velocity change, etc.

E. Interpretation of the translated data is the fifth step. Data interpretation involves evaluation of the reported and translated data with respect to their consistency with complementary investigator findings and conclusions [e.g., reconstruction, bio-mechanics, human factors, etc.].

Deriving a Scaling and Transfer Relationship From the Data. A standard for interpreting ECU data hexadecimal values is given as an SAE SLOT definition for the parameter saved at that address, so that the ECU data can be readily interpreted and used for engineering analysis. In general, information for specific ECU SLOT definitions is not publicly available, so it was required to open the appropriate ECU and photographically document its componentry, specifically, its accelerometer and its micro controller. An example of such a photographic documentation is shown in Figure 2.1. Once the key components are identified, as in this case, industry specifications will reveal the SLOT factors specific to those components. As a tutorial example,

A. We assume that the micro controller used an 8-bit A/D converter with a 5,000-volt reference.

B. We assume that the accelerometer used has an output sensitivity of 40G/volt, or 1G/0.0250 volt or 0.0250 volt/1G.

C. We assume that acceleration A/D counts are represented in EDR memory where each byte (8 bits) is a separate value.

For an 8-bit A/D converter as assumed above, it is known that its hexadecimal count range is $00 to $FF (0 dec to 255dec). It can be determined (from manufacturer public specifications) that its full count (255 dec) represents 5.000 volts and that it is a linear radiometric device. Thus, each linear count represents 5.000/255 volts or 0.0196078 volts.

For the accelerometer assumed above it can be determined (from manufacturer public specifications) that its nominal sensitivity of that device is 0.0250 volts/G or 1G/0.0250V.

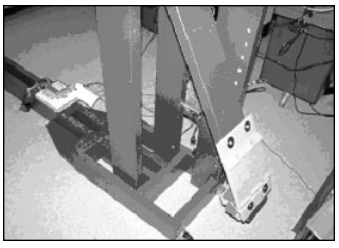
$$\frac{0.019698V}{1count} \times \frac{1G}{0.02500V} \equiv \frac{0.78792G}{1count}$$

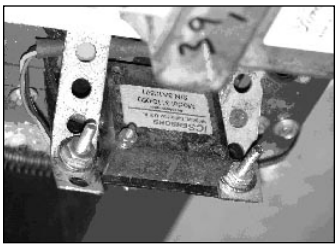
Using those two data specifications, the subject EDR data byte acceleration data sensitivity can be calculated as:

for each byte of an acceleration record.

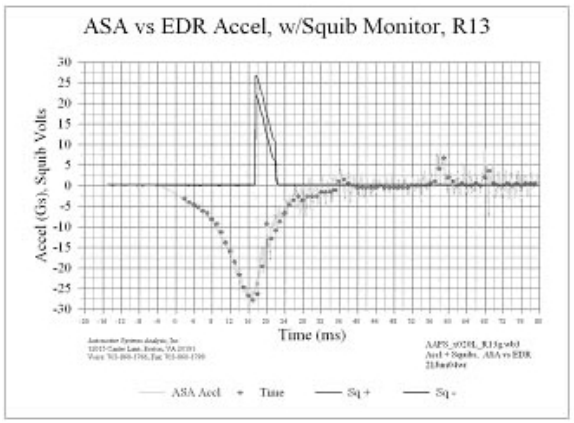
Some EDRs report their crash-related data in units of direct acceleration per time period ($a_{(t)}$), some report units of averaged acceleration per time period $\langle a_{(t)} \rangle$ and others report their data in units of cumulative velocity change per time period time ($\Delta v_{(t)}$) . Of course, for any unit time period (t_p), the period velocity change, $v_{(t)}$ is no more than the product *of* $a_{(t)}$ t_p, thus, any subsequent validation of EDR Delta V analysis is really validating the analysis of acceleration recording capability. The above discussion assumes that a reasonably complete crash pulse function is being analyzed. However many EDRs may report their data as a different function that incorporates only a portion of, or derivative of, $a_{(t)}$ or $v_{(t)}$. One such value that may be reported is the cumulative velocity at the time of a deploy command, $\Delta v_{(t)}|$at fire command. Next the methods and tests to determine and/or confirm such relationships are explored.

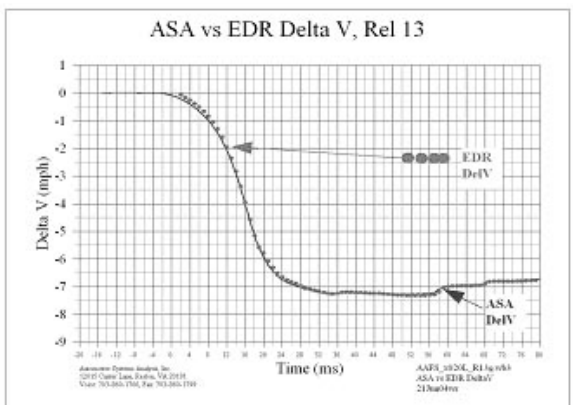
Conducting Tests to Verify the Above Analysis The ultimate validation of any theoretical analysis is a physical trial of the analysis theory. In this case such a trial consists of impinging a known calibrated acceleration pulse on an EDR and then comparing the EDR record with the known input pulse. For confidence this must be done over several calibration levels around the pulse magnitude of interest. Additionally, if the data acquisition system used to record the impinged acceleration pulse also records an air bag/pre-tensioner squib fire pulse, the time relationship from EDR acceleration record start to squib firing decision can be documented (for the test input acceleration pulse). An example of one of the calibration trial (from a process of several such trials) is illustrated the sequence of Figures 3.1, 3.2, 3.3, 3.4, 3.5. This figure sequence shows the acceleration-impingement fixture, the external recording accelerometer, the external acceleration record, the EDR acceleration record, the superposition of the EDR record on the external acceleration record and the squib fire pulse resulting from that external acceleration input. Lastly, Figure 3.6 shows a superposition of the (calculated) cumulative velocity changes for both the EDR and the external acceleration pulse. That superposition shows that the cumulative velocity changes are essentially congruent (thus proving that the EDR is recording a true representation of the input pulse that it was impinged upon it. Additionally, the time value data for the start of squib-fire time shown on Figure 3.5 is also called the time of deploy command. This time can be applied to Figure 3.6 to determine the cumulative velocity change at the time of the deploy command, $\Delta v_{(t)}|$at fire command·

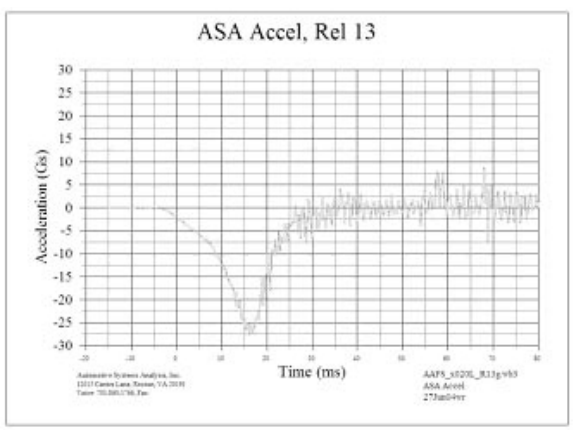


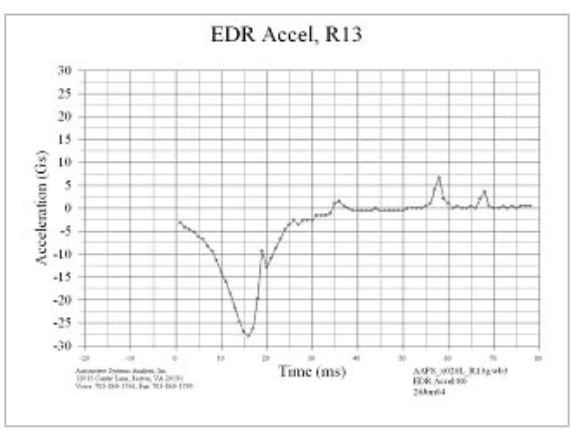


The above example illustrates a reasonably complete example for a substantially complete whole crash-event. However, a similar analysis could actually illuminate a sub-event. Postulating the sub-event as a whole event would be incorrect. Thus the investigator must consider the consistency and plausibility of the physical reconstruction assessment of the ensemble event with every EDR record analysis. Examples of plausible and implausible EDR analyses are shown to assist the investigator in future such determinations.









Electronic Data Recorders, EDR Analysis, Crash Data Analysis

C11 Multi-Variable Measurement and Comparison of Rear-Impact Head/Neck Injury Risk for Motor Vehicle Seats

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The goal of this presentation is to present a test protocol, and results, for objective measurement and comparison of motor vehicle seat safety system performance, as it relates to rear-impact head/neck injury risk factors for various size occupants subjected to a high-low range of impact severities (i.e. whiplash range up to 50 kph rear-impact levels).

This presentation will impact the forensic community and/or humanity by demonstrating the multi-variable, high-low impact, "side-by-side" test protocol, with full vehicle interiors, which provides a more accurate means for comparing vehicle safety system performance as it relates to occupant injury risk measures.

Prior studies dealing with evaluation of rear-impact head and neck injury performance of automotive seats have suggested that the more common, but weaker, single-recliner (SR) seat designs (i.e. about 3.2 kN strong), which tend to collapse rearward during rear impact, provide improved occupant protection over the much stronger and available "belt-integrated" seat (BIS) designs (i.e. about 14.5 kN strong), for impact severities ranging from low velocity "whiplash" levels (i.e. 17 kph or less) on up to more severe rear impacts of 40 to 50 kph. It has also been suggested in these studies that out-of-position (OOP) occupants in the stronger BIS designs are at greater risk of injury than if they were seated in the weaker SR seat designs. Unfortunately, these studies did not test the weaker seat performance within the full constraints of the vehicle interior and rear occupant space. These constraints include, among other things, non-yielding rear seatbacks, limited rear occupant space, hard rear surface structures like package shelves, and rear occupants themselves (such as children and infants). Also, other factors that are not likely to affect the BIS design, but can further degrade the performance of the collapsing SR seats (such as intrusion of rear seatbacks, vehicle pitch/yaw motions, and offset rear impact) have not been examined in these earlier studies.

This current study evaluates head and neck injury performance of each seat design by using a complete vehicle interior, with "side-by-side" testing of both the typical collapsing SR and strong BIS designs, for 3 sizes of restrained surrogates subjected to a "high-low" range of rear impact severity. Neck injury performance is based on the "percent risk of AIS (Abbreviated Injury Scale) 3+ injury" derived from the NHTSA (National Highway Traffic Safety Administration) combined load "Nij" values, calculated from the measured surrogate response. Head injury risk is based upon the HIC (Head Injury Criteria) curve for "percent population at risk of AIS 4+" head injury.

A typical 4-door family sedan vehicle, with full interior, was used as the baseline vehicle. Both "sled-body buck" tests and 2 complete "vehicle-to-offset barrier" pole impact tests were used. A total of 3 sled-buck tests were run at a low "whiplash" severity level (17 kph) and 6 were run at the severe high impact velocity change (50 kph) (repeat tests were run at the high impact levels). The crash pulse applied to the body-buck system was matched to the crash pulse of the actual vehicle. Three occupant sizes (i.e. 5th Female (50 kg), a 50%tile Male (80 kg), & a large Male (50%tile Male ballasted to 110 kg)) were tested for each of the 2 velocity change levels. Each surrogate was instrumented with head, upper neck and chest instrumentation. Lap belt loads were also measured. In all cases the surrogates were leaned forward "out-of-position" (OOP) from the headrests with a gap of 5 to 6 inches, to examine effects of occupants in non-optimum seating positions for both seat types (SR and BIS). The effects of "rear seatback intrusion" and "vehicle pitch" that could adversely effect the weaker SR seat were excluded in the "sled-buck" tests, so that it would be possible to evaluate the collapsing SR seat performance under optimum conditions. Ultimately, the adverse effects of rear seatback intrusion, etc, were

evaluated with the actual "vehicle-to-barrier" tests. These tests were run at the high severity level, with the heavy surrogate in the weaker SR driver seat in one test, and the other test run with the heavy surrogate in the BIS version of the driver seat. In some of the sled-buck tests a 6-year-old surrogate was placed in the rear bench seat to study other hazards of the collapsing SR seat design.

The data and results of the "side-by-side" seat tests are summarized in several tables. Included in each table is a category for "% Risk of AIS 3+ Neck Injury Potential," and "% Population at Risk of AIS 4+ Head Injury." What the results indicate is that for the strong BIS design there is no significant risk of head, neck or chest injury at either the "whiplash" 17-kph levels or the more severe 50-kph range. On the other hand, the weak SR seat demonstrates "serious and dangerous" risk of head and neck injury in the "severe" 50-kph ranges, for all size occupants, even with optimum headrest height and no adverse rear seatback intrusion or vehicle pitch/yaw effects. Also, common vehicle mounted belts were ineffective in restraining all size occupants in the collapsing SR seat design at high severities. Finally, the effects of rear seatback intrusion, and vehicle pitch/yaw, as well as impact offset, clearly increases the injury risk factors for the SR seat, but have virtually no deleterious effect on the BIS designs.

Rear-Impact, Motor Vehicle Seats, Head/Neck Injury Risk

C12 A Semi-Trailer/Ambulance Collision on a Dark and Icy Night: Proof of a Bizarre Bounce Contradicts Witness Statements and a Police Report

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The goal of this presentation is to describe an unusual motor vehicle crash in which misleading eyewitness statements and a careless police report nearly obscured the true cause of the collision. In addition to being an object lesson in the unreliability of eyewitnesses, this case should also serve to instruct attendees on how conclusive statements, even those of official police reports, may be the result of prejudice and uncritical thinking. Finally, it will reemphasize the rewards of iterative investigation techniques.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of continued analysis followed by reexamination of physical evidence suggested by that analysis is an essential part of the forensic process and can yield big returns.

The Crash: A northbound ambulance on an emergency run with its blue lights activated collided at highway speed with the side of a southbound semi-trailer hauling 45,000 pounds of paper. The ambulance came to rest in the middle of the highway, rotated about 90 ccw and the tractor-trailer came to rest alongside the snow bank lining the southbound side of the road, with the rear of the trailer several feet into the snow bank.

Road Conditions: The highway sloped downward from north to south. The temperature was near freezing, with a drizzle falling and freezing along the portion of the road to the north of the crash site, but not to the south, from where the ambulance was coming.

Driver Statements: (1) The ambulance driver stated that as the ambulance approached the tractor-trailer the latter jackknifed, its trailer swinging around to block the northbound side of the road all the way to the guardrail. (2) The truck driver said that he had slowed and pulled to the right when he saw the ambulance approaching and just after the ambulance had passed him he heard a crash and, looking back, saw that the ambulance had run into the side of his trailer, which was tracking directly behind the tractor.

Eyewitness Statements: All four persons from abutting residences who came forward were insistent that it was the fault of the ambulance driver. The witnesses depicted the ambulance as traveling at a high rate of speed and veering into the truck, which they said was traveling slowly and entirely in its own lane. A northbound driver said that the ambulance lost control after passing a vehicle at a high rate of speed, after which it crashed into the trailer, which was in its own lane of travel. Another driver, who disappeared right after the crash, said that the tractor-trailer had jackknifed, causing the crash.

Police Report: The crash occurred in early evening, after dark. The local police investigator concluded that the ambulance had caused the crash and so stated to the region's newspaper, which ran a story to this effect, amplifying it with accounts of the repeated complaints reportedly made by residents concerning ambulances speeding past their houses. It also included the erroneous police statement that the speeding ambulance was just returning to its home station and not on an emergency run.

Physical Evidence: The most striking physical evidence was a 50-foot stretch of chewed-up guardrail on the northbound road edge was chewed-up. The top of the guardrail was originally a few inches higher than the bottom of the anti-underside bumper (ICC bumper) on the trailer. That bumper showed massive damage to all areas and it was clear that it had been struck either by the ambulance or by the trailer tires, the carriage for which had been dislodged from its mounts on the trailer's underside. The damage to the trailer, including paint transfer, showed that the ambulance had struck it approximately in the middle and then had slid along it until coming into contact with the trailer's front left outboard tire. (The trailer had dual tandem axles positioned near its aft end.)

The ambulance displayed massive damage to the front left quarter extending back to the region behind the driver's seat. There was essentially no damage to the right side of the ambulance.

The Problem: Although the guardrail damage upstream from where the vehicles came to rest strongly suggested that the truck had indeed jackknifed, the adamant statements of the witnesses initially cast doubt on that point. One of the witnesses even asserted that the ambulance post-impact caused the chewed up guardrail. However, a careful examination and re-examination of the ambulance turned up no portions of it that could have ridden the rail in the fashion required for that damage. The police report did not take that damage into account at all; by his own admission, the investigating officer never examined it closely. He was willing to say that both vehicles were slightly over the centerline and that the responsibility was therefore evenly divided.

The biggest sticking point to explaining the crash as resulting from the jackknifing that blocked the ambulance's path was the lack of damage on the right side of the ambulance. If the crash had occurred with the trailer's aft portion riding the guardrail, it would seem that the ambulance would have been forced into the guardrail; yet there was no marking on the ambulance to suggest that it had hit the rail at all. Also, it was not clear that the impact of the ambulance against the trailer would have provided the momentum necessary to swing the trailer back off the road on the other side.

The Solution: The road was so slippery at the time of the crash that the vehicle dynamics were akin to air table physics. If the truck had been jack knifing so as to bring the ICC bumper into contact with and past the guardrail on the opposite side of the road, the swinging of the trailer would not have stopped at that point, but would have continued so as to bring the outer sidewall of the trailer's left rear-most tire into contact with the guardrail. When that tire was re-examined, two horizontal wear lines at the height corresponding to the heights of the two guardrail protrusions were found. The portions of the rim corresponding to the respective centers of the two wear marks were scored in a way consistent with them having rubbed against the steel guardrail. The fact that there were two discrete wear bands had been overlooked before because of paint in the same area of the tire. Also, a faint black discoloration of the guardrail was found toward the south end of the chewed-up section. As it turned out, the impact between the front left outboard tire and the ambulance had forced the two left-side axles together so that none of the trailer tires could rotate following the impact. It was for this reason that the two parallel scuffmarks remained horizontal to the ground.

This additional evidence of contact between the trailer and the guardrail made it clear that when the truck driver slowed and pulled to the

right because of the approaching ambulance the trailer tires locked up on the very slippery surface, resulting in the jack knife. The jack knife went unnoticed by the truck driver, who was intent on the approaching ambulance. Meanwhile, the jack knife continued, the trailer tires not rotating, until the rear end of the trailer hit the guardrail on the opposite side, ultimately bringing its rear, left tire into contact with the rail. The swing continued, causing the tire to be compressed, until the rim came into contact with the rail, halting further swinging. When the swinging ceased, the trailer moved outward from the rail as the result of the force of the compressed tire on the rail. Making reasonable geometric assumptions about the compression, as well as the physical assumption that that part of the tire away from the rail did not change in shape, the reduction in volume of the tire could be estimated. The kinetic energy given to the trailer by its tire-related rebound from the rail was then equated to the tire pressure (which would have remained essentially unchanged because of the small relative volume change) multiplied by the change in volume as the tire pushed outward

$$W = p \Delta V.$$

This quantity turned out to be approximately 1,200 ft-lb, which in light of the trailer weight and moment of inertia about the fifth wheel, indicates that during the rebound the end of the trailer initially moved away from the guardrail at a speed of about 10 feet/second. As a result, an opening appeared between the trailer and guardrail by the instant of impact. In addition, the trailer was swinging away from the ambulance's lane at the time, and as a result of these two factors, the collision did not force the ambulance into the guardrail. Furthermore, this explains why, when the truck driver heard a bang after passing the ambulance, he looked back to see his trailer tracking behind the tractor. Finally, this explains how the trailer fetched up in the snow bank along its own side of the road, which was part of the basis for the witnesses and police investigator being convinced that the truck could not have been at fault.

Accident Reconstruction, Jackknife, Eyewitness

C13 Forensic Testing and the Characteristics of Seat Belt Webbing Force Limiting Expansion Loops

Kurt D. Weiss, MSME, Automotive Safety Research, Inc., 5350 Hollister Avenue, Suite D, Santa Barbara, CA 93111-2326*

After attending this presentation, attendees will have an understanding of seat belt force limiting expansion loops, the associated testing methodologies, and the force-displacement characteristics of several designs incorporated in late model vehicles.

This presentation will impact the forensic community and/or humanity by demonstrating expansion loop characteristics and providing several data points useful in analyzing vehicle occupant interaction with the seat belt system.

THEORY OF THE ANALYSIS: Seat belts remain the primary occupant restraint system in passenger vehicles. In the event of a collision, 3-point lap and shoulder belts help to reduce the risk of injury due to impacts with interior components or ejection. Seat belts offer ride-down by providing restraining forces early in the collision event, thereby decreasing the relative velocity between the vehicle and occupant. Seat belts also help distribute restraining forces over the skeletal areas of the body.

In an effort to modify occupant kinematics and to reduce the injury producing restraining forces, seat belt designs often incorporate expansion loops. An expansion loop is a commonly used force-limiting device whereby the seat belt webbing is folded along the short axis, and stitched in place by parallel rows of threading. The thread material and stitch pattern used to make the rows of stitching will tear at predetermined webbing tension levels. When the stitches tear, the webbing fold will open thereby lowering the tension in the webbing. A warning label is often visible after the stitches tear. Replacement of the seat belt assembly in this condition is strongly advised.

Testing was conducted on new and used front outboard seat belt assemblies of three different vehicle models to evaluate the percent elongation of the webbing, and to determine the force-displacement characteristics of the expansions loops. The instrumentation and scientific methodology used were typical and standard for this type of forensic testing and data acquisition.

SEAT BELT WEBBING TEST SET-UP: 14 type 2 seat belt assemblies were obtained for testing. Six new assemblies were purchased from local dealers, and eight used assemblies were obtained from salvage vehicles. Preparation of the samples included separating the webbing from the retractor mechanism. The rubber-like escutcheons that often encase the expansion loops were preserved and left intact for use in the second of two test series.

TEST SERIES: Two series of tension tests were conducted. The first series (Series A) contained 14 tests, one test per webbing sample. The test protocol was designed to determine the percent elongation of the webbing, and did not include the effect of the expansion loop. Webbing samples tested were sectioned from the portion of webbing nearest the seat belt retractor.

Webbing ends were held by split drum grips of the type specified under Federal Motor Vehicle Safety Standard (FMVSS) 209. One split drum grip was rigidly anchored to the test bench, while the other grip was secured to the crosshead of the test machine. Tension in the webbing was applied by raising the crosshead. A webbing pre-load of approximately 222.4N was used. The grip separation rate was 51mm per minute. The force was measured by a load cell. Elongation of the webbing was determined with a laser extensometer, as well as with an engineering scale, when the tension in the webbing rose to 11,120N.

The second test series (Series B) contained 14 tests, one test per webbing sample. These tests were performed to evaluate the force-extension characteristics of the expansion loop of the lap belt. The webbing section tested in this series was the portion nearest the outboard lap belt anchor. One end of the sample was secured to the test bench using the existing anchor bracket to which the webbing was sewn. The expansion loop remained concealed in its rubber-like escutcheon to maintain the original in-vehicle condition.

The other end of the webbing sample was held by a split drum grip attached to the test machine crosshead. The grip separation rate was 100mm per minute, a rate commonly used by the seat belt manufacturing industry. Force was measured with a load cell. The peak force to tear each row of stitching was determined. As tension in the webbing sample increased, the rows of stitching in the expansion loop subsequently failed. As the rows of stitching were torn, tension in the webbing decreased as a small amount of webbing was added to the sample overall length. This phenomenon produced a saw tooth-like force-displacement curve. Sample testing was stopped after all rows of stitches were completely torn.

TEST RESULTS: The results of Series A varied by vehicle model. For new samples, the webbing elongation was between 5.2% and 14.8% using the laser extensometer, and between 5.9% and 13.6% using the engineering scale. For used samples, the webbing elongation was between 5.5% and 11.4% using the laser extensometer, and between 5.8% and 10.7% using the engineering scale.

The results of Series B were dependent on the expansion loop design, i.e. by the fold pattern, the number of rows of stitching, the thread material, and the stitching pattern. One expansion loop design added an average 218mm of webbing at an average peak force of 2733N for new samples tested. The used samples added an average 267mm at an average peak force of 1900N.

Another expansion loop design added an average 238mm of webbing for the used samples. The first three rows of stitching yielded at an average peak force of 5067N and the remaining rows yielded at an average peak force of 3244N. The testing of the new sample in this vehicle model

resulted in a failure of the webbing during the test. The results of this sample were suspect and therefore not included.

The last expansion loop design added an average 248mm of webbing for the new samples. The first three rows of stitching yielded at an average peak force of 5910N and the remaining rows yielded at an average peak force of 4225N. For the used samples, an average of 231mm of webbing was added. The first three rows of stitching yielded at an average force of 4943N, and the remaining rows yielded at an average peak force of 3600N.

CONCLUSION: Expansion loops are often incorporated in seat belt designs to modify occupant kinematics and reduce occupant-restraining forces during the collision event. Expansion loops vary among vehicle models and each design exhibits unique force-displacement characteristics. Forensic testing of seat belt expansion loops can be used to quantify the force necessary to break the stitching and measure the amount of additional webbing added to the seat belt assembly. Subsequent testing results will be offered in future publications.

Seat Belt Webbing, Force Limiters, Expansion Loops

C14 Truck Unloading Caused Fatal Bunker Retaining Wall Tipover

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The goal of this presentation is to illustrate the investigations, measurements, testing and analysis, which determined the cause of a bunker wall overturning and resulted in a large settlement for the decedent's estate.

This presentation will impact the forensic community and/or humanity by demonstrating a methodology for analysis of unusual interactions of vehicles and structures, which may usefully be applied to other events of similar character.

A company in Molalla, Oregon, specialized in preparing and selling bagged bark dust and other soil amenities. The bulk bark dust was received from a single supplier, who delivered the bark dust in tractor-trailers. The bark dust was stored in open-top bunkers constructed of concrete blocks 2' x 2' x 6' with an interlocking tongue-and-groove which were stacked on the asphaltic concrete to provide the sidewall enclosure into which the trucks unloaded. The semitrailers had "walking floor" live bottoms for self-unloading. One of those bunkers was fairly close to a metal building on the property, and because there were no other sanitary facilities close by, there was a "Port-a-Potty" situated between the retaining wall of the bunker and the metal building.

The standard procedure was for the truck driver to back his truck up so that the trailer was about 6' from the wall of the bunker and then for him to wait for an observer from the processor's crew to stand by and watch the unloading and then to release the tailgate and release the brakes and begin the unloading process. The live bottom of the semitrailer would slowly move the bark dust cargo rearward, forcing the top-hinged tailgate open, and depositing the chips on the asphaltic paving in the bunker. Then, as the expelled cargo mounded behind the trailer, the tractor and semitrailer would be forced forward, allowing the mound to grow forward. At completion of unloading, the tractor-trailer would be driven forward to allow the tailgate to clear the mound and close.

The paper demonstrates a methodology for analysis of unusual interactions of vehicles and structures, which may usefully be applied to other events of similar character. On the occasion of the accident, a woman was in the Port-a-Potty; an observer from the processor's crew was not immediately available, and the truck driver decided to proceed with unloading anyway. As the unloading proceeded, the wall of the bunker tipped outward, partially crushing the Port-a-Potty against the building and exerting such pressure on the woman who was then standing that she was asphyxiated by compression of her chest and abdomen. The question was why the wall tipped.

Talbott Associates visited the site, measured the blocks of which the wall was formed, and measured the slope of the asphalt surface over which the tractor would have passed during its unloading. There was observed no foundation or soil failure. Next, the truck was examined at the supplier's yard, loaded in the manner and to the extent of the subject case. The slope of the drive on which the truck was situated was measured along its full length, and then with its brakes released, it was pulled by another truck while a dynamometer measured the force required to cause its motion. The trailer's top pivoting tailgate was measured, as were the general tractor-trailer dimensions. Observation was made of concrete abrasion marks on parts of the trailer gate.

Samples of the different grades of bark dust were taken and were used to determine its density and coefficient of internal friction, shear strength, and its lateral pressure coefficient.

Because the bunker wall had been moved and replaced since the accident, no artifacts of the accident were discoverable on the wall itself.

Structural analysis of the stability of the concrete wall revealed that it had a huge factor of safety against overturning for retaining the bark dust and wood chips. Further analysis revealed that if the tailgate did not contact the wall, the force that could have been exerted through the chips could not have been enough to tip over the wall. Analysis also indicated that even if the tailgate had made contact with the wall, the geometry and mechanics of the unloading bark would provide a forward horizontal force on the trailer which exceeds the rearward horizontal force at the tailgate to wall contact. If the brakes of the tractor and trailer were released, the force required to move the trailer forward and thus the force applied to the wall was found to be insufficient to cause a tipover of the wall even with the combined effect of the lateral pressure of the chips against the wall. Therefore, the conclusions were that the trailer was stopped too close to the wall, the brakes were still applied, and the unloading proceeded without the driver watching the process and without the observer, which was required by the normal procedure.

A videotape of an unloading procedure taken by the Oregon Occupational Safety & Health Administration was reviewed, and computerized animations were performed to illustrate the process of the accident.

Suit was filed on behalf of the estate of the decedent woman, and after the defendants' counsel's viewing the animation and other evidence; a substantial offer in settlement was proffered and accepted.

Unloading, Wall, Tipover

C15 Determination of Driver Identity in a High-Speed Vehicle Rollover: Vehicle Occupant Injury Patterns and Vaulting Velocities Correlated With Safety Defects and Accident Reconstruction

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After attending this presentation, attendees will understand forensic science techniques for determining vehicle occupant trauma pattern and vehicle collision damage, and correlation of this with scene evidence, vaulting velocities and vehicle dynamics, to assist in determination of driver identity. Attendees will also understand the application to general biomechanics, accident reconstruction, vehicle safety investigation, static and dynamic test techniques and evaluation.

This presentation will impact the forensic community and/or humanity by demonstrating a new method of utilizing static and dynamic testing as well as previously conducted non-case-related tests to determine critical factors in accident reconstruction, especially for determination of driver identity. Determination of driver identity is a well-recognized

demand for law enforcement, prosecutors, insurance companies, accident investigators, and medical examiners. A wide variety of forensic evidence identification and analysis techniques were utilized in this investigation, which occurred several years after the event.

LEARNING OBJECTIVES: The authors will present reliable forensic science techniques in analyzing trace evidence from photos, medical records and physical examination of a vehicle and accident scene. Via the scientific method, demonstrate vehicle safety failures, as well as how to utilize available test information to determine performance of vehicle subsystems and components in a unique collision.

PROPOSITION: Via the scientific method, show correlation between specific vehicle damage, occupant vaulting energy, and occupant injury, at specific points during a high-speed rollover event, as a reliable means to determine vehicle occupant identity.

SYNOPSIS: A forensic case study is evaluated which involves a single-vehicle high-speed fatal rollover accident with both occupants ejected. It was initially unknown which occupant was driving the vehicle, despite investigation by the state police and the regional medical examiner. The surviving occupant was severely brain injured with no memory of the accident. There was no witness to the rollover, which involved extensive off-road vehicle travel with significant vertical increase in elevation, followed by falling down a rocky cliff. No fingerprints, hair, blood, skin smears, fibers, fabric transfer, or other organic samples were positively identified.

Mud deposits on the vehicle interior and the lack thereof on one occupant's shoes, as well as specific evidence (or lack thereof) involving steering column, dash, control pedals, windshield, seats, seat belts, door interiors, side and rear windows, and headliner were analyzed and identified by the authors on the vehicle interior. Evidence (or lack thereof) on door latches, door structures, door window openings, exterior sheet metal, exterior mirrors and trim, axles, and numerous other exterior vehicle structures was analyzed and identified by the authors.

The occupants were ejected from different vehicle portals, at different locations, as a synergistic result of restraint system failure, seat failure, and door latch failure, correlated with vehicle collision and rollover dynamics. Occupant trauma pattern and severity was determined from photographs and review of autopsy and medical records. Occupant trauma pattern/severity and vehicle dynamics were accurately matched to vehicle interior and exterior evidence, occupant vaulting velocities, as well as occupant and vehicle final rest positions. The foregoing was correlated to evidence deposited by the vehicle, as well as each of the vehicle safety failures, to determine which occupant was ejected from which portal, at a specific place and time.

Static and dynamic testing by the authors and others was correlated with dynamic vehicle collision and rollover mechanics to also prove occupant ejection dynamics, occupant injury or lack thereof, and occupant location within the vehicle. This involved use of: A) Static and dynamic seat tests to determine that a specific seat was unoccupied at a certain point in the rollover event. B) Dynamic crash and sled tests to prove restrained and unrestrained occupant kinematics, injury level and restraint system failure. C) Static seat belt tests with human surrogates to determine likelihood of restraint system use by a specific individual.

The vehicle rollover path was accurately matched with location and type of each significant collision/ground contact, vehicle exterior damage, and vehicle parts/debris deposits. Each significant collision/ground contact was then correlated with vehicle velocity and safety failures as well as occupant ejections, vault velocities and trauma patterns.

SUMMARY/CONCLUSION: Reliable, positive identification of the driver was made via multiple cross-correlation of all the foregoing evidence with biomechanical and vehicle dynamics analysis. What may be a new technique of correlating static and dynamic test data to a specific real-world crash event was developed.

Biomechanics, Reconstruction, Rollover

C16 Conspicuity vs. Visibility in Accident Reconstruction

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The goal of this presentation is to show that the conspicuity of a hazard is a critical factor in reconstructing the visibility aspects of a collision between a vehicle and a hazard.

This presentation will impact the forensic community and/or humanity by demonstrating a better understanding of conspicuity and visibility in reconstructing the visibility aspects of vehicle/hazard collisions.

The objective of this paper is to discuss and analyze the factors that affect a driver's ability to visually perceive and then recognize hazards such as pedestrians, objects, and obstructions ahead under varying conditions of background clutter. The outcome will be to show that the conspicuity of a hazard is a critical factor in reconstructing the visibility aspects of a collision between the vehicle and the hazard.

A common cause of roadway accidents is the driver not seeing a hazard in time to respond and avoid collision. It is not uncommon for drivers who have hit pedestrians, for example, to report that they *"heard the thump but never saw him"* or that they *"didn't see him until it was too late."* When presented in court, the outcome of the case may depend on whether the jury believes the driver's testimony or concludes that since the pedestrian was in plain sight, the driver must be lying. The job of the expert, then, is to determine whether the signal value of the struck pedestrian was sufficient relative to the driver's visual field to assuredly capture the attention of all reasonable alert drivers exercising ordinary care with respect to lookout in time to enable them to respond in time to avoid collision. Through a review of published scientific literature, it will be shown that it does not follow that simply because a pedestrian, obstacle or obstruction is in plain sight that it will necessarily be perceived as a hazard and responded to in time by all reasonable alert drivers.

Under low-light-level and/or nighttime conditions, and at locations with no or minimal background clutter or visual confusion (e.g., rural settings), the visual perception and recognition of a hazard in the roadway simply requires that it be either more or less luminous than its immediate background and have a sufficient luminance and contrast to be distinguishable from its background. Contrast is related to the difference in the luminance of an object of interest and the luminance of its immediate background. Contrast sensitivity is quantitatively equal to the reciprocal of contrast threshold and represents a measure of an observer's ability to discriminate different levels of contrast. The contrast sensitivity of the human visual system decreases with age and with lower light levels.

Other factors that need to be considered in determining the visibility of a hazard under low-light-level and/or nighttime conditions are such things as observer expectancy, the age of the observer, exposure time, disability glare, light adaptation, purkinje effect, positive vs. negative contrast, headlight beam-pattern, and the relative geometry of the driver and headlights with respect to the hazard.

Under daytime and nighttime conditions at locations with significant background clutter and/or visual confusion, hazards can be perceived and recognized when they differ from their surroundings in such aspects as size, shape, luminance, color, motion, texture or some other visual disparity. Conversely, hazards that are visually identical to their surroundings cannot be seen or recognized and are said to be perfectly camouflaged.

To correctly express these concepts to a jury, it is important to understand the relevant terminology as it relates to visibility. To *detect* an object means to discover or determine its presence. A *detected* object that is also a hazard, however, may not necessarily be *recognized* as a hazard. To *see* the object, simply means to *perceive* it by the eye or by vision. To *perceive* it means to become aware of its presence through the senses (here by vision). An object is *visible* if it is capable of being seen. An object is *conspicuous* if it attracts or tends to attract the attention of an observer so as to be readily discovered by vision. Conversely, an object is *inconspicuous* if

it is not readily noticeable or discoverable by vision. The term *conspicuity*, then, is the capacity of an object to stand out in relation to its background so as to be readily discovered by vision

Even though a hazard may be in plain sight and visible, it must be conspicuous relative to its surroundings to be seen in sufficient time by all drivers. Hazards that are more conspicuous are going to be perceived quicker and therefore at greater distances than hazards that are less conspicuous. At the extremes, hazards that are highly conspicuous should be seen at the greatest possible distances and hazards that are perfectly camouflaged will not be seen or recognized at all.

In conclusion, since it is clear that hazards such as pedestrians, objects and obstructions that are more conspicuous can be seen earlier and therefore at greater distances than hazards that are less conspicuous, and since it can be shown that inconspicuous or perfectly camouflaged hazards may not be seen at all, then it follows that hazards that are less conspicuous can in fact be shown to be the primary contributing cause of being hit by vehicles with drivers exercising ordinary care with respect to lookout.

Conspicuity, Visibility, Accident Reconstruction

C17 Facial Comparison of Persons Using Non-Standardized Image Material

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The goal of this presentation is to describe quality issues and a standardized procedure to perform facial comparisons, in order to make the process of performing facial comparison as objective and consistent as possible.

This presentation will impact the forensic community and/or humanity by presenting quality issues and methods for visual comparison.

Facial recognition and comparison is still one of the 'promising' biometric systems considered, and even implemented, in security systems. Error rates at settings with equal percentage false accepts and false rejects (equal error rates, EER) of 5-10% are considered reasonably good, especially with long time-lapse (a year or more) between enrollment and surveillance. Four aspects of image acquisition are of major importance for automated facial recognition: background, lighting, camera position, and facial expression. The more variability in one of these factors, the higher the error rates. Most images of surveillance cameras are taken under sub-optimal conditions at best: backgrounds vary, lighting is poor, camera position is mostly with a downward angle, facial expressions are variable, and added to that people wear hats or disguises, and finally most images are saved at high compression levels.

It is clear from the above, that biometric systems for facial recognition are not appropriate for forensic applications. Although maybe useful in the investigational stage, the error rates, even in reasonably well-standardized images, are too high for final legal proof.

This means that visual matching does the final confirmatory check of the identity of a person. Especially in criminal cases, where the available evidence mostly is limited, but the correct identification of the criminal is crucial, the final decision will also be made by means of a visual check. However, this process is still subjective, and clear guidelines on how to perform such a comparison are hard to find. Therefore, the authors have developed procedures to standardize facial comparisons as much as possible depending on the material available.

Preferably, a comparison will take place with pictures taken from the same camera position, and from the same distance. If a person and original camera equipment are available for comparison pictures, a three-point matching method is used to position the person according to the available pictures, and a more robust comparison can be made. This also provides the opportunity to validate the comparison using the actual system: also 5-6 foils are imaged under the same circumstances, and analysis results of the foils and the suspect are compared. This will give an indication of the reliability of the facial comparison with the available system set-up.

If the original equipment is not available, or the position of the person is hard to estimate, a 3-D laser scanner can be used to build a 3-D model, followed by calculation of the most likely camera position and properties. This provides the opportunity to position suspect and perpetrator images alike, improving the comparison process.

However, in many of criminal cases, no additional comparison pictures can be made (e.g., when a crime suspect is still at large), and comparisons have to be performed using pictures from different time periods, camera positions and camera distances. Therefore, the authors have developed a procedure to standardize facial comparisons as much as possible. The method comprises description of general information concerning the material, and a step-by-step comparison and scoring of general facial features (contours, relative measures, and positions), specific features (eyes, nose, ears, mouth, neck and throat), facial lines, folds and wrinkles, and typica like scars, moles, tattoos, and piercings. This approach has been compared the approach used in other countries. From this study it is clear that although the general approach is similar, the level of detail and the reporting of results can be quite different in different countries. In general it is recognized that direct measurements are not suitable for facial comparison, that consistent judgment of images is hard to achieve, and that there is a lack of statistical data for facial features. Implications and possible solutions to some of these issues are presented.

Facial Comparison, Identification, Objectivity

C18 Body Length Estimation From Surveillance Video: Procedures and Validation

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The goal of this presentation is to describe procedures and validation techniques for estimation of the height of a person in surveillance video.

The Netherlands Forensic Institute uses a technique with 3-D computer models to estimate the length of a person in a surveillance video. The 3-D-computer model is made with commercial photogrammetry software from photos taken at the scene. The model is then imported into commercial software for 3-D modeling and animating. The model can be viewed from every desired perspective in this software. This implies that the model can also be viewed from the same perspective as the camera that has taped the (video) image. To find this perspective, the software is provided with a camera match algorithm. This algorithm calculates the position and field of view of the camera through the similarity of points between the image and the 3-D model. The user in both the image and the 3-D model must point out these points. The model can now be looked at through a virtual camera with the video as a background. By positioning a 3-D modeled object in the 3-D space in such a way that they fit the person in the image, the height of the person is measured.

Mistakes and inaccuracies in this procedure are caused by:

- The quality of the 3-D model
- The choice of the virtual camera
- Uncertainties in the interpretation of the (video) image. (Which pixel on which video line belongs to a certain point of the 3-D model?)

Inaccuracies in the 3-D model will systematically affect all the measurements. A mistake or inaccuracy in the interpretation of the (video) image can be random, but also a systematical error from the investigator. For this reason it is wanted that the camera match and the measurement is repeated several times by several investigators.

Reference images are made to validate the measurements and to get a better understanding of the measuring errors. This means shooting images with the same equipment and at the same location that was used for the questioned images.

The shooting takes place under controlled circumstances and the camera view is checked for changes. If the camera view has been changed compared to the questioned image, the view will be restored as good as possible. Reference objects with a known size and location are placed in view of the camera. Also, several persons will stand still at known locations. At the lab of the Netherlands Forensic Institute, these reference images are treated the same way as the questioned images.

When performing a height measurement on a person in a (video) image it is necessary that the person be fully displayed. In other words: both the head and the feet of the person should be visible in the image. The gait and pose of a person is of great influence to the result of the height measurement. For this reason the aim is to use an image in which the person stands tall and still. When this is not the case an extra error should be taken into account for the height measurement. The quantity of the error for not standing tall can only be estimated for every individual case. However, the influence of the gait of a person to the height measurement has been studied by several people [1,2]. These studies show a maximum variation of the measured height of a person of 8 cm.

At this moment there is a study going at the Netherlands Forensic Institute to the influence of the pose of a person, camera view, lighting, and also interpretation of the images by the investigator on the result of height estimation. One of the experiments includes measurements on about twenty people shot by the surveillance cameras from the institute. On the day they were shot on camera and where they were also measured in real live by the investigators. The purpose of this study is to narrow the errors in future cases on height measurements.

Literature:

[1] David Compton, Clair Prance, Mark Shears and Christophe Champod, A Systematic Approach to Height Interpretation from Images, in Proceedings of SPIE Vol. 4232, Enabling Technologies for Law Enforcement and Security, 2001

[2] Antonio Criminisi and Andrew Zisseman, Luc van Gool, Simon Bramble and David Compton, A new approach to Obtain Height Measurements from Video, in Proceedings of SPIE Vol. 3576, Investigation and Forensic Science Technologies, 1998

Height Measurement, 3-D Computer Models, Surveillance Video

C19 Questions About the Integrity and Authenticity of Digital Images: A Review of Case Reports From the Netherlands Forensic Institute

Zeno Geradts, PhD, Derk Vrijdag, BSc, Ivo Alberink PhD, Mirrelle I. Goos, MSc, and Arnout Ruifrok, PhD, Netherlands Forensic Institute, Volmerlaan 17, Rijswijk, 2288 GD, Netherlands*

This presentation will impact the forensic community and/or humanity by developing standard operating procedure for determining the authenticity and integrity of a digital image file.

For forensic casework the question of authenticity has to be answered if a certain image has allegedly been made with a specific digital camera. Another question that may be asked is if two images have been made with the same camera. In order to answer this question pixel defects, and information from the headers and footers of image files can be used. Furthermore, the method of examination of pixel defects combined with headers and footers is useful for integrity research: finding traces of manipulation (e.g. cut and paste) of the images.

A digital image is composed from a matrix of pixels (picture elements). For capturing a digital image a Charge Coupled Device (CCD) is used in a camera. When manufacturing large CCD arrays, they sometimes contain defects. A defect is visible in the image as a pixel defect if the CCD element has a different light sensitivity compared to the surrounding CCD elements.

For the examination of pixel defects the authors have developed a standard operating procedure in forensic casework. The examination has two approaches. If the camera is available, test images will be made with the camera with a white, gray, or a black surface. These images are used as a reference set. If the camera is not available, one set of images is used as reference set.

In some casework the pixel defects could be visualized without averaging or image processing, since they were visible in the images themselves without any processing. However, for visualizing the pixel defects it is often necessary to add and average the intensities of the images. As a result of this, fluctuations in the images due to the image itself will be averaged. In order to visualize the pixel defects a filter, for instance a median filter can be used.

The locations of the pixel defects in the reference images are compared with the location of the pixel defects of the questioned images. If the locations of the pixel defects agree with each other, this provides strong support for the hypothesis that they have been made with the same camera. The conclusions are not quantitative however, since not enough statistical data is available from the randomness of pixel defects.

Conclusions from pixel defects are reported as level of support to the hypothesis that an image has been acquired with a specific camera, and/or the level of support to the hypothesis that the have been acquired by a different camera. The following levels of support can be given: no support, limited support, moderate support, strong support, and very strong support. In cases with similar support to both hypotheses, no conclusion can be drawn due to discrepancies.

Header and footer-information is often available in the digital files received. The information in the headers and footers is not visible in the image itself, however by using software (for example a hex viewer) the information can be made available. In JPEG images from cameras this information often provides camera settings and brand and type of the camera itself, and sometimes provides information with which software the image has been edited. It is possible to modify the header and footer information by using software, so for forensic casework the examiner has to be aware of this possibility before drawing conclusions. If the header provides information that the image has been taken with a specific camera, it is possible that someone has altered the contents of this header, and that the picture actually has been taken with a different camera.

The results of examining pixel defects can be combined with information from the headers and the footers, for determining the integrity and authenticity of images. Several cases that have been received will be discussed in the presentation, and a review is given of the results reported.

Image Processing, Pixel Defects, Standard Operating Procedure

C20 Preserving Audio Quality When Converting Digital Audio File Formats

Kenneth W. Marr, BSEE, MS, and David J. Snyder III, BSET*, Federal Bureau of Investigation, Forensic Audio, Video and Image Analysis Unit, Engineering Research Facility, Quantico, VA 22135*

The goal of this presentation is to describe techniques to convert digital audio files from one format to another and to review precautions and limitations to observe when converting audio files so that the maximum audio quality possible is maintained after conversion.

This presentation will impact the forensic community and/or humanity by demonstrating to the digital evidence examiner the knowledge of the procedures and limitations to consider when converting digital audio files so that the maximum audio quality is maintained.

Analysis of digital audio files is becoming more and more common for law enforcement in today's Internet world. Cell phone technology, Internet communications, and commercial digital telephone service are examples of the numerous occurrences in which proper digital analysis procedures and the limitations of digital audio formats must be recognized by the digital evidence examiner. Digital forensic tools must be used with skill, the characteristics of the digital file format under question must be identified, and the proper steps must be followed in order to convert a digital audio file from one format to another while maintaining the maximum audio quality.

Selection of proper digital analysis tools will include a forensically approved digital hex editor program; a high quality computer-based audio analysis application, and a high-quality computer and operating system. The work on this presentation is based on a Windows 2000 operating system. The reasons for converting digital audio files from one format to another could include the needs of the requesting agency, errors in the audio file rendering it unplayable, or a variety of many other reasons. The goal of the forensic audio examiner in this conversion is to maintain as much audio quality as possible after the conversion.

The format and characteristics of the digital audio file to be converted must be determined. Then the format and characteristics of the converted file must be determined. This can be accomplished by use of a digital hex editor program to identify file characteristics in the header portion of the file. This information could include the type of file, sampling rate, bit rate, Codec, compression characteristics, size of header information as well as the size of the data portion of the file. Comparison of this header information is essential both before and after file conversion. One of the most important features to consider when converting digital audio files is the effect of compression. Since many digital audio files are already compressed when received, case-by-case analysis is required before using any compression algorithms. Nevertheless, preserving audio quality should remain the most important consideration for the digital evidence examiner.

Digital Evidence, Digital Audio, File Conversion

C21 Case Study - Imaging the Memory of a Digital Audio Recorder

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The goal of this presentation is to review the procedures and precautions for making an exact digital copy of the memory contents of a handheld digital audio recorder.

This presentation will impact the forensic community and/or humanity by providing to the digital evidence examiner procedures and precautions for making an exact digital copy of the memory contents of a digital audio recorder.

Commercial digital audio recorders are used throughout society today. This case involved a commercial off-the-shelf digital recorder that the submitting agency requested to be examined to determine the contents of the recorder's memory. Since there were questions involving alleged alterations of the recorded information, an image of the recorder's memory was required. This is the same concept in use by computer analysis response teams when downloading the contents of a computer's hard drive. The image of the hard drive is an exact digital copy of the contents of the original drive. This allows the examiner the opportunity to review and analyze the image contents without affecting any parameters of the contents of the original drive. Potentially vulnerable information on a hard drive includes file names and the dates/times files were stored.

Since this case involved an unknown recorder system, a thorough search of law enforcement and Internet forensic sources was made to find existing forensic tools which could be used to image the recorder memory. None were found but valuable forensic consultation information was obtained. It was determined that a new procedure must be validated and approved before the image could be obtained. The same make and model recorder with the same characteristics and features was used to conduct the validation testing.

Established forensic principles of write-protection, data verification by use of MD5 Hash calculations, and use of validated procedures were followed. Consultation with the recorder manufacturer confirmed the design and operating specifications. Digital tools used in the validation included a forensically approved digital hex editor program, a commercial monitoring utility for USB interfaces, a computer utility written to query the recorder memory contents, and a high-quality computer and operating system. All steps of the procedure were conducted with repeated tests using the same make and model recorder to verify and validate the procedure. MD5 Hash calculations confirmed that the image of the test recorder memory matched the contents of the test recorder.

After validation and approval of the procedure, the memory content of the original digital recorder was downloaded and the exact image of the recorder's memory was returned to the requesting agency.

Digital evidence is taking a more and more important role in law enforcement in today's society. Analysis of digital files requires a high degree of knowledge and expertise to maintain the integrity of the memory contents of digital storage systems.

Digital Evidence, Computer Forensics, Computer Image

C22 Temperature Tests on Halogen Lamps

Harold E. Franck, BSEE, PE, and Darren H Franck, BSCE, PE, Advanced Engineering, 4713 MacCorkle Ave SE, Charleston, WV 25304*

After attending this presentation, attendees will gain knowledge about the dangers and temperatures of halogen lamps and their propensity to start fires.

This presentation will impact the forensic community and/or humanity by revealing the fire propensity available when halogen bulbs are used in lamps.

Halogen lamps come in a variety of shapes, sizes and wattage options. These lamps are available for a variety of applications including medical and dental, car lamps, as well as household and shop lights. These lamps are filled with halogen gas, which reacts with the lamp filament producing a brighter light source than an incandescent light bulb. Generally, halogen lights are more efficient and have a longer life span than incandescent light sources and are designed to fit most applications. Typical wattage of halogen lamps ranges from 10 watts at 6 volts to 5000 watts at 420 volts. Many of the household type halogen lamps are classified according to their tubular double-ended shape as T-3. This investigation centers on test measurements conducted on T-3 style halogen lamps and a comparison to standard incandescent lamps.

A standard incandescent light bulb in the 60 to 75 watt range produces temperatures that vary over the surface of the bulb. At the base the temperature is approximately 120° F while at the maximum radius the temperature climbs to 180° F. This temperature at the maximum radius of the bulb explains why, although very hot to the human touch, a lit incandescent light bulb can generally be unscrewed from its socket and changed. Surprisingly, the temperature at the very top or tip of a standard incandescent light bulb is approximately 350°F. Tungsten-halogen lamps are also incandescent (filament) lamps but are significantly different from standard or conventional lamps in size and design. Halogen lamps operate on the practical application of the halogen regenerative cycle in filament lamps. Iodine and bromine gas, members of the halogen family of gases, are the most commonly used fillers for these lamps. As the lamp burns, the halogen gas combines with the tungsten that is evaporated from the filament. The circulation of the gas inside the bulb deposits the tungsten back on the filament instead of inside the bulb wall. This regenerative effect

keeps the bulb wall clean and allows the lamp to essentially deliver a constant light output throughout its life.

In comparison to standard filament lights, halogen lamps may achieve bulb temperatures in excess of 900° F. Consequently, most halogen light fixtures have supposed safety features that isolate the bulb from the surroundings by the use of lenses or guards. In some of these halogen lamp designs, the lenses or guards are insufficient so that significant temperatures may be achieved that will ignite combustible materials such as clothes and paper. Owing to the lamp temperatures, halogen lamps use quartz rather than glass for the lamp bulb. Tests conducted on halogen lamps varying from 150 watts to 500 watts revealed a serious risk of fire on two common light fixture designs.

Halogen Lamp, Temperature, Ignition

C23 Outdoor Bus Duct - Maintenance, Diagnostics, and Failures

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The goal of this presentation is to emphasize the importance of testing and inspection of surviving outdoor bus duct for the forensic engineer; highlight some common manufacturing defects; and show common failure modes and resulting injuries.

This presentation will impact the forensic community and/or humanity by demonstrating to forensic electrical engineers faced with outdoor bus duct failures awareness of some newly discovered causes of bus duct failure and the manner of detecting incipient failures.

Modern bus duct operating at 120/208/480 and 600 Volts at current rating of 400 – 4000 Amps is generally of the low impedance type, feeder or plug-in-type utilizing one or two bolts per joint type of construction. The conductor is flat ¼" thick plated copper or plated aluminum 3, 4 or 5 wire insulated with PVC or epoxy and sometimes with an additional Mylar sheet or tape. The enclosure is often powder coated, painted aluminum or painted steel.

The newer versions of bus duct are constructed in a ''sandwich configuration'' and consist primarily of bus bars coated or dipped in either an epoxy or PVC resin. This type of construction has certain benefits and disadvantages. For instance, one draw back is that certain material defects are not readily detectable using commissioning / maintenance test procedures.

The bus duct is constructed to one or more of the following Standards UL 857 or CSA C22.2, No. 27.

Outdoor bus duct does not accept plug-in switches.

Outdoor bus duct is usually installed in a vertical or horizontal manner between transformer and buildings. Outdoor bus duct is expected to be weather sealed except for certain drainage features.

1.0 Failure Modes and Reasons
- 2.1 A common failure mode is the hot spot fault at a joint or connection. It is often attributed to misalignment, defective manufacture and loose or corroded connections.
- 2.2 Insulation failure near or at the joints due to defective manufacture, lack of clearances or damaged insulation.
- 2.3 Damage caused by entry of water, cement, slurry rain and defective weatherproofing.
- 2.4 Multiple pinholes in the insulation in the presence of water in horizontal installations.
- 2.5 Bolt hole penetration not waterproofed.
- 2.6 Incorrect orientation of the bus duct.
- 2.7 Condensation of moisture.

2.0 Older Bus Duct

Older bus duct is often of the higher impedance type with larger spacing between phases. It may be enclosed or ventilated. The conductors are often supported on separate insulating spacers exposed to rain, snow, etc. Failures have occurred at support points.

3.0 Injuries

Injuries seldom occur on outdoor bus unless being worked on while energized. In these instances, workers are very close to the fault, which usually manifests itself as a sustained electrical arc, which produces intense searing heat along with molten metal ejecta. The incidence of shock and electrocution occurs less often on outdoor bus duct than indoor bus duct.

4.0 Consequential Damages

The most serious outdoor bus duct failures usually result in major building fires and lengthy business interruptions. Sometimes a particular defect exists in an incipient form throughout the entire bus duct system, necessitating shutdown with resulting business interruption in order to take corrective actions on the entire run. Malfunction of protective equipment such as circuit breakers and relays usually increase the degree of damage.

5.0 Tests

Infrared scans, heat runs, insulation resistance, capacitance and dissipation factor/power factor, conductor resistance, plating and insulation thickness, alignment, correct installation, weather and water resistance tests and ''holiday'' tests are a menu of tests often used by the forensic engineer.

6.0 Case Studies of Bus Duct Failures
- 6.1 Cement and water slurries
- 6.2 Tools
- 6.3 Insulation failure and holidays
- 6.4 Manufacturing defects
- 6.5 Hot spots
- 6.6 Misalignment
- 6.7 Condensation

Electrical Bus Duct, Arcing, Product Liability

C24 New Standards in Forensic Engineering & Science

Harold E Franck, MSEE, PE, Advanced Engineering, 4713 MacCorkle Avenue, SE, Charleston, WV 25304; and Helmut G Brosz, BASc, PEng, Brosz and Associates, 64 Bullock Drive, Markham, Ontario L3P 3P2, Canada*

After attending this presentation, attendees will gain knowledge on the current status of standards available to forensic engineers and the need for further standard development to deal with F*rye* standard and *Daubert* challenges.

This presentation will impact the forensic community and/or humanity by demonstrating the use of recognized standards in the practice of forensic engineering, which allows the practitioner's opinions and results to withstand court challenges.

Goals of a forensic engineer/scientist include safeguarding the life, health, property, and welfare of the public, establishing and maintaining a high standard of integrity, skill, and practice in the profession of forensic engineering. The rules of professional conduct for engineers dictate that the forensic engineer shall be completely objective and truthful in all professional reports, statements and testimony. He shall include all relevant and pertinent information in such reports, statements, and testimony. When serving as an expert or technical witness before any court, commission, or any other tribunal, he shall express an opinion only when it is founded upon adequate knowledge of the facts in issue, upon a background of technical competence in the subject matter, and upon honest conviction of the accuracy and propriety of his testimony. These statements or similar ones are generally found in the rules of conduct for engineers in the United States and Canada.

In light of these requirements of conduct, the forensic engineer can ensure that his opinions, reports, and testimony stand on solid ground if they are based on recognized standards. In the last few years, forensic engineers and scientists have been subject to court challenges as to their opinions. These challenges originally stem from a court case in 1923 that established the minimum standard required for the admission of expert testimony in federal cases. The *Frye* Standard, as it has become known, requires the expert to use data and methodology "generally accepted" by other experts. A more recent landmark case is the *Daubert* decision concerning birth defects that were allegedly caused by the mother's use of the anti-nausea drug, Bendectin. The defendant's, Merrill-Dow, motion for summary judgment was granted by the trial court because *Daubert's* experts relied on a technique that the court felt had not received general acceptance within the scientific community. Furthermore, in support of its finding of no general acceptance, the court observed that the proffered findings had not been published or subjected to peer review. The appellate court affirmed the lower court's decision based on the *Frye* Standard. However, the Supreme Court of the United States found that the Federal Rule of Evidence 702, issued in 1975, had superseded the *Frye* Standard and that "general acceptance" was not the *sine qua non* of admissibility. Rather, the Supreme Court stated, any reliable and relevant scientific evidence was admissible. For guidance, the Court then listed some suggested reliability criteria, as follows:

1. Has the theory or technique underlying the proffered evidence been tested and found to have a reasonably low error rate?
2. Has the theory or technique been subject to peer review and publication?
3. Are there recognized standards for applying the theory or technique?
4. Does the theory or technique enjoy general acceptance in the scientific community tantamount to the *Frye* Standard?

The Court emphasized that no one of these criteria needed to be satisfied and that they may not apply to all types of scientific evidence. In any event, all federal courts are now governed by this Supreme Court decision. Many states have also accepted the "*Daubert* Standard," though there are still a sizeable number that have continued to apply the *Frye* Standard and a few that follow neither standard.

Standards in forensic engineering have two main goals: to educate the practitioner and to codify the recognized practice in a particular field. Consensus standards, such as those promulgated by ASTM, ensure that the procedures followed by the investigating engineer follow recognized and well-documented outlines. These procedures aid the investigator by ensuring that pertinent items are addressed, that available evidence has been gathered, and that a scientifically provable hypothesis has been developed and tested. When properly applied, standards and guides are an invaluable aid to the practicing forensic engineer. These guides also place the investigator's opinions on solid foundations with respect to the laws of the land as dictated by the Code of Federal Regulations. Various standards, such as American National Standards Institute (ANSI) Institute of Electrical and Electronic Engineers (IEEE), American Society of Civil Engineers (ASCE), Society of Automotive Engineers (SAE), and many others serve to support the forensic engineer's work and can provide a sound basis for his forensic opinions as well as for having those opinions accepted into evidence at trial.

Forensics, Standard Development, *Frye* Standard

C25 Analysis of Case Factors in a Surface Mine Electrocution

James A. Ruggieri, PE, 10710 Timberidge Road, Fairfax Station, VA 22039*

After attending this presentation, attendees will understand the application of engineering judgment.

This presentation will impact the forensic community and/or humanity by identifying innovative techniques, critical thinking, and application of engineering to judgments and conclusions in forensic sciences.

In late November 1999, a 44-year-old dredge operator working a gravel pond from a small metal boat, was electrocuted when he tightened a chain clamp around one phase of an energized 440 Volt, 3-phase dredge service power conductor fed from a corner-grounded delta transformer. The operator was in the process of clamping the dredge rubber discharge line to a metal section of pipe when the power conductor was drawn up with the chain clamp. The operator had a total of two years and four weeks mining experience, all at this mine, as a dredge operator, yet had not received electrical safety and hazard recognition training in accordance with Mine Safety Health Administration regulations (MSHA) 30 CFR Part 48.

After struggling for some time to get the chain clamp to seat, the operator hit the chain clamp handle with a pipe to get the chain's clamping teeth to seat into the chain links. The chain clamp finally seated and the operator began to tighten the clamp.

An assistant on the boat reported that he then heard the operator make grunting noises while shaking violently. Recognizing that the operator had contacted a power line, the assistant failed in his attempt to push the operator free, and fearing for his life, entered the water and swam to a nearby floating stanchion. The assistant climbed onto the float and reportedly experienced "tingling" sensation, and when he looked back, observed arcing in several locations.

This paper provides an analysis of case factors used in a professional negligence and wrongful death case on behalf of the Plaintiff against two defendants, the mine owner (employer) and an electric contractor tasked in performing annual safety inspections of the mine facility as required by MSHA. This analysis shows that both the employer and the contractor had ample knowledge of substantive electric risk, and provides an axiomatic breakdown of case factors shown to be recurring in such incidents. This analysis evaluates system grounding deficiencies, deficient personnel training and personnel protective equipment policies and procedures, and in general, a grossly deficient system architecture. Additionally, this paper identifies impacts of federal regulatory policies, while evaluating rule-making politics and enforcement of the provisions of the 1977 Mine Safety and Health Act.

Electrocution, Grounding, Surface Mine

C26 Forensic Investigation of a Gas Phase Explosion in Building

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Through the systematic and detailed examination of the scene and physical evidence collected, the goal of this presentation is to provide the examiner means to identify the fuel source from a number of potential sources and reconstruct the sequence of events that led to the gas phase explosion in a building

This presentation will impact the forensic community and/or humanity by illustrating how forensic scientist can complement structural design and civil engineers as well as gas safety experts in determining the cause of gas-phase explosion.

Background: The explosion occurred in a design and advertising office on the second floor of a seven-story flatted factory building of reinforced concrete structure with flat roofing. The occupier of the affected unit carried out the manufacture of advertising signs and displays within the premises, which was partitioned into an office area and a production area. Four persons were killed and another two workers were injured in the accident.

Prior to the accident, two of the deceased were involved in the replacement of the oxygen cylinder and the usage of the oxygen-acetylene equipment in the production area.

Eyewitnesses reported seeing a dazzling brightness immediately after the initial explosion, suggesting an oxygen-rich fire. Flames were also seen shooting out from one of the liquefied petroleum gas (LPG) cylinders in the office during fire fighting.

Scene Examination: The explosion/fire totally destroyed the factory unit. The concrete wall, window frames, doors, and gates at its main entrance were displaced from their original positions. The concrete wall was found to bulge outward, attesting to an explosion from within the factory unit. Along the corridor of the affected factory unit, partially burnt remains of several metal racks, an air compressor (used for spray painting), and a number of paint containers were found. The damages observed to the areas within close proximity to the affected unit included displaced doors of the passenger/cargo lifts, shattered window panes in neighboring units, and broken windows of cars parked downstairs.

Within the affected factory unit, partially burnt remains of paint containers and solvents were found at several locations at its production area. Tools such as an electric saw and drilling machine were also found at the scene. At the locality within the production area where the oxygen-acetylene equipment was claimed to be used at the time of accident, a circular indentation of about 20 cm diameter was observed on the floor. Also, impact marks were noted on the wall surface nearby, probably caused by fragments from the explosion.

A badly dented acetylene cylinder was found, among the debris, at close proximity to the circular indentation. The shattered remains of a second cylinder (believed to contain oxygen prior to the accident) were found at several locations within the factory unit. The damaged remains of two sets of regulators and flexible gas hoses were also recovered from the scene. Two cylinders containing liquefied petroleum gas (LPG) were found within the affected factory unit. No flashback arrestors, non-return valves and torch were recovered from the scene.

Potential sources of gas that led to the explosion include:

- A leak of flammable gases from the LPG cylinders.
- A leak of acetylene from the acetylene cylinder.
- The oxygen cylinder and/or hose being contaminated with flammable gases.

Findings:

(a) LPG cylinders

The on/off gas valves of both cylinders were found to be in the close position. The plug within one of the valve was found to be burnt. One of its ends had expanded causing the seat disk within the plug to drop by approximately 0.3cm from the top. This resulted in poor sealing and gas to be leaking out from the on/off gas valve even though it was close. The above findings indicate that both LPG cylinders were not in use before the accident and any gas leakage was the result of heat from the fire. The leaking gas resulted in flames, which were seen to be emitting out from one of the cylinders by the firefighters.

(b) Acetylene cylinder, pressure regulator, and red hose

The on/off gas valve was found to be in the close position. It was clotted with melted rubbery material from the safety plug within the cylinder. This was consistent with effects from external heating. The pressure release valve was also found to be damaged by the heat from the fire allowing acetylene to escape into the atmosphere.

The pressure regulator believed to be attached to the acetylene cylinder was found to be relatively intact. Both the cylinder and working pressure gauges remained fixed to the regulator body. One of the gauges was found to be bent forward indicating external force acting on it.

The lengths of red acetylene hoses had damaged ends and were found to be intact with burn marks along their lengths. These damages were consistent with those caused by external forces and heat.

The above findings indicate that the acetylene cylinder was not in use before the incident and any gas leakage from the cylinder was the result of heat from the fire.

(c) Oxygen cylinder metal fragments, pressure regulator, and blue hose

The on/off gas valve was found to be in the open position. Four of the metal fragments physically fitted to form the base of the cylinder with a diameter of approximately 20 cm. This was consistent with the size of the indentation mark found at the scene. One of the fragments was found to bend outwards indicating an outward force from within the cylinder.

The pressure regulator believed to be attached to the oxygen cylinder was found to have its regulator bonnet and working pressure gauge blown off from the regulator body. Soot and burn marks were observed within the bonnet and regulator indicating internal burning within the regulator.

The blue oxygen hoses were severely damaged with splits and burn marks along its lengths consistent with those caused by internal bursting forces and heat.

Damages observed on the damaged oxygen cylinder metal fragments, pressure regulator and blue hose indicated that the cylinder was used during the time of incident and that flashback had occurred along the lengths of blue hoses causing them to split. Burning and excessive pressure within the regulator caused the bonnet to be detached and the working pressure gauge to be blown off. A powerful outward force from within the cylinder caused it to fragmentize.

The above findings indicate that both the LPG and acetylene cylinders were not in use prior to the explosion. The source of gas that led to the explosion was hence likely to be from the oxygen cylinder and/or hose.

Possible causes for the explosion:

1. Contamination of the oxygen hose by flammable gases from paint cans, acetylene or other sources to within explosive limit resulted in an explosion when the torch was ignited.
2. Contamination of the oxygen cylinder by flammable gases.
3. Absence of safety devices e.g. flashback arrestor, non-return valves in the oxygen-acetylene gas equipment resulted in the explosion of the oxygen cylinder.

Typical set-up and operation of oxygen-acetylene equipment: The oxygen-acetylene equipment was primarily used for cutting, welding, brazing, or heating of metals. A typical set-up of oxygen-acetylene equipment comprises oxygen and acetylene cylinders, gas regulators, flashback arrestors, hoses, non-return valves, and a torch. A gas regulator serves to regulate/reduce the pressure of the gas coming out from the cylinder before feeding to the hose/torch. A flashback arrestor prevents the flashback of in the torch/hose from propagating back into the regulator and gas cylinder, which could lead to an explosion. The function of a non-return valve is to prevent the gas from flowing back into the cylinder. The internal pressure of an oxygen cylinder (when full) is around 150 bar and the internal pressure of an acetylene cylinder (when full) is around 20 bar. The two types of gases are channeled via hoses to a torch where the gases are mixed and ignited.

The low-pressure control valves are typically adjusted to 2 bars for oxygen and 0.2 bars for acetylene before the valves are opened to release the gases into the hoses. The oxygen valve at the torch was then opened momentarily to clean the nozzle and closed back. The acetylene valve (about ½ turn) will then be opened, followed by the oxygen valve (about ¼ turn). The torch is then ignited. To stop the torch, the torch's acetylene valve was closed followed by the oxygen valve in order to prevent acetylene from flowing into the oxygen hose. Due to the potential fire hazards associated with oxygen-acetylene equipment and the strict protocol required in its operation, only trained personnel should be allowed to operate the equipment.

Tracing the source for contamination: Experiments conducted on an oxygen-LPG equipment not equipped with non-return valves or flashback arrestors showed that if the internal pressure of the LPG cylinder (when full) was higher than that of the oxygen cylinder (when it was near empty), and if the torch nozzle was obstructed, it was possible for the LPG to flow into the oxygen cylinder. The oxygen in the oxygen cylinder would thus be contaminated with LPG.

Investigations showed that no non-return valve and flashback arrestor were connected to the oxygen-acetylene equipment used in the affected

company. Also, the company was not licensed to carry out hot works within the office premises; hence the workers might not be trained in the operation of oxygen-acetylene equipment. The absence of these safety devices coupled with untrained workers using the equipment may have resulted in acetylene contaminating the oxygen hose and cylinder resulting in the explosion.

Gas Phase Explosion, Oxy-Acetylene Gas Equipment, Flashback Arrestor

C27 Lethality of Taser Weapons

James A. Ruggieri, PE, 10710 Timberidge Road, Fairfax Station, VA 22039*

Upon completion of this presentation, attendees will understand applications of some engineering applications.

This presentation will impact the forensic community and/or humanity by identifying innovative technologies, critical thinking and application of engineering to judgment and conclusions in forensic science.

On April 28, 2004, Montgomery County Police MD police responded to a disturbance. A 45-year-old mentally ill adult, 6'4", 275-pound son pushed his elderly mother when he became agitated when a car carrying Chinese delivery food parked in front of the suspects house. The driver left the headlights on and ran next door to deliver food. Family members said the suspect apparently believed the car carried agents coming to take him away. He then pushed his mother and ran out of the house. The son had received prior treatment for a mental disorder and reportedly was "off" his medication. The police found the suspect in a nearby back yard and the officers noticed the suspect had in his possession a large machete-type knife. Apparently, the knife was a gift he had received when he was a boy and the suspect was screaming that the police would never take him alive. The suspect ignored the officer's commands to get down on the ground. A Taser weapon was used, but did not take effect. The suspect was again commanded to get down on the ground and told that the Taser would be used a second time if he did not comply. The suspect was physically aggressive and verbally combative and failed to comply with the second command. The same Taser was used a second time and the suspect dropped to the ground. The suspect fought and wrestled with the officers but unexpectedly lost consciousness. Three officers immediately began administering Cardio Pulmonary Resuscitation (CPR). CPR was maintained until Fire/Rescue personnel arrived on the scene. The suspect was taken to an area hospital where he was pronounced dead. Seven officers were placed on administrative leave pending an investigation and autopsy results. The preliminary autopsy report found that the suspect died of cardiac arrhythmia in a setting of acute psychosis and had a blood alcohol content of 0.18.

The final autopsy report confirmed the cause of death as cardiac arrhythmia in the setting of acute psychosis during restraint, and the death determined to be a homicide. Other contributing factors were alcohol intoxication and a markedly enlarged heart with scarring in the heart muscle, yet the medical examiner concluded that the Taser did not contribute to death.

At the time of the preparation of this document, there have been about 50 Taser-related in-custody deaths, and this expert was asked to opine by a local police department on the lethality of a weapon characterized by the manufacturer as "less-than-lethal" or as "non-lethal." Following review of the available documents and uncovering incontrovertible and important technical errors on the part of the manufacturer, this expert opined that the device, although likely to be less lethal in many cases than a conventional handgun projectile, was indeed capable of killing. This paper identifies and discusses these errors, and discloses fallacies in the manufacturer's argument when contrasted to fundamental electrical engineering principles and affirmed technical standards governing electric shock and electrocution.

Taser, Cardiac Arrhythmia, Electrocution

C28 Forensic-Engineering Anthropology: Defining Acceptable Practice in Building Design and Construction

Mark I. Marpet, PhD, PE, St. John's University, 300 Howard Avenue, Staten Island, NY 10301*

After attending this presentation, attendees will learn to use historical documents to document the diffusion of and changes acceptable construction practice over time.

This presentation will impact the forensic community and/or humanity by demonstrating how in the past, most practitioners defined "acceptable building practice" in an ad hoc manner. This presentation will give practitioners a tool to make such acceptable-building-practice determinations are a rigorous, defensible manner.

Over time and for a number of reasons, the very way that buildings have been (and are) built has changed—evolved—because of new construction materials, land-use practices, and so forth. One important reason that building-design and -construction practice evolves is to enhance building safety and accessibility. While year-to-year changes are, to say the least, generally slight, one can see obvious change when one compares a current building with one -built generations ago.

In general, unless explicit exception is taken in the law, building design and construction practices are *grand fathered*. That is, if a specific feature of a building (let's call it a widget) would have been permitted by on-point code or by acceptable practice at the time the building had been designed (assuming the feature was a part of the original construction) or built (assuming there was no explicit design or that the widget had been the result of a building modification), that widget would be permitted to remain without change even though current code or, in the absence of on-point code, acceptable practice) would forbid the widget if built today. On the other hand, widgets that are in violation of code or acceptable practice at the time of design or construction, as the case may be, are not grand fathered into acceptability, the passage of time can not confer acceptability to defective construction. The reason for grandfathering is simple, without grand fathering, the building stock of the country might have to be heavily modified—or bulldozed—each time a new edition of the code came out. Because this is simply impractical, a lack of grandfathering would place tremendous pressure on code-development organizations to *not* revise the code. Grandfathering, in other words, encourages progress in building construction, the use of new construction materials, and building safety.

A brief example of grandfathering is in order. Handrail height is presently governed by code: the handrail must be between 34 and 38 inches (measured vertically) above the step nosing. In the past, before the mid 1980s, handrail height was, by custom and often by code, required to be between 30 and 34 inches. A building built in, say, 1975, would not, because of grandfathering, be required to move its 30-inch-high handrails to conform to current code.[1]

Because old construction built to acceptable practice is grand fathered, but that which is built in violation of acceptable practice is not, forensic-engineering practitioners must frequently determine what would be considered acceptable building design and construction practice in past eras. Understanding what constitutes acceptable practice in recent times can be discerned from review of applicable building codes, which are, to a large extent, a written manifestation of past acceptable practice.[2] To determine what would be acceptable construction practice in a given era is often no small task. How would one, for example, determine what constituted acceptable handrail and step dimensions and stair uniformity for a building built in an area that did not have a building code at the time the building had been built?

One cannot credibly discuss from direct experience the building practice of the time before one is a practicing engineer or architect. One cannot discuss from experience the building practice from the time before one's birth. This brief paper takes the position that acceptable practice can be 'reverse engineered' by study of building codes, construction textbooks,

and similar treatises that were written in or before the era of interest. Early codes were promulgated to promote fire safety, building materials and construction methods, as well as design to facilitate quick building egress was mandated. Early codes, construction texts, and handbooks did not attempt to build to any utopian ideal; rather, they determined what was acceptable and memorialized that subset from what already existed out in the real world. In addition, the existence of model codes (codes published for the purpose of serving as exemplars to be adopted in whole or in part by municipalities) promotes textual uniformity in the code-adoption process. No town exists in a vacuum. People travel from town to town, and building architects, contractors, and journeymen get exposed to the construction around them. Thus, what constitutes acceptable practice will diffuse—and become more uniform—geographically over time.

The examples that will be discussed concern how to determine what constituted acceptable practice for the construction of original staircases in 1950's residential construction in suburban northern New Jersey. In each case, code is non-existent or not on point.[3] A study of building codes for the fifty years prior to the era of the building construction indicates that the hazards that were at issue in the examples were known about for generations prior to the construction of the residences. Specifically, riser and tread dimensions, stair-to-stair uniformity, handrail details, guard details, and landing configurations had all evolved in the first half of the twentieth century to the point where it can be convincingly demonstrated that the examples' construction can be shown to violate acceptable building practice for the era in which the buildings were built.

Among the many codes that will be discussed are the ordinances of the City of Plainfield (1902), the New York City Building Code (1908, 1916, and 1938), The Uniform Building Code (1927), The National Board of Fire Underwriters (1922 and 1931), and the Building Code of the City of Philadelphia (1949), as well as codes from smaller cities and towns.

Sources of references will be discussed.

1. We will not address here the question of widgets defective at construction but gaining acceptability because of changes in code over time. (Looking at this example, think of a building built in 1975 with 38-inch-high handrails.) This author would not attempt to make the case that the 1975-era 38-inch-high handrails, in violation when the building had been built, were today defective.

2. Building codes evolve over time for a number of reasons: first, the changes in construction practice that comes about through construction evolution; secondly, research (the handrail-height change discussed above stems from research accomplished by Brian Maki of the University of Toronto in the 1980s.); and thirdly, by legislative technology forcing, e.g., the push to make buildings more energy efficient.

3. By not on point, reference is made to a situation where a code exists but does not cover the issues of interest. In the one of the examples, the town had a building code, but that code was silent with respect to stairs.

Building Code, Acceptable Practice, Grandfathering

C29 Panel Discussion: A Proposed ASTM F-13/E-30 Standard Guideline for Best Forensic Practices in Walkway-Safety Tribometry

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Attending this presentation, forensic practitioners will learn about the latest developments in ASTM standards that will impact upon Walkway-Safety Tribometry tests and, importantly, will be able to present comments and suggestions directly to those involved it the development of the standard.

This presentation will impact the forensic community and/or humanity by demonstrating how fall accidents are the second most significant source of accidental injury costs (direct, mortality, and morbidity) overall, and the largest generator of accidental mortality amongst the elderly. Forensic Engineers and scientists must access the safety of facilities and situations, often by tribometfic tests. It is essential that forensic engineers and scientists practicing in that area understand the changes in standards that are in process. Attending this panel discussion will bring practitioners up to date in this area.

Background: The four authors constitute the Task Group that is responsible for the preliminary work on this proposed standard. The discussion will start with a brief overview of the ASTM Standards-Development Process, emphasizing the voluntary consensus nature of that process, and the requirement for substantial agreement among the various interest blocks. The method that the ASTM utilizes to ensure participation by all interested parties will be discussed. The process of standards development, starting with a Task Group, proceeding to a subcommittee, to a committee, and thence, to the ASTM as a whole, will be discussed. The voting process will be discussed, as well as the ability of a persuasive negative vote to send the standard back for modification. The scopes of the E-30 and F-13 Committees will be discussed as a means to show why this standard may overlap the two committees. The direction of F-13's tribometric standards, towards non-proprietary test methods, will be discussed, along with the significant implications the non-proprietary standards presently in development have for the forensic practitioner. Finally, the authors discuss how you, if you are interested, can participate in the process of the development of this standard.

Discussion: The Title and Scope of the proposed standard in the present, preliminary incarnation will be discussed. The ambit of the proposed standard will be discussed, and comments and suggestions relative to the coverage of the proposed standards will be solicited from the audience of Forensic Engineers. Among the specific topics to be discussed are:

1. what does a tribometric test represent;
2. what constitutes a meaningful test;
3. how is the question of test and measurement error meaningfully addressed;
4. what constitutes a meaningful tribometric test design, especially with respect to test-site selection and test sample size;
5. how can a practitioner ensure that tests conducted have validity;
6. how should tribometric-test results be presented, i.e., how to properly factor test uncertainty into the result;
7. what can be said about a test result and its connection to pedestrian safety (the Required-Friction/Available-Friction) paradigm; and
8. what does Reasonable Engineering/Scientific Certainty mean in the context of tribometric testing.

Walkway-Safety, Slip and Fall, Tribometry

C30 The Characterization of Binary-Output Walkway-Safety Tribometric Instruments by Characteristic Functions: Part 2

Mark I. Marpet, PhD, PE, St. John's University, 300 Howard Avenue, Staten Island, NY 10301; and Howard I. Medoff, PhD, PE, Pennsylvania State University, Woodland Road, Abington, PA 19001*

Attending this presentation, attendees will learn how to characterize the performance of a generally used tribometer, viz., the PIAST

Pedestrian/walkway accidents are the second largest generator (after vehicle accidents) of direct, morbidity, and mortality costs. They are the single greatest cause of accidental deaths among the elderly. There is a significant amount of litigation that revolves around fall accidents. Slip-precipitated accidents arguably constitute the largest generator of pedes-

trian/walkway accidents. The impact of this paper will be to give insight into the characterization of walkway-safety tribometers. This is important to the forensic community because the measurement of pedestrian friction is a complex matter, and the better an engineer or scientist's understanding of the measuring process, the more likely that obtained results will hold up to critical scrutiny.

At the 2004 American Academy of Forensic Sciences meeting, the authors presented a paper entitled, "The Characterization of Binary-Output Walkway-Safety Tribometric Instruments by characteristic functions." This work expands upon that base. To briefly recap that paper, the authors discussed the development of a low-friction, weighted sled, based upon a roller-bearing-equipped machine-tool carriage slide, to serve as a highly repeatable 'test surface. To this test sled was connected a set of weights, which simulated the lateral force present in a friction situation. A Slip Test Portable Inclinable Articulated Strut Tribometer (PIAST) was operated using the weighted sled to define the characteristics of the tribometer (actually, the operating characteristics of the tribometer, test-sled acting in concert). This was accomplished by repeatedly operating the tribometer at a given setting and recording the number of times (out of ten) that a slip was observed. The independent variable was whether or not the PIAST's test foot slipped, and logistic regression was utilized to model the test data. This paper expands upon the previous work in two significant directions: (a) the tribometer has been tested using a given test foot (1/4 inch thick Neolite® Test Liner (NTL)) under a wide range of surcharges (the weight attached to the test sled) and (b) using variants of test-foot drop height and test-foot thickness at a constant surcharge. The results are presented below.

(a) Varying the Test-Sled surcharge

It can be seen that in the surcharge regime used in these tests, the PIAST's sensitivity appears to remain roughly constant. This is seen by noting that the slopes of the curves do not vary appreciably as the surcharge is varied.

It can also be seen that the friction-sled itself has little effect upon the testing. This is seen by noting that, with zero surcharges, the probability of a slip at the PIAST's zero setting is 0.6; if there had been no influence, the Probability of a slip at that point would have been 0.5. To obtain a slip Probability of a 0.5, the tribometer's minimum setting (its zero point) was moved to –0.001—a tenth off the PIAST's finest scale division—beyond zero.

(b) Varying the test-foot thickness

Of import here is the fact that the test foot configuration, and not just its composition bears at least a small effect upon the test results. In the idealized (Amontons Coulomb) world that was studied in college physics, friction was hypothesized to be a function of solely of the materials in contact. While that simplification may provide an adequate underpinning for conducting walkway-safety tribometry tests, there are circumstances where the Amontons-Coulomb model may turn out to be an oversimplification. Here using a thicker test foot generated slightly more friction, presumably because the thicker pad was able to absorb more energy due to hysterisis effects.

We will be expanding this work in the future, notably to study other binary-output tribometers.

Reference:

Marpet M and Medoff H, "The characterization of binary-output walkway-safety tribometric instruments by characteristic functions" in *Proceedings of the American Academy of Forensic Sciences (w003).*

Walkway Safety, Tribometry, Slip Fall

C31 Analyzing Failure of Rubber O-Rings

Robert N. Anderson, PhD, RNA Consulting, Inc., 27820 Saddle Court, Los Altos Hills, CA 94022-1810*

After attending this presentation, attendees will be able to identify common causes of o-ring failures, and to distinguish between installation problems and manufacturing problems.

This presentation will impact the forensic community and/or humanity by providing the forensic engineering community with methods of rubber failures and with the literature concerning those failures.

The use of o-rings is common in hydraulic systems to prevent leaking of fluid at connections. However, sudden failure of an o-ring under high pressure can result in loss of property and/or injury to the operator. The case covered here involved a sudden failure of an o-ring that sprayed hydraulic fluid on the operator and on the exhaust manifold, causing a fire and severe injury to the operator.

The operator was driving an earthmoving vehicle when a leak was detected and the o-ring was replaced. Within approximately an hour after replacing the o-ring, it failed catastrophically, allowing hydraulic fluid to spray into the cab and onto the hot exhaust manifold. The operator was severely burned by the resultant fire and a lawsuit was started against the o-ring manufacturer.

The author was retained by the plaintive attorney to analyze the o-ring and to determine the cause of the failure.

O-rings commonly used in hydraulic service are referred to as BUNA-N, which is a co-polymer of butadiene and acrylonitrile. The material has a good resistance to hydraulic fluid and can operate at the elevated temperatures found in most hydraulic systems. The type of rubber is identified by FTIR analysis. Then, the application specification should match the hardness of the o-ring on the Shore D scale.

The common failure patterns of o-rings are listed in Reference #1. Other applicable standards are referenced below in Reference #s 2-6.

In addition, there are manufacturing causes for exceptionally short life and dramatic failure, such as backrinding and porosity.

The installation errors causing failure are:

- Extrusion and Nibbling: If the o-ring is too small or too soft, small nibbles are torn off during pressure fluctuations that force the o-ring into the downstream clearance area.
- Spiral Failure: A condition that causes the o-ring to slide and roll, resulting in a deep, spiral cut and is usually associated with piston seals.
- Abrasion: Occurs in systems where the o-ring is in motion. Usually, one side of the o-ring will be rough and slightly flattened. The metal surface is either too rough or there are contaminants in the system.
- Compression Set: A flat surface on the bottom and top of the o-ring indicate compression set. This is generally caused by the o-ring material exceeding its high temperature range.
- Weather and ozone cracking: This appears as many small cracks, generally perpendicular to the direction of stress. Typically found in o-rings exposed to atmospheres containing ozone and air pollutants
- Heat aging and oxidation: This condition is one of the temperatures being too high for the rubber, causing hardening by additional cross-linking in the rubber.
- Plasticizer extraction: Exhibited by small cracks due to the extraction of the plasticizer by the service fluid.
- Installation Damage: Appearance is short cuts or notches on the surface due to the mis-sizing of the o-ring in the application.
- Gas expansion Rupture: Exhibited by splits or ruptures due to absorption of gas under high pressure.

The manufacturer errors causing failure are:

- Backrind: Backrinding occurs when the mold is too hot for the specific formulation and the excess rubber that flows in the flash cavity is rapidly cured and pushed further in by the curing of the rubber behind it. When the mold is opened, the rubber in the flash cavity snaps back and makes a crack in the parting line.
- Porosity: Explosive decompression occurs when pressure varies and gas or liquid is absorbed into the o-ring.

The examination by Scanning Electron Microscope (SEM) clearly showed a great deal of backrinding and porosity in the o-ring.

Each time the hydraulic pressure cycled, the o-ring filled and emptied, causing tearing and rapid failure. It was clear that a manufacturing error caused the failure. In addition, the o-rings were mistakenly sized metrically, but marked and sold as English measure.

The case went to trial in Los Angeles County and resulted in a verdict for the plaintive.

References:
1. SAE Aerospace Information Report 1707, "Patterns of o-ring failure"
2. ASTM D2000-01 "Standard Classification System for Rubber Products in Automotive Applications."
3. SAE Surface Vehicle Standard J515, "Specifications for Hydraulic o-ring Materials, Properties, and Sizes for Metric and Inch Stud Ends, Face Seal Fitting and Four-Screw Flange Tube Connections."
4. ASTM 471-98, "Standard Test Method for Rubber Property—Effect of Liquids."
5. ISO 3601-3 part 3, "Fluid systems—Sealing Devices—o-rings."
6. ASTM D1414-94, "Standard Test Methods for Rubber o-ring."

O-ring Failures, BUNA-N Rubber, Rubber Failures

C32 When Stronger is Weaker: A Dynamic Failure of an 8-Inch Natural Gas Transmission Line Coupling System

James F. Lane, MS, Applied Technical Services, Inc., 1190 Atlanta Industrial Drive, Marietta, GA 30066*

The goal of this presentation is to both inform and instruct the attendee about the potential hazards of unknowingly bypassing or disabling the proper operating mechanisms of a designed component.

As forensic investigators, participants invariably encounter situations where installers, maintenance personnel and/or end users have made improvements to mechanical systems that have unwittingly created dangerous situations. This presentation will impact the forensic community and/or humanity by providing a concrete example of how well intentioned installation personnel created a potentially deadly condition by providing external reinforcement that prevented the engineer-designed mechanism from properly seating.

The intent of this presentation is to both inform and instruct the attendee about the potential hazards of unknowingly bypassing or disabling the proper operating mechanisms of a designed component. As forensic investigators, participants invariably encounter situations where installers, maintenance personnel and/or end users have made *improvements* to mechanical systems that have unwittingly created dangerous situations. The case outlined in this presentation will provide a concrete example of how well intentioned installation personnel created a potentially deadly condition by providing external reinforcement that prevented the engineer-designed mechanism from properly seating.

When natural gas transmission lines are moved or bypassed, the original line is generally left in place, but closed off to gas flow. Often times, the original line is partially removed, with a short stub section remaining at both ends of the transition from the old to the new. When this is accomplished, the short stub sections have to be capped. Traditionally, the end cap has been welded to the stub section, requiring significant installation time and manpower. Recently, within the past 10 to 15 years, a coupling device that utilizes a mechanical gripping mechanism has been introduced to the industry, which greatly reduces the manpower and man-hours necessary to achieve capping.

One such device was installed on an 8-inch natural gas transmission line, operating at approximately 300 psi, used to service the inhabitants of two affluent island communities. The installation of the coupling devices was made when the line was moved from beneath the accessing street to underneath the sidewalk area. A catastrophic failure of one of the installed couplings occurred on the Friday of a holiday weekend during the late fall, excavating a large crater in the center of the street and cutting off gas service to both islands.

A complete metallurgical analysis was performed on both the coupling and pipe sections. The results of the analysis indicated that both the materials of construction and the fabrication were in accordance with the manufacturer's design requirements. Anomalistic features associated with the gripping mechanism within the coupling were inconsistent with anticipated results. Thus, mechanical and full-scale testing of the devices was conducted.

A systematic series of statically loaded tests and experiments yielded data that was not consistent with the observed findings in the failed coupling. The discrepancy in data led to the performance of dynamic full-scale testing. The results of the dynamic loading indicated that the use of external reinforcement of the coupling prevented proper seating of the gripping mechanism. When the external support failed, the sudden application of load associated with the 300-psi line pressure did not allow sufficient time for the gripping mechanism to seat, propelling the end cap and coupling off the end of the short stub section. The cavity created under the road quickly filled with gas until the asphalt failed and a large crater was formed in the middle of the street.

Immediate memoranda, followed by additional training, were provided to the installation crews. The use of external reinforcement was explicitly forbidden, and similar conditions at other locations were excavated and repaired to prevent additional incidents.

Metallurgical Failure Analysis, Natural Gas Transmission Line, Explosion

C33 Inward Deformation Under Outward Pressure: Failure of a Ductile Iron Pipe Joint

Anastasia D. Micheals, MS, San Jose State University, Engineering 385, San Jose, CA 95192*

After attending this presentation, attendees will understand the causes of joint failure in boltless pipe systems.

This presentation will impact the forensic community and/or humanity by creating awareness of the failure modes, and differentiation of root failure causes, in the construction industry.

A new 600 MW natural gas power plant, the Metcalf Energy Center, is under construction in south San Jose. The plant will use 3.5 million gallons/day of reclaimed wastewater in its cooling towers. Up to 80% of the water will evaporate, but 700,000 gallons per day will be expelled to the municipal wastewater system. Part of the wastewater pipeline runs along side a bridge crossing a creek. The pipeline rises vertically from below grade, crosses the creek horizontally, and returns vertically to below grade. At this location the pipeline is constructed from 30-inch diameter ductile iron pipe segments. The pipe segments are attached using boltless, push-on flanges, which use metal wedge retainers to form the joint.

During a pressure test of this segment, the joint between one vertical pipe segment and the elbow at the top failed catastrophically. The damaged vertical pipeline was removed and replaced. Subsequently, a similar failure occurred at the joint between the vertical pipe and the elbow at the other end of the bridge. The two failed pipe segments were dented inward where the metal wedges were positioned. While it seemed counterintuitive that a

pipe under pressure could have failed by deforming inward, inspection revealed that movement of the metal wedges could have caused the inward deformation to the pipe.

Misalignment of the components that make up the joint, specifically the pipes and/or the retainers, can lead to this failure mode. As the joint is pressurized, it expands, and the retainers can shift position if the parts weren't aligned during installation. Once they move, the outward force on the retainers and the inward force of the bell socket are no longer balanced, and the joint can fail. The same problem can occur if the pipes are allowed to move during pressurization. This movement could cause misalignment of the retainers, leading to this type of failure. For this reason, concrete thrust blocks are required at 90° bends and 45° bends to restrain the pipe from movement.

Failure can also occur if the pipe properties do not meet industry specifications. The subject ductile iron water pipe was specified as grade 60-42-10, which, according to the ANSI/AWAA C151 standard, has a minimum tensile strength of 60 ksi, minimum yield strength of 42 ksi, and minimum elongation of 10%.

Inspection revealed grinding marks at several locations on the outside surface of one pipe, resulting in the pipe being out of round. Its overall diameter, and its thickness at several locations, was less than specified. Mechanical testing revealed tensile strength to be 10% below, and elongation 55% below the specified values.

The inspection and testing showed that this pipe did not meet the manufacturer's specification, with respect to strength, ductility and thickness. It appears that the pipe was manufactured out of round, and was subsequently ground down. Non-uniform grinding, and reduction of thickness to below spec, resulted in decreased effective strength. That, in conjunction with the substandard mechanical properties, led to the initial failure. Movement of the horizontal pipe caused by the initial failure may have caused movement at the other end of the bridge, despite the thrust blocks, resulting in misalignment of the joint and subsequent failure of the other joint.

Ductile Iron, Push-On Joint, Wastewater Pipe

C34 Got Cracks? Identifying and Preventing Damage Caused by Soils Movement

Michael D. McDowell, MS, Ninyo & Moore, 3001 South 35th Street, Suite 6, Phoenix, AZ 85034*

The goal of this presentation is to describe to the forensic community and/or humanity the cause and effect relationship between soils movement and construction defects.

This presentation will impact the forensic community and/or humanity by identifying problematic soils and demonstrating preventative measures for commonly occurring soil problems that result in loss of use and/or functionality of structures. By increasing the understanding of engineers, design professionals, and homeowners, multi-million dollar law suits and expensive repairs can be avoided.

Several components go into the design and construction of a home or structure. Some of these components include a preliminary soils investigation, structural design, and building pad preparation. Should any of these components fail to adequately account for expansive or collapsible soils, the result could be devastating. This presentation provides basic geotechnical information about expansive/collapsible soils and the potential for adverse effects to structures.

This presentation has four objectives: (1) to provide an overview of expansive soils and the basics of geotechnical engineering; (2) to identify conditions leading to construction defects resulting from soils movement; (3) to describe the difficulties inherent in identifying construction defects caused by soils movement; and (4) to describe how modifications to landscape or drainage may result in damage to structures.

Rapid development and multi-million dollar jury awards involving construction defects have brought an increase in litigation to the western and southwestern United States– particularly in California, Nevada, and Arizona. Construction defects caused by expansive (or collapsible) soils are frequently among the primary allegations made in class-action lawsuits. Adequately sampling and testing on-site soil samples prior to construction, the potential for soil movement and resultant damage can be mitigated. An adequate laboratory-testing program may include in-situ moisture content and dry density, gradation analysis, Atterberg limits, expansion index tests, response-to-wetting tests, and soil classification per the Unified Soil Classification System (USCS).

An engineer or design professional can identify problematic soils with adequate laboratory data. With this data an engineer can modify standard foundation and structural designs to mitigate the potential damage caused by expansive/collapsible soils. Without detailed information engineers may under-design a structure or even make erroneous assumptions that result in loss of use and/or functionality. However, in some cases it is not the engineer, but rather, the homeowner that creates the problem. Homeowners may modify the drainage or landscaping around their homes and alter the pre-existing moisture content of soil. This action may result in significant soils movement and damage to the home.

Soils are heterogeneous and can vary greatly from one site to the next. Factors such as soil type, percent clay, plasticity, density, moisture content, and placement during the earthwork operations, which vary from home to home, will affect soil behavior. Because each home is different, care must be taken to adequately evaluate site-specific soils conditions before alleging construction defects resulted from soils movement. Some distress, such as drywall cracking, cannot be differentiated from that which can be expected from normal shrinkage of construction materials such as concrete, stucco or wood.

Modifications to landscape or drainage are some of the most common factors leading to soils-related damage in homes. By altering the pre-construction moisture content of soil, homeowners may inadvertently cause soils to expand or collapse resulting in cracked walls, floors, and foundations.

Soil, Construction Defect, Litigation

C35 Forensic Engineering Evaluations of Causes of Rapid Deterioration in Wood Frame Building Envelope and Relationship of Building Codes

Geoffrey G. Jillson, MSCE, PE, Guy Engineering Corporation, 1002 Main Street, Hopkins, MN 55343*

The goal of this presentation is to determine causes of the rapid deterioration of building envelopes and structural elements in wood frame structures and the contributing causes of materials and building codes.

This presentation will impact the forensic community and/or humanity by adding technical insight to the forensic community to facilitate investigations into the causation of the rapid rot and deterioration syndrome in modern wood frame construction

Wood frame structures constructed in accordance with recent building codes in the 1990s to present are sustaining dramatic and rapid deterioration and rotting of sheathing and structural elements. The conditions result from multiple elements of causation including leakage at clad windows coupled with high insulation levels and with sealing requirements required by modern building codes. This paper provides a summary of research conducted by Guy Engineering Corporation and a synopsis of field evaluations of hundreds of wood frame and primarily residential structures.

Laboratory research and testing was conducted by Guy Engineering Corporation into the causes of leakage at window areas using both wood windows and clad windows. The testing of windows in wall assemblies was conducted in accordance with ASTM 1105.00 protocol (Standard Test

Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Air Pressure Difference). This protocol requires application of water spray to the exterior of the assembly at the rate of 5 gallons per square foot per hour. A negative pressure was applied to the interior of the wall assembly in accordance of the protocol at a rate of .55 inches water column (14 mm). Wall assemblies were constructed in accordance with the building code requirements using 2 x 6 framing members and 7/16" OSB sheathing. Windows were installed in conformance with manufacturers' installation requirements. The building paper (weather resistive barrier) was installed in conformance with the 1997 UBC and in conformance with the industry standard/practice in place for residential stucco. All water applied to the exterior of the wall/window assembly was captured and quantified. The water was captured in specially constructed vessels on the interior of the wall assembly, exterior of the sheathing, and on the exterior of the building paper (weather resistive barrier). Results of the testing determined that water intrusion occurred at the integral nail flange/self flashed window at a rate in excess of 100 oz occurring within four 5 minutes cycles as called for in the referenced spray test protocol.

Testing was conducted without sealant at the perimeter of the window between the stucco siding and window assembly. Subsequent comparative tests with sealant applied at the perimeter of the window assembly were conducted. Data are presented which quantitatively show the amount of water intrusion at each surface of the building envelope. Identical tests were carried out using a wood window of similar dimensions.

The results of the testing found that the modern clad windows with nail flange/integral flashing elements sustain leakage rates in excess of an order of magnitude greater than those experienced by the traditional wood windows with brick mould. This element of substantial water intrusion into the building envelope is a major cause of rapid deterioration/rotting of structural elements. Other contributing elements relate to modern elements of both the Federal Energy Code and state versions of energy codes of which specifically have required increased levels of insulation, sealing vapor barriers on the interior of the envelope, and the addition of weather-resistive barriers which are sealed to rough openings and to windows. The combination of the above elements has resulted in water intrusion and accumulation in building envelopes and the requirements of the Codes do not permit drying of the building envelope, resulting in rapid deterioration. Properties of certain sheathing materials such as OSB and Bildrite with respect to water penetration and vapor permeance, combined with the similar properties in weather resistive barriers required in the modern building codes further contribute to retention of water in the building envelope. At northern latitudes/cold climates, the result is accumulation of ice and frost within the building envelope, which further reduces both the permeability, and vapor permeance of the building sheathing, which exacerbates the problem of rapid deterioration/rotting of sheathing and framing elements.

Outcome: the rapid deterioration of the building envelope has been found to relate to multiple causes including leakage at clad windows coupled with modern construction elements and changes in building sheathing and with multiple aspects of the Building Code including adverse effects of insulation levels and sealing of interior and exterior surfaces of the building envelope.

Clad Windows, Water Intrusion, Building Envelope

C36 Detecting Liquid Metal Embrittlement Cracking of Galvanized Structural Steel

Richard M. Beldyk, PE, BME, State Route 31, RR 1 Box 249, Williamstown, WV 26187*

After attending this presentation, attendees will learn the basics of Liquid Metal Embrittlement; and learn what non-destructive examination methods that can be applied to the detection of LME.

Liquid Metal Embrittlement (LME), or Liquid Metal Assisted Cracking (LMAC), as it is know in the UK, is a rare but potentially catastrophic mode of failure. The forensic community will become aware of this mode of failure. It has been postulated that terrorist may utilize other liquid metal s to cause catastrophic failure of bridges and structures. This presentation will impact the forensic community and/or humanity by educating the forensic community to the damages and methods of detecting Liquid Metal Embrittlement cracking.

The author presents causes, problems, and recommendations for reducing and detection of galvanization related cracking of post hot dipped welds and base materials. LME: Liquid Metal Embrittlement causes and remedies are outlined. Post hot dipped welding problems and solutions are reviewed. The author will discuss the problem in the North America and the UK. Current, traditional and future nondestructive inspection technologies are compared including: Visual, Magnetic Particle, Ultrasonics, manual and automated Shear Wave, and Phased Array UT, Eddy current and ACFM Alternating Current Field Measurement are profiled.

Liquid Metal Emrittlement, Non-Destructive Examination, Structures

C37 Petroleum or Coal Ash: Determining the Origin of PAH Compounds in Soils

James S. Smith, Jr. OAK CREEK, Inc., Toxicology & Risk Assessment Consulting. 60 Oak Creek, Buxton, ME 04093-6616

After attending this presentation, the participant will understand how methyl aromatic ratio ("MAR") analysis may be used to determine the origin of polycyclic aromatic hydrocarbon ("PAH") compounds in soil and/or sediment. Dr. Smith will describe how MAR is applied to sites in Massachusetts, where the association of PAH compounds with coal and/or coal ash can be used to exclude them from reporting requirements under the Massachusetts Contingency Plan ("MCP"). In addition, recent research into the bioavailability of hydrophobic organic compounds ("HOC") suggests that MAR analysis may be used to support higher remediation goals for PAH compounds in sediments.

This paper has three objectives:

1. to illustrate the importance of determining the legal framework for site investigation activities;
2. to illustrate how MAR analysis may be used to exclude PAH compounds from notification requirements under the MCP and/or identify sediments with low HOC bioavailability.
3. to demonstrate how MAR analysis is applied to site to eliminate a client's environmental and financial liability for PAH compounds in soil and sediment.

The source of PAH compounds in environmental media determines whether such compounds are subject to the provisions of the Massachusetts Contingency Plan ("MCP"). The MCP contains requirements and procedures for notifying the Massachusetts Department of Environmental Protection ("MADEP") of releases and threats of release of oil and/or hazardous material ("OHM") [310 CMR 40.0300]. The release and threat of release of OHM related to coal, coal ash, or wood ash, but not wood ash resulting from the combustion of lumber or wood products, is exempt from this notification rule [310 CMR 40.0317]. As a result these same OHM may also be excluded from risk characterization. Simply stated, if PAH compounds can be shown to source from coal and/or coal ash, they are exempt from regulatory requirements under the MCP. Additionally, sediments shown to contain black carbon (e.g., coal or coal ash) have lower HOC bioavailability to benthic organisms.

Several published papers have demonstrated that analytical techniques can distinguish between sources of PAH compounds related to coal and/or coal ash from those originating from the release of petroleum. One such technique, methyl aromatic ratio ("MAR") analysis, may be used to determine the origins of PAH compounds in soil and/or sediment.

Three major types of hydrocarbon are ubiquitous in environmental media: petrogenic (i.e., crude oil and its refined products), biogenic (i.e., compounds generated by biological processes), and pyrolytic (i.e., compounds generated in combustion processes). Although gas chromatogram/mass spectra ("GC/MS") of PAH compound mixtures from these various sources may not look substantially different to the naked eye, petrogenic and pyrolytic sources of PAHs can be differentiated by relative abundance of methylated and non-methylated PAH compounds. Generally, low temperature generation of PAH compounds (i.e., temperatures below 150° Celsius), such as occurs in the natural generation of crude oil, processing of refined petroleum product and in biogenic processes, yield abundant methyl-substituted PAH compounds. In contrast, high temperature processes (i.e., those greater than 600° Celsius), like those historically associated with manufactured gas plant operations that evolved methane gas from coal, generate predominately un-substituted non-methylated PAH compounds. This is because such high temperature processes provide the energy required to remove methyl groups from methylated PAH compounds, leaving the thermally stable non-methylated compound. The overall result of high heat processes, therefore, is a reduction in the abundance of methylated PAH compounds and an apparent increase in the abundance of heat stable non-methylated PAH compounds.

In this presentation, Dr. Smith describes how MAR is applied; illustrating the use of MAR analysis to differentiate between petrogenic and pyrolytic sources of PAH compounds.

Methyl; Ratio; Coal/Ash

C38 Biotic and Abiotic Compositional Changes in Heavy Crude Oil Determined by ESI-FT-ICR Mass Spectrometry

Lateefah A. Stanford, BS, Sunghwan Kim, PhD, Ryan P. Rodgers, PhD, and Alan G. Marshall, PhD, National High Magnetic Field Laboratory, 1800 East Paul Dirac Drive, Tallahassee, FL 32310*

After attending this presentation, attendees will learn basic principles of ESI FT-ICR MS and applications to environmental and forensic complex mixture analysis.

This presentation will impact the forensic community and/or humanity by demonstrating ultra-high mass resolving power (greater than one million), high mass accuracy (less than 1 ppm) and rapid analysis of environmental and forensic complex mixtures.

Crude oil is a complex and geographically unique combination of saturates, aromatics, resins, and asphaltenes. The great diversity of chemical classes present and the concentration range over which they exist make compositional analysis by traditional analytical methods difficult. Routinely used bench top analytical techniques such (such as GC-MS and LC-MS) are ineffective in characterizing crude oils due to limited peak capacity and resolving power and thus commonly result in the detection of a large unresolved complex mixture (UCM) "hump." The recent application of (ESI) Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) to petrochemical analyses has assisted in unraveling the complexity of crude oil and petroleum products, detecting >20,000 compositionally distinct polar acyclic, polycyclic, and polyaromatic polar –NSO compounds in a single sample. Such analysis serves to generate a detailed compositional fingerprint without the need for pre-chromatographic separation. However, environmental stressors such as bacterial remediation, solar UV photochemical transformations, and volatilization "smear" this fingerprint by generating new and removing previously identified components. For example, photochemical and bacterial mineralization of petroleum products result in decreased alkyl carbon chain length, dearomatization, denitrogenation, desulfurization, and increase in carboxylic acid content, whereas removal of short chain paraffinic compounds is attributed to volatilization. These changes further complicate source-to-sink forensic identification of crude oil spills as well as combusted particulate organic matter in the environment. Environmental modifications that increase the polar nature of a crude oil are of concern since they may result in increased water-solubility and toxicological impact. ESI FT-ICR MS provides ultrahigh-resolution mass analysis of polar species in complex mixtures, such as crude oil, achieving high resolving power $m/\Delta m_{50\%} > 300{,}000$ and high mass accuracy (< 1 ppm). Therefore FT-ICR MS provides an effective method of monitoring (on a component by component basis) environmentally induced changes in complex organic materials.

Here ESI negative-ion FT-ICR MS is applied to heavy South American and medium Arabian crude oils and their water-soluble acidic –NSO containing species, before and after photochemical modifications. The analysis of a seven oil biodegradation sample ranging in quality from undegraded to severely biodegraded is included to emphasize changes in polar –NSO containing species as a function of increased biodegradation. Molecular formulas (elemental compositions) from each sample are assigned from accurate mass measurement combined with a Kendrick mass sorting procedure. Both class based, aromaticity, and carbon number variations in the samples are highlighted by a combination of three-dimensional van Krevelen, Kendrick and aromaticity plots. The NSF National High Field FT-ICR Facility (CHE-99-09502), Florida State University, and the National High Magnetic Field Laboratory in Tallahassee, FL supported this work.

FT-ICR MS, Petroleum, Environmental Chemistry

C39 Forensic and Environmental Applications of Stable Carbon, Hydrogen, and Chlorine Isotopic Composition of Individual Compounds

Richard P. Philp,, PhD, DSc, Jon Allen, and Tomasz Kuder, PhD, School of Geology, University of Oklahoma, Norman, OK 73019*

After attending this presentation, attendees will learn what is meant by a stable isotope; the areas related to forensic science where stable isotopes may be used to solve problems; levels of detection currently available; future developments, and other isotopes that will used in future studies.

This presentation will impact the forensic community and/or humanity by demonstrating the use of stable isotopes in forensic problems.

Utilization of stable isotopes, such as carbon, hydrogen, and chlorine, in a variety of forensic and environmental applications has seen a significant increase in popularity in recent years. The primary reason for this has been the development of combined gas chromatograph-isotope ratio mass spectrometer (GCIRMS) systems that permit the determination of the isotopic composition of individual compounds without the need for isolation of the individual compounds. It is the purpose of this paper to provide a brief overview of this relatively new technique and then to provide examples of the utilization of the approach in a variety of forensic and environmental problems. A number of the examples will illustrate the use of stable carbon and hydrogen isotopes for the purposes of determining the origin of refined hydrocarbons and other organic carbon compounds in the environment. Wherever possible these fingerprints are combined with data from GC and GCMS and other evidence. However in certain cases, when looking at individual spills such as toluene, stable isotopes will discriminate toluene derived from different feedstocks. Products such as gasoline, even if heavily weathered through evaporation; will still maintain the original isotopic signature in the weathered residue. In this manner even though the GC fingerprints of a suspected source and product in the environment will look very different, the isotopic composition of individual compounds in the two samples will still be able to show whether the samples are related or not. Engine oil samples from hit and run accident victims would be another application whereby it would be possible to relate oil spots on the victim with oil samples taken from the suspected vehicle

through a combination of the isotopes and GC and GCMS. From an environmental perspective it is often necessary to determine whether a particular compound has been undergoing biodegradation as a result of natural attenuation. It is often very difficult to do this on the basis of concentration data since a decrease in concentration may simply represent a dilution effect. However work with compounds such as MTBE and various BTEX compounds clearly show that a decrease in concentration accompanied by an isotopic enrichment for both carbon and hydrogen is overwhelming evidence for the onset of natural attenuation. The source and fate of chlorinated solvents such as PCE, and TCE along with perchlorates compounds in the environment is an area where chlorine isotopes are starting to play an ever-increasing role in the same manner.

In addition to the topics mentioned above stable isotopes play an important role in the food and liquor industry. For example in tequila isotopes can be used to determine whether the tequila has been adulterated from cane sugar rather than agave. Are all spices sold natural or do some contain synthetic compounds? Again isotopes play a key role in this type of study. Isotopes can be used to determine geographic source areas for drugs such cocaine. Isotopic differences between synthetic testosterone and natural testosterone for example can play an important role in doping controversies. Arson investigations can also benefit from use of isotopes since accelerant residues can be correlated to the original product used to start the fire.

In brief, the number of applications of isotopes to these types of problems is limited only by the level of one's imagination. Applications are in their infancy and will continue to grow with additional isotopes being utilized in the future at ever decreasing levels of detection.

Isotopes, Environmental, Forensic

C40 Carbon Isotope Ratios of PAHs in Urban Background Soil

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After attending this presentation, attendees will learn a method for comparing and contrasting source samples with low concentration potential background samples

This presentation will impact the forensic community and/or humanity by further refining the source allocation of PAHs in urban environments

A GC/IRMS (gas chromatograph with an isotope ratio mass spectrometer) is capable of measuring the ratio of the two natural isotopes of carbon for individual PAHs in a sample. This method yields a compound-specific carbon isotope ratio (CSIR). Researchers have noted that the CSIRs of PAHs from different hydrocarbon sources (coal, oil, biomass) are often different. Other studies indicate that the CSIRs of PAHs from refined petroleum products, coal tar products, and vehicle exhaust will also be different because the carbon originated with different coals or oils. Finally, it has been documented that the CSIRs of tars from different MGPs can be reproducibly different and can differ significantly from PAHs from other non-MGP sources. Several dozen surface soil samples from cities across the USA were collected from randomly selected locations and analyzed by GC/IRMS and GC/MS. Some samples were analyzed in duplicate or triplicate to assess variability inherent in the method. In addition to the surface soil samples, a substantially contaminated sample from an MGP site in each city was analyzed for CSIRs. All these surface soil samples contained PAHs in a pyrogenic pattern. The PAH concentrations ranged from about 500 to 50,000 □g/kg total PAHs. Further, all of the samples appeared to be "weathered" with much lower concentrations of 2- and 3-ring PAHs than higher molecular weight compounds. The MGP site samples contained tarry residues with PAH concentrations in the many thousands of parts per million. A comparison of the PAH profiles and the CSIR values from these samples show that, for some MGP sites, CSIRs can clearly distinguish between MGP PAHs and general urban background.

Isotopes, Background, PAHs

C41 Dialkyl Disulfides: Another Diagnostic Tool for Petroleum Products in the Environment?

Carol A. Erikson, MSPH, Trillium, Inc., 356 Farragut Crossing Drive, Knoxville, TN 37922*

After attending this presentation, attendees will learn about an unusual petroleum product fingerprint that may prove useful in determining the source or identification of released materials.

This presentation will impact the forensic community and/or humanity by presenting data to illustrate an unusual fingerprint in a petroleum product found in the environment; this information may offer additional forensic clues as to the source or identification of the product released.

Fingerprinting techniques are commonly used in environmental forensics to identify classes of petroleum products and/or to link contamination to a particular source. Gas chromatography with flame ionization detection (GC/FID), a very sensitive measurement technique for alkanes and acyclic isoprenoids (e.g., pristane and phytane), allows evaluation of characteristic peak patterns to establish the type of petroleum product (gasoline, kerosene, diesel fuel, motor oil, etc.) present. Gas chromatography with electron capture detection (GC/ECD) is not sensitive to hydrocarbons but readily detects halogenated and unsaturated materials, among others, and is often used in tandem with GC/FID to evaluate the presence of additives such as the alkyl lead compounds (e.g., tetraethyl lead).

Typical GC/FID and GC/ECD fingerprints of a modern Jet A fuel are presented in Figure 1. The hydrocarbon pattern exhibited in the FID fingerprint is characteristic, and the ECD fingerprint gives little additional information.

A recent GC/FID fingerprint analysis of ground water samples taken from a petroleum storage facility showed the presence of several different petroleum products, including Jet A fuel. GC/ECD fingerprints were also generated, and, as expected, most gave little additional information. In three samples, however, the GC/ECD chromatogram showed a peak pattern very similar to the GC/FID fingerprint but eluting approximately 8 minutes later (Figure 2).

What was this? Too early in the chromatogram to be polychlorinated biphenyls, the ECD results were quite puzzling. To generate more information, the extract was subjected to gas chromatography/mass spectrometry (GC/MS) analysis to allow a closer look at these peaks, and, hopefully, to facilitate identification of the compounds they represent. The answer: a series of dialkyl disulfides, ranging from C_{11} to C_{18}.

ASTM specifications regarding sulfur content of Jet A fuel have not changed since 1959, when *Standard Specification for Aviation Turbine Fuels* (ASTM D 1655) was first issued. So, the presence or absence of dialkyl disulfides does not appear to be a candidate for forensic age-dating based on a particular point in time when the total sulfur content of Jet A had to be reduced to meet specifications.

However, high concentrations of organic sulfur compounds (mercaptans) are undesirable in petroleum refining for many reasons, including corrosivity, color changes, and unpleasant odors. Removing mercaptans from petroleum streams is a process known as sweetening. When the total sulfur content of the petroleum product is already within final product requirements, most gasoline, jet fuel, kerosene, and diesel fractions can be successfully sweetened using a caustic solution to oxidize the odorous and corrosive mercaptans to disulfides, which have much more acceptable

characteristics. Thus, the total sulfur content remains unchanged but the undesirable characteristics are eliminated.

Perhaps, then, the presence of dialkyl disulfides can serve as an indicator of the characteristics of the crude oil from which the petroleum product was distilled. While this type of information may or may not be particularly helpful in every site investigation, it is clear that careful, comprehensive evaluation of all available forensic data can provide clues - potentially important clues - for answering the "who, what, where, when, how, and whys" surrounding a contaminated site.

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2. Test Plan for Reclaimed Substances: Streams Containing Naphthenic Acids, Phenolics, Disulfides, Acids, or Caustics, The American Petroleum Institute, Petroleum HPV Testing Group, Consortium Registration #1100997, December 15, 2003.
3. ASTM D 1655, Standard Specification for Aviation Turbine Fuels, 1959 through 2000.

Figure 1 - Jet A Fuel Standard. Top - FID fingerprint; Bottom - ECD fingerprint.

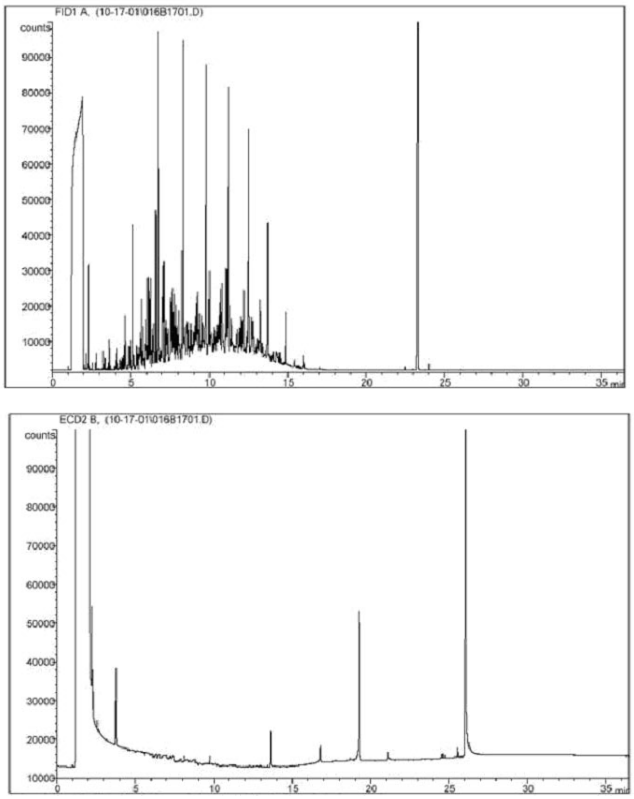
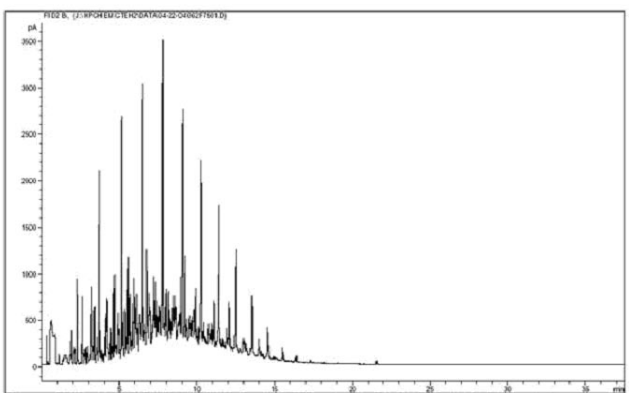
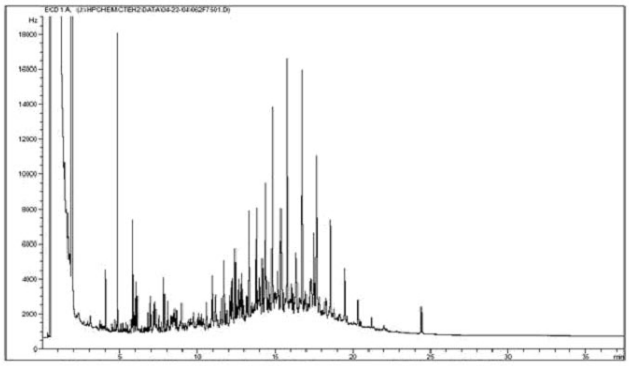


Figure 2 - Site Sample. Top - FID fingerprint. Bottom - ECD fingerprint.





Dialkyl Disulfides, Jet A Fuel, Fingerprinting

C42 Dust Particulate From the World Trade Center Disaster of September 11, 2001

James R. Millette, PhD, and Richard S. Brown, MS, MVA Scientific Consultants, 550 Oakbrook Parkway, Suite 200, Norcross, GA 30093*

After attending this presentation, attendees will be provided information about how the microscopical analysis of dust particles from the World Trade Center Disaster of September 11, 2001, can be used to compare with dust from other sources.

This presentation will impact the forensic community and/or humanity by showing the differences between WTC dust and other dusts from other sources in indoor environments thereby helping to provide the scientific information necessary for judicial decisions.

The results of the microscopical analysis of dust samples collected within a short time after the 11 September 2001 attack on the World Trade Center buildings in New York City show that the dust was composed primarily of construction debris containing glass fibers, plaster, and cement particles as well as soot, wood particles, paper, and cotton fibers. Based on a number of samples and a number of different types of analyses including polarized light microscopy, scanning and transmission electron microscopy, and FTIR microscopy, the general composition of the WTC dust was found to be: Glass fibers (primarily mineral wool) - 35 – 40 %, Gypsum particles - 25 – 30 %, Cement/Calcium-containing particles - 10 – 15 %, Cellulose (paper, cotton, wood fibers) - 5 – 10 %, Combustion Products (soot and char) - 1 – 10 %, Crystalline Silica ~ 6 %, Asbestos (primarily chrysotile with some amosite and tremolitic) - < 1 – 2 %, Other Material Classes (paint, metal, vermiculite, glass shards) <1 % per class.

All the classes of components in the WTC dust have been found in other residential and office dust samples but the population of small particles containing a combination of a high amount of glass fiber, a high amount of construction debris material (plaster/cement) and obvious presence of combustion product particles (both char and soot) serves as a distinguishing characteristic of WTC dust when compared to most typical residential or office dusts. Pieces of asbestos large enough to be seen with the light microscope are also a characteristic of some WTC dust samples because large asbestos particles are not seen in normal building dust samples. With the exception of some elongated calcium/sulfur/silicon particles described in Millette, et al., 2002, all the types of particles in the WTC dusts have been reported as associated with normal dusts. At this time, no single particle type is considered a signature particle for WTC dust.

Dust, Microscopy, WTC

C43 Reconstruction of a Hazardous Material Release Using Real-Time Air Monitoring Data and Air Dispersion Modeling

Dyron T. Hamlin, MS, Center for Toxicology and Environmental Health, LLC, 615 West Markham Street, Little Rock, AR 72201*

The goal of this presentation is to focus on the value of air monitoring data and air dispersion modeling to assess potential exposures, determine release rates for emergency planning purposes, and defend against unreasonable litigation claims. The conceptual use of such data will be drawn from specific experience in emergency responses.

This presentation will impact the forensic community and/or humanity by demonstrating real examples of accident reconstruction from a health-based perspective

After the spill of a hazardous chemical, questions invariably arise regarding the exposure of individuals impacted by the release. Various tools are used to assess the magnitude of such exposures. Atmospheric dispersion modeling allows estimation of concentrations in space and time over the potentially affected area. These estimated air concentrations can be coupled with exposure information for specific individuals (time of exposure, location of exposure, etc.) to estimate inhalation exposures. Historically, atmospheric dispersion modeling has been the tool of choice for reconstructing hazardous materials releases.

Geolocated air-monitoring data allow one to pinpoint specific concentrations at specific locations and times. Combining air-monitoring data with atmospheric dispersion modeling allows better estimation of chemical concentrations over large areas. These air monitoring "data checkpoints," which are used to determine whether modeled concentrations match reality, vastly improves reconstruction of chemical exposures after the spill of a hazardous chemical. Uncertainties associated with each component will be discussed, and additional factors that will require additional research and development will be mentioned.

Reconstruction, Accident, Dispersion

C44 Geo-Spatial Information Extracted From Historical Aerial Photographs Aids in Cost Recovery Litigation and Remedial Investigations

Mary D. Sitton, BS, CMS, and Glen H. Hickerson, BS, Environmental Research, Inc., 5267 John Marshall Hwy, Suite C, Linden, VA 22642*

After attending this presentation, attendees will understand the analysis of historical aerial photographs and generation of a geographic information system (GIS) database to support environmental engineering forensic science.

This presentation will impact the forensic community and/or humanity by describing valuable historical and current forensic information, which can be used for environmental engineering and litigation support.

Method: Research, acquisition and comparative stereoscopic analysis of a series of historical aerial photographs and maps. Creation and presentation of the GIS database containing geo-referenced digital images of the conventional, analog aerial photographs.

This abstract illustrates an accepted scientific approach to document onsite activities at two industrial sites utilizing aerial photographs and GIS technology. The first project example outlines the methodology of gathering and displaying historical information at an industrial site associated with cost recovery litigation. The second project example involves the analysis of aerial photographs and the extraction of geo-spatial information to support remedial investigations at a DOD facility.

The methodology employed at both sites included the research, acquisition and detailed stereoscopic analysis of aerial photographs. Historical aerial photographs spanning the period from approximately 1930 to the present is readily available from various government and private sources. Aerial photographic researchers utilized databases and indexes to locate government and private sources of aerial photographs based on the coordinates and/or boundaries of the specific area of interest. Relevant stereo film positives were acquired for analysis. Digital scans of the historical photographs were generated and prepared for the geo-referencing process.

The first project example involving cost recovery litigation utilized the analysis of historical aerial photographs to identify the existence of an industrial facility and to locate onsite environmentally significant activities. The objective of the case was to locate potential responsible parties that may have contributed to onsite contamination and contamination of a creek extending through the study area. From the analysis of the aerial photographs, two trucking facilities were identified as potential contamination sources; however, only one of which was recognized by the owner/operator. The operators of the trucking facility maintained they had no responsibilities of operation or contamination that occurred at the second facility and in the nearby creek. Analysis of aerial photographs identified the existence of liquid filled impoundments, staining, and surface runoff from the second trucking facility toward the creek. Chemical analysis of sample data taken onsite and toward the creek coincided with environmentally significant activities identified from the aerial photographs.

The second project example involving remedial investigation utilized the analysis of historical aerial photographs and GIS database technology to spatially locate a historical burn pit at a DOD facility. No onsite visual evidence identified the location of the burn pit. To assist remediation personnel, x and y coordinates extracted from the GIS database were utilized with a global positioning system (GPS) technology to locate the former burn pit.

These examples illustrate how the analysis of historical aerial photographs and the generation of geo-spatial information can be used to precisely locate and assist in remediation environmentally significant features and activities.

Historical Aerial Photographs, Geo-Referenced Images, Cost Recovery Litigation

C45 Source Determination of Fugitive Particulate on Parked Automobiles by Environmental Forensic Microscopy

Richard S. Brown, MS, MVA Scientific Consultants, Suite 200, 5500 Oakbrook Parkway, Norcross, GA 30093*

The goal of this presentation is to present to the forensic community information about how the microscopical analysis of particles discovered on parked automobiles can be used to identify the source of the particulate and determine liability for remediation.

This presentation will impact the forensic community and/or humanity by demonstrating the use of microscopical techniques in determining their origin.

The microscopical analysis of dark brown resinous particulate collected from the surface of parked automobiles, identified a possible source of the dark brown resinous particles to be from a nearby manufacturing plant. A combination of polarized light microscopy (PLM), Fourier transform infrared microspectroscopy (FTIR) and scanning electron microscopy was used to characterize the particles collected from the parked automobiles. Particles collected from exhaust fan vents at a nearby manufacturing plant were characterized using the same microscopical tech-

niques. The particles collected from the exhaust vents of the manufacturing plants were determined to be similar in chemical and physical composition to the particles collected from the parked automobiles.

The classification of unknown materials and particles by techniques developed by microscopists enable the environmental forensic microscopist to eliminate natural sources such as insect excretions and narrow the possible sources of a particulate emission that was damaging the painted surfaces of automobiles parked in close proximity to exhaust vents that were releasing the offending material into the environment. The procedures used to classify the particle emission involved collection and classification using techniques that can only be performed with the aid of a microscope.

The source of the particulate could not be identified to the extent that it was the only source to the exclusion of all other potential sources, however, the microscopical examinations did reveal a strong association between the particulate emissions of one manufacturing facility and the particles collected from the parked automobiles.

Environmental forensic microscopical analyses are used to determine a possible source of fugitive particulate emissions that were damaging the painted surface of automobiles parked nearby.

Particles, Microscopy, Forensic

C46 A Method to Prioritize Differences Between Chromatograms

William A. Schreuder, PhD, Principia Mathematica, 575 Union Boulevard, Suite 320, Lakewood, CO 80228; and Jeffrey W. Short, MS, National Marine Fisheries Service, 11305 Glacier Highway, Juneau, AK 99801*

The goal of this presentation is to introduce the audience to a new method of identifying the relative order of importance in differences among peaks in the chromatogram.

This presentation will impact the forensic community and/or humanity by demonstrating a case study of the application of the technique to samples analyzed by very high resolution mass spectrometry (Fourier Transform Ion Cyclotron Resonance) is presented.

The talk describes an algorithm for ordering the peaks in a pair of chromatograms in order of importance for determining how different two chromatograms are. The method provides an unbiased measure of the relative importance of peaks for determining differences, which may lead to new insight into the classification of samples.

The algorithm uses the Aitchison metric to measure the difference between two chromatograms by calculating the sum of the log of the ratios of all the peaks. This metric has the desirable property of being strictly monotone decreasing when any peak is removed from both chromatograms. The algorithm orders the peaks to in order of minimum difference in the remainder of the peaks.

An important property of the algorithm is that it scales well to chromatograms with tens of thousands of peaks and therefore can be used as an effective data reduction technique.

A case study of the application of the technique to samples analyzed by very high-resolution mass spectrometry (Fourier Transform Ion Cyclotron Resonance) is presented. This technique produces a very large number of peaks. The samples were chosen for known differences and similarities. Researchers evaluate how the technique performs in ordering the compounds in order of importance for establishing these differences.

Chromatogram, Characterization, Classification

C47 Performing 3-D Recreation as a Tool for Understanding Emergency Incidents

Matt C. Wood, BS, Center for Toxicology and Environmental Health, LLC, 615 West Markham Street, Little Rock, AR 72201*

The goal of this presentation using 3-D modeling is to illustrate what did, or did not occur during a chemical emergency incident.

This presentation will impact the forensic community and/or humanity by providing models, which are an invaluable tool for demonstration where a visual understanding of an event is important. Here is a tool that can illustrate, using the best data available, a video showing the most likely scenario. Anyone watching the video should be struck by the amount of realism it contains and the data that stands behind it.

This presentation is to show the value of using 3-Dimensional (3-D) video representations of a wide variety of events as a tool to illustrate what actually happened to interested parties. 3-D modeling has been shown to be helpful in re-creation of accidental chemical releases from rail, highway, and fixed manufacturing facilities. By interfacing with engineering analyses such as failure analysis and dispersion modeling, videos can illustrate how a mechanical failure helped cause an accident, or how a chemical release ultimately impacted (or *didn't* impact) people and the environment. 3-D models can be as detailed or as generalized as the situation requires – for example, a house fire or vehicle accident can be illustrated generically, or down to details including site aerial photographs and actual topography and meteorological conditions. These models are an invaluable tool for demonstration where a visual understanding of an event is important.

For most site recreations, it will be necessary to have an IT specialist actually visit the site. During this site visit, the IT Specialist will photograph, measure, and otherwise document all relevant aspects of the site to increase the realism of the model. Remember, the goal of this is to make the viewer of the recreation video actually feel that they are there. This adds to the effect of helping people believe that what they are seeing is actually what happened. The recreation will be generated using the best data available. This includes but is not limited to: Air dispersion models, depositions, aerial photographs, topography, and engineering failure analysis. Often, existing Computer Aided Design (CAD) models can be obtained and will speed up the generation of 3-D recreations.

There is practically no limit to the type and quantity of videos that can be generated once a 3-D model has been created. Unlike Hollywood, the number of cameras and lights are not going to increase the cost of the movie. Cameras can be placed in locations that litigants claim to have been during the incidents. Cameras can also move in the same paths as litigants say they moved in their depositions while the model moves in real time around them. People can be illustrated in the model with striking detail. They can walk, gesture, and do any number of movements. Or for cost reduction purposes people can be illustrated by a moving dot or a static human figure. Models can be detailed down to vehicles, telephone poles, building material, trees (yes, even species of trees), furniture, and weather conditions.

3-D, Chemical, Recreation

C48 Web-Based Data Acquisition, Analysis, and Presentation of an Environmental Investigation

Brady Davis, BS, Center for Toxicology and Environmental Health, LLC, 615 West Markham Street, Little Rock, AR 72201; and Todd R. Crawford, BA, Center for Toxicology and Environmental Health, LLC, 615 West Markham Street, Little Rock, AR 72201*

The goal of this presentation is to demonstrate the techniques used for data acquisition across multi-party/multi-facility projects. The tools used to

analyze this data are discussed as well as the methods of presentation for a forensic environmental investigation.

This presentation will impact the forensic community and/or humanity by improving the number and types of tools available for the acquisition, analysis, and presentation of forensic environmental data.

Web-based technology has given us an opportunity to transform the way data is collected by providing a cost-effective method to improve corporate communications and to distribute and share vital information. The authors utilize the latest technologies in web-based applications to deliver remote database management for this projects. Scenarios are provided to many clients whether it is temporary data acquisition for a specific project or a corporate wide portal interface to manage continual data collection. Listed below are scenarios of remote data acquisition applications that have been utilized:

- **Multi-Contractor Sampling Plan:** A Web-based interface has been developed to acquire many related data points from several different contractors nationwide. Each contractor used their own mechanism of data collection but submitted the data on a common user-interface on a World Wide Web site. The data was stored on a local server and utilized to interpret the data.
- **Emergency Response Content Management Framework (CMF):** The Emergency Response Portal (ERP) provides a central location to store vital information during a crisis situation. Data is shared between the project managers and their clients as well as with other contractors and agencies via web-based applications.
- **Multi-Contractor Web-Based Equipment Management Console:** A custom application was developed for a client to manage a nation-wide network of responders and their air monitoring equipment. Most of the consumable supplies used in air monitoring have limited shelf lives. To address this critical issue an interface was developed that allows the user and the clients to know when critical inventory is about to expire. The clients also have the ability to view important details about each responder including monitoring equipment and capabilities, contact information, and training compliance.
- **Multi-Facility IH Air Quality Portal:** This application aids in collecting and reporting industrial hygiene data across a multi-facility corporation. The goal was to construct an application that was easily accessible to all facilities and corporate offices, but still remain highly secure from the public while maintaining production efficiency. Floor personnel enter data real-time to a remote database, which corporate users can access at any time. Email alerts were programmed to execute at certain action levels providing corporate safety officials with real-time updates from all of their plants simultaneously. Custom reports were generated based on corporate's needs and continue to change as needed.
- **Data Analysis and Interpretation:** Methods of data analysis depend on the mechanism of data collection and scope of the project. For short-term/temporary projects the data is typically imported into different software packages to statistically and visually interpret it. For more permanent applications, the analysis and reporting interface is built directly into the application itself. An enterprise database system is utilized to store the raw data collected. Graphs and statistics are generated on the fly as the data changes. Historical views of the data quickly show changing trends in the working environment. When dealing with more than just raw data, CMF is used to manage supporting documentation and files. All raw data, graphs, and documents are available to clients through an internet browser.

World Wide Web, Data Analysis, Data Presentation

C49 Performing Medical Review and Analysis of Plaintiff Records in an Environmental Exposure Class Action Litigation

Rosalyn G. Huss, BS, RN, Kim Alvis, RN, and Kristen N. Williamson, AA, Center for Toxicology and Environmental Health, LLC, 615 West Markham Street, Little Rock, AR 72201

The goal of this presentation is to focus on the value of utilizing a legal nurse in analysis of plaintiff medical records as a method for assisting toxicological and medical experts in the causation analysis for each litigant. Work product examples will be provided and several specific environmental cases will be highlighted.

This presentation will impact the forensic community and/or humanity by utilizing a legal nurse to review and analyze medical records in a large class action suit who can provide invaluable expertise and support in the case analysis and reduce medical record review time required for medical and toxicological experts.

Utilizing a legal nurse to review and analyze medical records in a large class action suit can provide invaluable expertise and support in the case analysis and reduce medical record review time required for medical and toxicological experts. In addition, the legal nurse serves as a liaison between the designated experts and the litigation team, identifying when additional medical records are needed, coordinating Independent Medical Evaluations when indicated (license requirements, facility, supplies, staffing), and assisting in development of potential deposition questions of opposing experts and plaintiffs.

The legal nurse begins the medical review process with obtaining and preparing litigant medical records for abstracting. Medical records are then reviewed and a detailed, factual abstract is developed for each plaintiff. Upon completion of the plaintiff medical record abstract, the legal nurse works with the team of experts and attorneys to develop specific work products to support the case needs. Work products will vary depending on the case elements and health claims reported but may include items that outline plaintiff demographics, diagnoses found in medical records review, medication summary, potential other causes for exposure health claims, and identification of potential confounders.

A legal nurse is well suited to read, understand, and interpret the volumes of medical records often provided for each plaintiff. As the records are reviewed the legal nurse develops a detailed, factual medical record abstract in ascending date order that has the actual medical records pages identified. This allows the reviewing expert to identify and access specific medical records of interest in his/her analysis. This detailed review and abstract preparation provides the experts and the litigation team a foundation necessary for the critical analysis of health care facts and issues pertinent to the case. Once the records are reviewed and the abstract completed, the legal nurse works closely with the litigation team and/or testifying experts to develop work products that are valuable and supportive as the experts analyze the case and formulate their opinions. Examples of some of the ways the legal nurse supports the litigation team and testifying experts are:

- Interpretation of medical records
- Significance of disease states and how the disease may affect the toxicological/medical issue
- Significance and interpretation of laboratory tests
- Compile tables of medical events pertinent to the case
- Compile tables of laboratory tests pertinent to the case
- Research medical issues pertinent to the case
- Prepare summary of medical records
- Provide assessment of case from a nursing point of view
- Prepare timelines of medical events

Presentation will review the nursing analysis, methods utilized, and products developed in litigation support for two large toxic tort cases: a class action suit filed by numerous residents following a train derailment where xylene was released and a large class action suit involving hundreds of plaintiff residents against a former aluminum plant.

Toxic Tort, Litigation Support, Records Analysis

C50 Characterizing Human Health Risk: Art or Science?

James S. Smith, Jr. OAK CREEK, Inc., Toxicology & Risk Assessment Consulting. 60 Oak Creek, Buxton, Maine 04093-6616

After attending this presentation, the participant will begin to understand why the characterization or assessment of human health risk is more art than science. Dr. Smith will use three examples to illustrate how different risk assessors might use information, methodology, and professional judgment to paint very different pictures of health risk associated with chemical exposure at a hazardous waste site.

This paper has three objectives: 1) to introduce the practice of characterizing human health risk to chemical exposure; 2) to illustrate the role of information, methodology, and professional judgment in human health risk characterization; and 3) to demonstrate that the characterization of human health risk is art, not science.

One role of Federal and State government is to protect human health from the harmful effects posed by exposure to chemicals. Regulatory Agencies like the U.S. Environmental Protection Agency ("U.S. EPA") have developed programs for responding to chemical releases in the environment. Federal and State Agencies use well-established chemical risk assessment principles and procedures, described by the National Academy of Sciences ("NAS") to determine whether a chemical in the environment poses a "significant" health risk to exposed persons.

The NAS risk assessment model integrates five (5) separate components: hazard identification; dose-response or toxicity assessment; exposure assessment; risk characterization; and uncertainty assessment. Risk assessors typically rely on regulatory Agencies for hazard identification and dose-response or toxicity information. In contrast, a risk assessor may have little, if any, specific information about the potential exposure of people to chemicals in soil, water, biota, and/or air. In such cases, the risk assessor must identify potentially exposed populations and choose appropriate parameters to represent the magnitude and frequency of exposure for each population identified. Exposure assessments can vary greatly in the amount and quality of site-specific information used to quantify exposure. Health risk estimates, calculated using exposure and toxicity information, are compared to socially acceptable target risks. Finally, the risk assessor identifies and describes the uncertainty inherent in the process of risk characterization.

Risk characterization is an art, not science. An appropriate definition of art is the use of a system of principles and methods in the performance of a set of activities. In contrast, science is defined as the observation, identification, description, experimental investigation, and theoretical explanation of phenomena. Risk characterization uses exposure assumptions and toxicity information and the principles and procedures established by the NAS to describe the probability of a future health condition in an exposed population. The art of the risk assessor is to apply these principles and methods to characterize human health risk associated with chemical exposure.

Dr. Smith illustrates how three different risk assessors, given the same basic exposure and toxicity information, can achieve very different human health risk characterization results. For each risk assessor, Dr. Smith identifies commonly used default exposure parameters, regulatory guidance, and site-specific information used in the characterization of human health risk. A simple comparison of the resulting quantitative estimates of human health risk with applicable regulatory target risks determines whether there is significant human health risk associated with the site and whether remedial action is required. Dr. Smith uses three different risk assessors to illustrate the art of applying NAS principles and methods to human health risk characterization, demonstrating that the characterization of human health risk is an art, not science.

Art, Assessment, Characterization, Risk

C51 Whose Contamination Is It? Distinguishing Groundwater Contamination Sources Using Chemical Signatures Combined With Hydrologic Evidence

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The goal of this presentation is to show how multiple lines of independent evidence can be used to identify sources of groundwater contamination and distinguish between possible sources of co-mingled or adjacent plumes.

This presentation will impact the forensic community and/or humanity by demonstrating chemical signatures, or "fingerprints," that can frequently be combined with other independent evidence, such as hydrologic data, to distinguish relative responsibilities of different potential sources of groundwater contamination. If developed early, this evidence can be used to help avoid litigation and to assist in negotiated settlements. At trial, such evidence can be vital to the judge or jury in reaching the correct conclusion.

Outcome: The audience will see how these techniques have been successfully applied to resolve disputed contamination responsibilities in at least three real-world cases.

Many complicated groundwater contamination cases end up in litigation because of disputes among potentially responsible parties (PRPs) over who is responsible for the contamination when two or more parties or sources may have caused the releases. A typical situation is a site with several known or likely sources of chlorinated solvent contaminants, such as trichloroethylene (TCE), tetrachloroethylene (PCE), and trichloroethane (TCA). PRPs often take the denial position of "Its not mine! It must be his!", pointing the finger at other PRPs. Or frequently, "A small portion might be mine, but most of it has to be his!" Forensic environmental scientists and hydrogeologists are then hired to try to sort out the relative responsibilities. In many, of not most, cases, the chemical compositions of the waste discharges from different facilities, from different times, or from different parties, have unique chemical signatures or "finger prints," even if the key contaminants of concern are the same for all. An experienced expert can often decipher these signatures. There are several types of chemical signatures that can be useful. These include: 1) the suite of chemical compounds associated with each party's waste stream; 2) ratios of different chemical constituent concentrations to one-another; 3) presence and relative abundance of degradation products from parent chemical contaminants; (4) isotopic composition of a given chemical from different production facilities or times. The history and configuration of individual contamination plumes is determined by the hydrologic factors that control the flow direction and velocity of groundwater and dissolved contaminants over time. The configuration of contamination plumes must be consistent with the position and timing of the alleged source(s) for each plume. Combining hydrologic analysis with chemical signature analysis can provide a powerful tool in proving or disproving an alleged source. The success of this approach is demonstrated on at least three case histories: 1) The principal source of wide-spread ethyhlene dibromide (EDB) contamination in a major water supply aquifer could have originated from land applications of EDB as a crop nematocide or from leaks and spills of leaded gasoline (which contained EDB as a lead-scavenger additive) from fuel pipelines and storage tanks. Evidence developed with this combined approach resolved the issue. 2) TCE, PCE, TCA, carbon tetrachloride and related chlorinated volatile organic compounds (VOCs) from multiple sources contaminated a major public water supply aquifer in the Midwest. Individual contributions to commingled plumes containing many of the same compounds were distinguishable using this technique. 3) At a well-known site in the northeast, a public well field became contaminated with chlorinated VOCs and a nearby commercial facility was blamed. Analysis

of chemical signatures and groundwater flow pattern history proved that the alleged facility could not have been the source. Furthermore, the analysis identified the true source at a different location.

Groundwater, Contamination, Hydrology

C52 Contaminant Release Dating Continued - Can Sediment Core Analyses Be Used to Date Contaminant Releases?

James H. Clarke, PhD, Vanderbilt University/AquAeTer, Inc., VU Station B 351831, 2301 Vanderbilt Place, Nashville, TN 37235-1831, and Raymond J. Lawing, PE, ME, AquAeTer, Inc, 215 Jamestown Park, Suite 100, Brentwood, TN 37027*

After attending this presentation, attendees will understand the utility and limitations of sediment core analyses to determine contaminant release dates.

This presentation will impact the forensic community and/or humanity by demonstrating a real world example of the integration of chemistry, fate and transport theory, hydrology, bathemetry, construction management, storm water management and monitoring, GPS, and historical aerial photographs to determine contamination release dates in a complex scenario.

Contaminant release dating is an important and challenging part of environmental forensics. A determination of when contaminants were released to the environment plays a critical role in liability determinations and remedial cost allocations.

In an earlier paper, presented to the American Academy of Environmental Forensics, the merits of several approaches to contaminant release dating were assessed. This presentation continues the analysis with a focus on surface water sediment contamination and associated contaminant release dating.

An environmental forensics analysis was conducted to determine the source of DDT contamination that is seen today in the sediments of an estuary on the Gulf Coast. DDT was produced at a manufacturing facility that ultimately discharged to the estuary. The production of DDT ceased at this facility in 1970 and the plant changed ownership in the early 1980s. The estuary is tidal and is routinely subjected to tug and barge traffic. Intense rainfall and storm events were not uncommon.

Clearly, the DDT that is seen in the estuary sediments was most likely produced when the plant was manufacturing DDT. The presence of DDT at depth in several sediment cores was presented as evidence that the DDT contamination was "old" and consequently due to releases that occurred during the time when DDT was being manufactured. However, there are several reasons that suggest that the DDT was released later after the plant-changed ownership.

The presentation will provide the results of a detailed environmental forensics analysis that included the evaluations of sediment quality at different locations over time, bathymetric surveys over time, dredging events that removed large volumes of potentially contaminated sediments during DDT plant operations, and the analysis of construction projects, that occurred after the ownership change that had the potential to release large amounts of highly contaminated surface and subsurface soils to the estuary.

Release Dating, Sediment Cores, DDT Contamination

C53 Is Your Analytical Result Accurate?

James S. Smith, PhD, Trillium, Inc., 28 Grace's Drive, Coatesville, PA 19320*

The goal of this presentation is to demonstrate how the method of standard additions (MSA) is an excellent test to determine the accuracy of an analytical result.

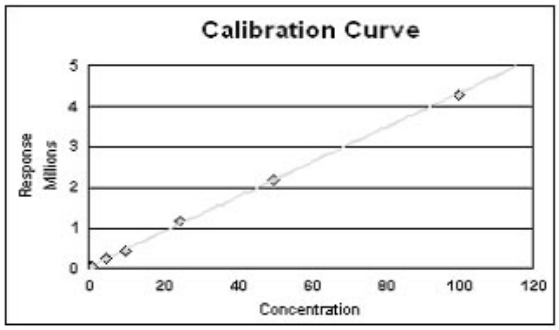
This presentation will impact the forensic community and/or humanity by acting as a reminder that there is a method to check the accuracy of analytical results.

New analytical instruments and more sophisticated analytical methods have lead the data user to rely unconditionally on the accuracy of the environmental measurement. Yet, this measurement is of lower concentrations of a pollutant than ever measured in the past. Environmental chemists, engineers, companies, and regulators are presently concerned with low parts per trillion concentrations. For example, a company has a permitted concentration of mercury of 150 parts per trillion in their plant's effluent to the local sewer authority. Elemental mercury at the parts per trillion levels can be measured by USEPA method 1631 Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry.

The Method: Method 1631E is for the determination of mercury in the concentration range of 0.5 to 100 ng/L (parts per trillion). The sample must be obtained using USEPA method 1669: Sampling Ambient Water for Determination of Trace Metals at EPA Water Quality Criteria Levels. In an ultra clean laboratory, the sample is oxidized producing mercury plus two (Hg^{++}). After the oxidation process the mercury ions are reduced to elemental mercury and removed from solution by purging with an inert gas. The elemental mercury is trapped and hopefully many interferences are not trapped and thus, removed from the analysis. The trap is heated releasing the elemental mercury, which is moved to a second trap with the inert gas, and again hopefully removing interferences. The second trap is heated and the elemental mercury is moved to a cell to be measured by atomic fluorescence spectrometry.

The Calibration: The calibration curve from 0.5 to 100 ng/L is given in Figure 1. The correlation coefficient for this calibration curve is 0.999. The instrument responses to low concentrations of mercury in pure water indicate that the method and the laboratory are doing very well.

Figure 1



The Analysis: The effluent sample is analyzed after it has been diluted by a factor of 10. The sample that enters the instrument contains what is then measured at 21 ng/L. After a multiplication by the dilution factor of 10, the reported concentration is 210 ng/L. This is a permit violation. The laboratory is certified for this method by the state and has performed the analysis according to the method. The sample was diluted, thus reducing the possibilities of interferences causing false positives. Is the reported result accurate?

The Method of Standard Additions (MSA): In USEPA SW-846 method 7000A, the method of standard additions is described. This technique is best seen in Figure 2. When the MSA was applied to the diluted sample, the results strongly indicated that the reported value was wrong. The MSA experiments are given in Table 1. The MSA plot is given in Figure 3. With a R^2 of 0.809, the MSA shows there is so much positive interference in the method for this sample that the real mercury concentration may be "ND" (non-detected).

Figure 2

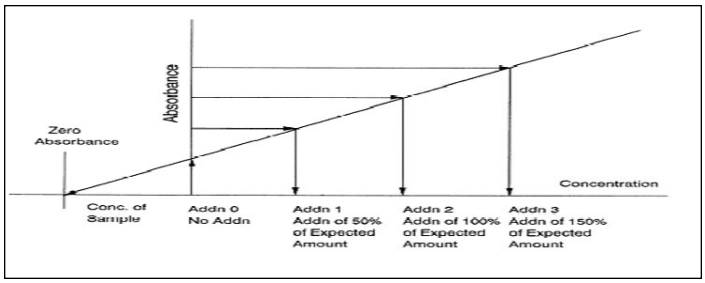
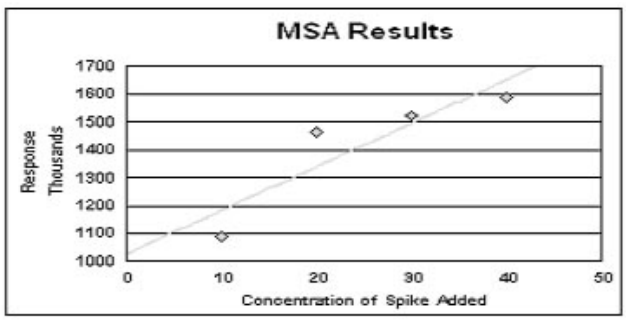


Table 1
Mercury Analysis by Method 1631E

Spike Concentration	Original Concentration	Expected Concentration	Measured Concentration
10 ng/L	21 ng/L	31 ng/L	23 ng/L
20 ng/L	21 ng/L	41 ng/L	31 ng/L
30 ng/L	21 ng/L	51 ng/L	33 ng/L
40 ng/L	21 ng/L	61 ng/L	34 ng/L

Figure 3



Conclusion: All results from any analytical method can be checked for accuracy using the method of standard additions. The MSA is applicable to organic analyses as well as inorganic analyses by any quantitative method.

Method of Standard Additions, Calibration, Mercury

C54 Validating Asbestos Data - What Do We Have to Go On?

Denise A. Shepperd, BS, Trillium, Inc., 2014 Carol Drive, Wilmington, DE 19808*

After attending this presentation, attendees will understand the current limitations involved in assessing the quality of results from asbestos analyses in environmental matrices.

This presentation will impact the forensic community and/or humanity by increasing awareness of some of the limitations in evaluating the usability of asbestos results in risk assessment and remediation, reported results are not always what they may seem.

Learning Objective: to address the present state of validating asbestos data, the tools already possessed as well as the additional tools that are needed.

When an outside source is asked to validate data it is hoped the results are usable. If there were problems with the analysis, find out how they may have affected results. Another reason to ask someone to validate data is to ascertain whether or not the data would be defensible in court, i.e., do the data support the reported results?

The whole point of environmental analytical chemistry is to determine what is present and how much there is. The data have to support both the presence of the compounds or elements identified as well as the concentrations of any compounds or elements reported in a sample.

Validation of data produced by methods such as those included in EPA Solid Waste methods (SW-846) and the EPA Contract Laboratory Program Statements of Work (EPA CLP SOWs) is a "by the book" process. One can follow a guideline, fill out a checklist, refer to specific limits for the quality control (QC) analyses, and have the decisions on how to qualify the data generally laid out. "If this, then that," so to speak.

But what happens when the data and results are from methods that have no "book" to follow? It's still the same process, still the same questions to answer. Are the correct analyses identified in the sample? Are the reported concentrations correct? Do the data support the identifications and the concentrations reported?

Asbestos analysis is not new. Interest in identifying and quantifying asbestos minerals began in the 1960s when adverse health effects were first identified in workers involved in the use of asbestos as fire retardant coatings. The concern grew as awareness of the dangers of these materials grew. The earliest sampling and analysis methods were designed to measure exposure by inhalation so airborne particles were the matrix of concern. All asbestos fibers were treated the same and the intent was to err on the conservative side. False positives are much more welcome than false negatives when human health is at stake.

As time passed and work on asbestos monitoring continued, it was determined that some types of asbestos fibers are more dangerous to human health than others. Methods and instrumentation have been improved for the detection and differentiation of asbestos materials. But the tools a validator relies upon are not all there. There are no National Functional Guidelines to follow. There are no EPA regional SOPs for validation of these data. It is back to the basics of, "what's there and how much."

But there are some tools available. There are QA/QC measures that allow laboratories to demonstrate their ability to identify and quantify asbestos fibers and for validators to evaluate that ability. Deficiencies have been identified in the availability of standard reference materials and guidance for laboratories. Methods are in development to address additional matrices. Meanwhile, professionals use what is necessary to ensure that the results are usable and defensible.

Validating, Asbestos, Defensibility

C55 Forensic Investigations of Chemical and Biological Contamination in Buildings

David A. Weeks, PE, MS, and Kenneth M. Goodman, BS, Risk Management & Engineering, Ltd., 9206 Briarcrest Drive., Rowlett, TX 75089*

After attending this presentation, attendees will understand procedures for conducting IAQ investigations; understand common mistakes that can lead to incorrect conclusions; and gain information from real-life case studies that demonstrate the procedure with respect to both chemical and biological contamination.

Experience has been that many IAQ investigators conduct investigations without a clear hypothesis of the problem that lead to complaints about the air quality in a building, or they develop hypothesis based only on past experience without full considering site-specific factors. This presentation will impact the forensic community and/or humanity by presenting investigation procedures that have been proven in numerous studies and will facilitate the correct diagnosis of indoor air quality problems in buildings.

The goal of the forensic building investigation is to determine the cause of an Indoor Air Quality (IAQ) complaint or problem and resolve the issue in a way that (1) prevents it from recurring, (2) addresses all concerns relative to the occupant risk, (3) addresses liability, and (4) does not create

other problems. The process for diagnosing IAQ complaints in a building include: 1) an initial walkthrough, 2) interviews with occupants and building maintenance staff, 3) collection of preliminary data (visual and analytical), 4) the development of one or more hypotheses, 5) collection of data needed to test the hypothesis, 6) evaluation of data to determine if results support the hypothesis, 7) implementing the control strategy, and 8) validation to determine if the control strategy is effective. Not every step is necessary in every case.

While many IAQ problems can be resolved by in-house personnel that are trained and knowledgeable of a building, diagnosing some IAQ problems may require equipment and skills that are complex and unfamiliar. Risk Management & Engineering, Ltd. will present two case studies that illustrate the process for solving IAQ complaints. One case study will address an odor complaint that is related to chemical contamination caused by an off-site source. In this case, it was also determined that the affected property contributed to the cause of the indoor odor due to unique features related to the heating, ventilation, and air conditioning system (HVAC). The second case will address an odor complaint related to biological contamination. In this case, the biological contamination was caused by poor construction related to the exterior of the building. The two case studies represent a range of complexity in forensic investigation of IAQ problems.

Indoor, Air, Quality

C56 Case Studies in Indoor Air Quality: It's Not Always What You Think

James S. Smith, Jr., PhD*, OAK CREEK, Inc., Toxicology & Risk Assessment Consulting, 60 Oak Creek, Buxton, ME 04093-6616

After attending this presentation, the participant will be better prepared to plan, conduct, and evaluate investigations of indoor air quality ("IAQ"). Dr. Smith will describe a preferred approach to the planning and conduct of IAQ investigations. Dr. Smith will use three case studies of IAQ assessment in schools, where the IAQ assessment was confounded by polychlorinated biphenyl ("PCB"), chlorinated volatile organic, or volatile petroleum hydrocarbon ("VPH") compounds, to illustrate common problems in the evaluation of IAQ.

This paper has three objectives: 1) to describe a useful approach for the investigation of indoor air quality ("IAQ"), 2) to identify common problems associated with IAQ investigations; and 3) to illustrate how the preferred approach was used in IAQ investigations at three elementary schools.

There are many potential sources of indoor air pollution, including vapors emanating during the cooking of foods, operation of heating and air conditioning systems ("HVAC"), off gassing of vapors from deteriorating furnishings and building materials, stored materials, as well as vapors and particulate from a large variety of outdoor sources (i.e., dusts, pollens, molds, automobiles, etc,) and personal life-style choices (i.e., smoking, perfumes, hobbies, etc.). The potential for any single source agent(s) to cause adverse health effects in people depends on the magnitude of exposure, personal sensitivity to the agent, and the agent's inherent ability to cause an adverse effect (i.e., toxicity).

Over the last 5 years, people have become very much more aware of the potential for agents in indoor air to adversely impact their health. Recent news stories have focused on the potential for second hand smoke, mold, asbestos, and fine airborne particulates to adversely affect health. U.S. Environmental Protection Agency ("U.S. EPA") ranks Poor IAQ as one of the greatest potential health threats within the home. Poor IAQ has been used to justify the abandonment of homes and the closure of schools and businesses. In the last couple of years, regulatory Agencies like the U.S. EPA has devoted significant resources to IAQ issues. Yet, with all this attention, regulatory Agencies have provided very little guidance to ensure that IAQ investigations are properly conducted.

Indoor air quality investigations often begin as the result of a general health complaint linked to the perception of poor indoor air quality. Dr. Smith describes a simple phased approach to the investigation of indoor air quality that includes the identification of potential confounders of IAQ analysis, focused sampling and analysis, and a little common sense. This presentation provides a road map for the phased evaluation of IAQ problems. Dr. Smith uses three case studies of IAQ investigations at elementary schools to illustrate how the phased approach was used to successfully identify IAQ problems requiring remedial action, while eliminating common confounders.

Air, Quality, Confounders

C57 Microbial Consulting - Science Limitations in Expert Work

Gary R. Brown, BS, RT Environmental Services, 215 West Church Road, King of Prussia, PA 19406*

The goal of this presentation is to help those engaged in microbial consulting understand how scientific proof (and lack thereof) affects expert work and to what degree.

This presentation will impact the forensic community and/or humanity by providing a technical understanding of the limitations of the science behind microbial consulting as relates to expert work.

The science, which forms the basis of microbial consulting, is currently based on association of microbe genus and species to observations or self reported complaints. Even though the science is only a few years old, experts are all too often reaching conclusions, which go beyond the scientific basis available in this practice area.

This presentation will examine the basis of microbial science and focus on the limitations that the state of the science places on the expert. Focus will be made in three key case studies and why it frequently occurs that cases settle before going to trial.

Many mold-consulting projects also involve opinions on building materials and building design and how both play into resulting microbial amplification issues. The interplay between engineering design opinions and microbial consulting experts work will be examined as well.

Mold, Microbial, Evaluation

C58 NIST Standard Reference Materials® (SRMs) for Environmental Measurements and Analysis

Mario J. Cellarosi, MS, National Institute of Standards and Technology, MS 2320, Gaithersburg, MD 20899*

After attending this presentation, attendees will understand the use of NIST Certified Standard Reference Materials® (SRMs) to validate environmental measurements and data and related NIST SRMs Web presence and navigation techniques.

This presentation will impact the forensic community and/or humanity by presenting to the forensic community the availability and use of NIST Certified Standard Reference Materials to establish validity for environmental measurements and data.

This paper discusses physical and chemical properties of certified NIST Standard Reference Materials (SRMs) related to environmental measurements on the identification and/or comparison of specimens to be linked to forensic data. Environmental SRMs provide the measurement benchmarks to assess the levels of a range of toxic chemicals and the movement of such potentially harmful substances through ecosystems and food webs.

NIST supports accurate and compatible measurements by providing over 1300 Certified SRMs with well-characterized composition and/or properties. These SRMs are used to perform instrument calibrations in situ

as part of overall quality assurance programs, to verify the accuracy of specific measurements and to support the development of new measurement methods. NIST SRMs are currently available for use in areas such as industrial materials production and analysis, environmental analysis, food and agriculture, radioactivity, health measurements and basic measurements in science and metrology. Each SRM is supplied with a Certificate of Analysis. Along with other standardization organizations methods and procedures, such as ASTM and ANSI. NIST has published many articles and practice guides that describe the development, analysis and use of SRMs. NIST SRMs provide the benchmarks of precision, accuracy, and trace ability, which validate the measurements and data.

The measurement of physical, optical and chemical properties of environmental samples is often employed to identify the type of material and/or application. Measurements of material properties can be used to track and identify the original producer, the date or period of manufacture and the intended use or application for the material or product. For example, property or chemical measurements and/or the evaluation of environmental samples or product characteristics, in addition to visual markings if present, can establish a link in the chain from producer, fabricator, distributor, vendor, end-use or application, down to a specific geographical area or sample origin.

In the measurement of properties, chemical composition, or characteristics of environmental samples, accuracy and uncertainty terms and trace ability statements are of paramount importance in forensic investigations for the validation of data. These concepts must be used correctly to avoid possible confusion and inadmissibility of evidence. SRMs and the associated Certificate or Certificate of Analysis documentation state the intended purpose and application of a particular SRM, its certified property value(s) with associated uncertainty (ies), and present technical information deemed necessary for its proper use. The uncertainty attached to a certified value is especially important as it represents a quantity, which characterizes the range of values within which the true value is asserted to lie with a stated level of confidence. A NIST SRM certificate bears the logo of the U.S. Department of Commerce, the name of NIST as certifying body, and the name and title of the NIST officer authorized to accept responsibility for its contents. In addition to the certified values, the SRM certificate may contain references and/or other pertinent information and data. SRMs certified values with their associated uncertainties, in applicable situations insure the integrity and the validation of forensic measurements. NIST certified values are obtained by one or more of the following measurement modes: 1) A definitive (or primary) method using specialized instrumentation capable of high accuracy and precision and whose errors have been thoroughly investigated and corrected; or, 2) Two or more independent methods at NIST using commercial instrumentation that is calibration based and with differing sources of systematic errors; or, 3) Interlaboratory data from selected laboratories using multiple methods and SRMs as controls. However, the sources of error with the latter mode will generally result in uncertainties greater than those for the other two modes.

There are a number of measurement methodologies related to the determination of materials properties and /or chemical composition. For instance chemical composition methods cover basic “wet chemistry” procedures and other very sophisticated techniques, which utilize atomic and radiation physics principles, and nuclear interactions that require complex and expensive apparatus. Fortunately, a number of SRMs having components comparable with those of the materials to be evaluated have been established. These SRMs and associated methods or standard procedures are available for equipment calibrations.

This paper will discuss and illustrate the use of a number of environmental SRMs of interest to the forensic community. The discussion will encompass measurement practices, methods, standards, and precision and accuracy considerations to be taken into account for the measurement methodologies employed. This paper will also provide insights on the future needs for SRMs for environmental measurements and characterization.

Standards , Certified Reference Materials, Forensic Science

General

D1 The Physical, Psychological, and Physiological Effects of Mefloquine on Armed Forces Personnel Re-Deploying From Combat Theaters

Pamela M. Callaway, MS, MFS, MA, United States Army, 20180 Selby Road, Waynesville, MO 65583; and Celia M. Story, MFS, Policy Branch, Headquarters, U.S. Army Criminal Investigation Command, Fort Belvoir, VA 22060*

Pathologists, psychiatrists, and investigators will learn about the preliminary survey results on the effects of mefloquine to soldiers returning from combat theaters of operation, to include Iraq, Afghanistan, Saudi Arabia, and Somalia.

It is important to know and understand the effect mefloquine may be having on U.S. soldiers fighting and dying, in a deployed area. If this preventative is having adverse effects, it may be causing them to act out violently toward others or succumbing to depression and taking their own lives. Equally important are the delayed effects on Reservists and National Guard soldiers returning to civilian life. This presentation will impact the forensic community and/or humanity by identifying this issue, which may be the first step in finding a more innocuous preventative for malaria for U.S. soldiers.

Mefloquine is an anti-malarial drug with a trade name of Larium. Studies have revealed mefloquine has been known to cause neuro-psychiatric adverse effects ranging from anxiety and paranoia to depression, hallucinations, psychotic behavior, and possible suicide. A history of depression, generalized anxiety disorder, or a psychotic or seizure disorder has been known to exacerbate the symptoms.

The authors conducted a preliminary self-reporting survey of military police personnel who have returned from combat theaters. All of the soldiers surveyed were administered mefloquine. Results will be provided to exhibit trends, or the lack of trends, pertaining to side effects.

The authors were given permission to conduct the survey among students attending the U.S. Army Military Police School. Since this was a preliminary survey instrument for future research, the results are not provided in an official military capacity and should not be construed as being the opinion of the Department of Defense, U.S. Army or the U.S. Army Military Police School.

Larium, Effects, Soldiers

D2 An Army Forensic Puzzle Solved

Susanna Rudy, RN, MSFS, University of California Medical Center at San Diego, 200 West Arbor Drive, San Diego, CA 92103; and David Flohr, MSFS, U.S. Army Crime Laboratory, 4555 North 2nd Street, Forest Park, GA 30297-5122*

After attending this presentation, pathologists, forensic nurses, and investigators will learn how to recognize the characteristic markings on the chest made by implementation of the First Access for Shock and Trauma (FAST-1) intraosseous infusion system used by emergency medical personnel for rapid sternal intraosseous infusion.

This presentation will impact the forensic community and/or humanity by educating forensic nurses, pathologists, and investigators to be able to identify this type of wound pattern should they encounter it in the future.

During an attack on U.S. forces in Iraq, a soldier died of wounds that were first thought to have been caused by a shotgun blast. At autopsy, numerous round steel pellets and minute pieces of olive green plastic were removed from the victim's body. In addition, a circular pattern was noted on the victim's chest and a metal device was found under the skin in the center of the patterned impression. These items of evidence and images of the chest impression were submitted to the U.S. Army Criminal Investigation Laboratory for examination in an attempt to determine the source of origin for the pellets, plastic, metal device, and patterned impression.

The steel pellets and olive drab plastic were ultimately determined to be consistent with the types of materials used as the shrapnel and casing, respectively, for foreign anti-personnel hand grenades. This determination was supported by the presence of blast injuries suffered by the victim. But what was the cause of the circular pattern noted on the chest and what was the source of the metal object under the skin in the center of the pattern?

In an attempt to answer these questions, images of both the impression and the metallic device were posted on an Internet users group composed of individuals interested in forensic science applications of scanning electron microscopy. Though the web site is geared towards electron microscopy, perhaps some member of the group might recognize the pattern and metal object.

As a result of having cast a wide net, the answer to these questions quickly arrived. Susanna Rudy, a Registered Nurse, was serving as an intern in the Naval Criminal Investigation Regional Forensic Laboratory in San Diego as she worked on research for her MS in forensic science from National University in San Diego, California. Having read the scenario that accompanied the posted images, she e-mailed the images to her friends in the emergency medical field. Gary M. Vilke, MD and Associate Professor of Clinical Medicine, Medical Director, San Diego County Emergency Medical Services, responded: "The star pattern over the sternum with a central metal hollow tip makes it look like the tip of an intraosseous injection device. The FAST-1 intraosseous injector is utilized for sternal intraosseous infusion and has a threaded external end so that one can use a threaded removal device to extract the metal phalange after use (apparently not in this case)." Confirmation came from Michael W. Jacobs, Chairman/Founder, Pyng Medical Corporation, makers of the FAST-1 System.

FAST-1 Intraosseous System, Forensic Autopsy, Death Investigation

D3 VIRTOPSY® – Scientific Documentation, Reconstruction, and Animation in Forensics: Individual and Real 3-D Data Based Geo-Metric Approach Including Optical Body / Object Surface and Radiological CT / MRI Scanning

Michael J. Thali, MD, Ursula Buck, Marcel Braun, Peter Vock, MD, and Richard Dirnhofer, MD, University of Berne, Institute of Forensic Medicine, Berne, 3012, Switzerland*

After attending this presentation, attendees will learn the newest cutting edge technologies of 3-D documentation in forensic medicine. This presentation will impact the forensic community and/or humanity by demonstrating the possibilities of 3-D techniques in forensic.

Until today, most of the documentation of forensic relevant medical findings is limited to 2-D photography, 2-D conventional radiographs, sketches and verbal description. There are still some limitations of the classic documentation in forensic science especially if a 3-D documentation is necessary. The goal of this paper is to demonstrate new 3-D real data based geo-metric cutting-edge technology approaches. This paper present approaches to a 3-D geo-metric documentation of injuries on the

body surface and internal injuries in the living and deceased cases. Using modern imaging methods such as photogrammetry, optical surface and radiological CT / MRI scanning in combination it could be demonstrated that a real, full 3-D data based individual documentation of the body surface and internal structures is possible in a non-invasive and non-destructive manner. Using the data merging / fusing and animation possibilities, it is possible to answer reconstructive questions of the dynamic development of patterned injuries (morphologic imprints) and to evaluate the possibility, that they are matchable or linkable to suspected injury-causing instruments.

For the first time, to the authors' knowledge, the method of optical and radiological 3-D scanning was used to document the forensic relevant injuries of human body in combination with vehicle damages. By this complementary documentation approach, individual forensic real data based analysis and animation were possible linking body injuries to vehicle deformations or damages. These data allows conclusions to be drawn for automobile accident research, optimization of vehicle safety (pedestrian and passenger) and for further development of crash dummies. Real 3-D data based documentation opens a new horizon for scientific reconstruction and animation by bringing added value and a real quality improvement in forensic science.

Virtopsy®, Radiology, 3-D Surface Scanning

D4 Assessing Digital Photography: A Comparison of Crime Scene Photography Using Digital and Standard 35mm Film Based Cameras

Amanda L. Lokar, BA, BS, and Terry W. Fenger, PhD, Marshall University, Forensic Science Center, 1401 Forensic Science Drive, Huntington, WV 25701*

The goal of this presentation is to inform the forensic community about research comparing digital and film based 35mm cameras used for crime scene photography and present photographs from crime scenes using digital camera technology.

This presentation will impact the forensic community and/or humanity by serving as a starting point for agencies that need validation of digital technology before a decision can be reached on the conversion from film-based cameras to digital technology. This poster will show that there are many advantages to moving toward digital technology, and that the technology is a valid replacement for standard 35mm film-based cameras.

The goal of the research is to validate of the use of digital imaging as a replacement for standard 35 mm photography to document crime scenes. The research methodology involved crime scene photography, where two photographers documented crime scenes in duplicate. One photographer utilized a digital camera and a crime scene used a standard 35mm for comparison purposes. The parallel photography method was used on a variety of scenes, including homicides, suicides, unknown deaths, and cars processed in the evidence cage. The digital camera used for this study was the Nikon 5700 SLR 5.0 mega pixel camera. The crime scene technicians used a Pentax® K1000 camera with a 28-70mm zoom lens. The film used was Kodak 35mm color film with ISO 100. After digital picture capture to a 256 MB CompactFlash™ card, the images were then downloaded to a computer, saved to CD-ROM, and then printed. The pictures were then compared to the 35mm film prints by side-by-side visual comparisons.

The results showed very little difference between the standard 35mm and the digital pictures. In many cases, the digital pictures were actually clearer and represented the scene more accurately than the standard 35mm. In instances of close proximity to object of focus, the on-board flash was sufficient for scene illumination. However, in other instances such as the evidence-processing cage, the on-board flash was inadequate and produced images that were much darker then the 35mm prints that utilized a detachable sync cord attached flash.

The conclusion reached by this research is that digital photography at crime scenes can be as good as traditional methods, if not better in some instances. The digital camera had some shortcomings, especially concerning the flash. The flash problem could be easily remedied by using a detachable flash with the available hot shoe mounted on the camera. More research can and should still be explored in this area using the parallel scene method.

Over the course of this study, it was found that more law enforcement agencies have already made the switch to digital or are in the process of researching the method to make the conversion to digital. As technology improves, it is likely that more agencies will be moving to digital photography. A possible reason for the switch is a monetary savings, much needed by agencies that are incurring budget cuts. After the initial expenditure for conversion, one agency reported a savings of about six thousand dollars a year over film-based processing.

One of the stumbling blocks for the digital conversion is the technology's acceptance in the court system. Out of the thirteen agencies polled, seven of the agencies are using digital in some capacity for crime scene documentation. Of those seven agencies, there were no problems reported with court acceptance of the digital images. The Scientific Working Group of Imaging Technology (SWGIT) has created guidelines for the use of digital images in criminal justice system. Agencies should consider these guidelines and clearly define procedures for image captures, processing, and storage to properly account for images in the event of a court challenge to the technology.

The research presented may be able to serve as a starting point for agencies that need validation of digital technology before a decision can be reached on the conversion from one technology to another. Before considering the conversion to any new technology, law enforcement agencies should speak with district attorney's in their system to determine the probability of court acceptance. Agencies considering the conversion should also explore the cost of the conversion, any change in yearly cost (positively or negatively), and determine a set of standard operating procedures that will follow SWGIT guidelines and best suit their organization.

Digital Cameras, Crime Scene Photography, Digital Imaging

D5 Child Abuse: Physical Abuse

Diana K. Faugno, BSN, RN, Palomar Medical Centre, 555 East Valley Parkway, Escondido, CA 92025*

Attendees will be able to review healing injury photos of a case of child abuse and understand the court outcome, which will be discussed based on the prosecution's understanding of the findings.

This presentation will impact the forensic community and/or humanity by demonstrating to the audience that not all anal injury is sexual abuse.

The police rescued a 4-year-old Spanish-speaking male. The child had multiple bruises, burns, and patterned injuries all over his body. He was taken to Children's Hospital, where he was evaluated for his injuries. It is noted he had a bruise around his penis. A Spanish speaking forensic interview obtained a history of a bar of soap being "shoved up my butt and it hurt."

A forensic sexual abuse examination was completed seven (7) days after his initial evaluation. There were multiple areas of healing noted all over his body with fading bruises, burns, and patterned injury. His eyelashes are at varying lengths. His anus showed a healing laceration at 6 o'clock. This injury was consistent with the time frame and history stated.

Both the mother and significant other were arrested and placed in jail. The court case occurred eight (8) months later with the defense accepting a plea bargain of a required eight (8) years served before parole for both of them.

Key Point: The intent of shoving the soap bar into the anus was not sexual.

Child Abuse, Physical Abuse, Anal Injury

D6 Burns by Electric Burner Plate: A Case Study

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The objective of this study is to characterize burns caused by an electric burner plate. This presentation will impact the forensic community and/or humanity by providing more information regarding burn injuries.

The case presentation involves a 30-year-old woman who was found unconscious in her kitchen at 8:00 p.m. She was lying supine on the floor in front of an electric cooker. A wide burn was observed on the left side of her face (from eyebrow to chin and from nose to cheek). Another "arborescent" burn was present on the anterior side of the neck. Severe burns involved also the extremities of the first and the second finger of the right hand. There was no evidence of any other burned areas neither on the body and clothes. All four plates of the electric cooker were incandescent when the woman was found. Empty rum bottles and blister pack of Temazepam pills were found in the living room.

The woman was carried in hospital where her blood tested positive for a large amount of alcohol and benzodiazepines. After the emergency treatment, she fully recovered from the coma but she did not remember what happened after 6:30 p.m. when she deliberately took pills and alcohol with the purpose to get a long sleep. The accident was initially considered a suicide attempt and investigations were not conducted.

Three months lather, the case came to the attention of the public prosecutor. A man who had previously inflicted injuries to the victim and recently made threats against her was identified. The prosecutor asked the authors to reconstruct the circumstances of burn trauma, focusing their attention on the nature of injuring action. Were the burns accidental, self-inflicted, or inflicted by an assailant? At that point, the available evidence consisted of a few photographs of the victims taken in hospital two weeks after the trauma and the "crime scene," taking into consideration that the flat had been well cleaned in the meantime.

Extensive testing was conducted on the etiology of burns and the mechanics of injury. These results were compared with those obtained from the crime scene analysis. The location of the cooker in the kitchen and its dimensions were incongruous both with an accidental fall or an intentional action. Against the first possibility, the electric cooker was not wide enough to allow a full and balanced support of the upper part of the body for a prolonged contact between face and plates. Further, as all four plates were found incandescent, this reconstruction was denied by the absence of any other burned area on the body or clothes.

Against the second hypothesis, the height of the electric cooker surface would require a deep flexion of the upper part of the body (more then 90°). The women would be unable to balance in this position just holding the cooker, considering the elevated concentration of drugs and alcohol detected in her blood. Both substances have a well-known miorilaxant activity and they interfere with the ability to maintain her equilibrium.

In conclusion, the reconstruction strongly suggested an intentionally inflicted violence.

Indeed, despite the initial lack of disclosure, an inflicted etiology was supported by a multidisciplinary analysis involving the study of characteristics of unique burn pattern injuries, victim general conditions, and crime scene investigations.

Burns, Electric Burner Plate, Piglet-Model Study

D7 Is Pediatric Death Investigation Enhanced by the Credentials of the Investigator?

Dawn M. Zulau, Mary G. Ripple, MD, and David R. Fowler, MD, Office of the Chief Medical Examiner, State of Maryland, 111 Penn Street, Baltimore, MD 21201*

The purpose of this poster is to determine if credentials of an investigator enhance information gathering during the initial phase of child death investigation. This presentation will impact the forensic community and/or humanity by helping attendees to realize what credentials would be required for the development of dedicated pediatric investigators.

Like many other states in the nation, Maryland appoints people as investigators. Each brings their unique experiences and each person has varying credentials. Maryland has a detailed child death protocol that requires the forensic investigators or deputy medical examiners to inspect the child at the location where they are pronounced, to investigate the scene where they were last known alive, and to interview witnesses and family. In addition to the standard investigation report, a lengthy child death investigation protocol must be completed. A lack of total compliance with the child death protocol has been recognized. Many possible variables were the length of time required to complete the protocol, the interrupted flow of the investigation tool, the cooperation of the investigating police agency, the comfort level of the investigator, and lastly the credentials of the forensic investigator or deputy medical examiner. It has been suggested that the comfort level of the investigator often depends on their credentials. The investigators were divided into groups based on their credentials: physicians, nurses, pre-hospital providers, and those with no medical credentials. A five-year evaluation determined which group of investigators had the most complete data and highest compliance with the protocol procedures. The case data evaluation was based upon compliance with the entire protocol and the type of data collected during the initial phase of the investigation. The investigation tool was broken down into these categories: demographics, social history, birth mother's medical history and scene evaluation, and scene response. Each tool was evaluated for the presence of required information. A statistical comparison of results of the credentials of the investigators was performed. Geographic trends were taken into consideration. The results indicated that the most highly educated professionals had the lowest compliance rate and geographic trends tended to support this finding.

Forensic investigators are appointed to complete scene investigations for the medical examiner. Minimum qualifications are two years of trauma experience or thirty college credits in the science, forensics, or a related field of study. A county deputy medical examiner is an appointed physician who performs the same duties as the forensic investigator with the exception that they can complete a death certificate for cases that do not require an autopsy. Deputy medical examiners may or may not have formal training in forensics other than that provided by the authors' office in Baltimore. A child is defined as less than two years of age. The Maryland Child Death Protocol is a procedure which requires the investigating deputy medical examiner or the forensic investigator to complete all of the following: inspect the body at the location where it was pronounced, inspect the scene where the subject was last known alive, obtain photograph, obtain pertinent records, retrieve medications, retrieve admission lab samples, interview the family and the witnesses, and discuss the case with the police. Medical examiner jurisdiction is determined by the physical location at which the child was pronounced; therefore, cases which were determined to be a Maryland Medical Examiner's case but the incident location was not in Maryland were excluded. Staffing limitations prevent Baltimore City Forensic investigators from completing the entire child death protocol. The homicide detective will often evaluate the scene of the incident, interview the family, and supply the information required for the Child Death Investigation Form. Due to the described operational differences, Baltimore City cases were excluded. There are some occasions where warrants were necessary and the police restrict access to the scene or to witnesses. Cases where it is documented that the investigation police agency did not allow protocol compliance were excluded.

It has been suggested that a group of dedicated pediatric investigators would provide a higher level of investigations. The impedance of this study was to determine which credentials, if any, a pediatric investigator should have.

Child Death Protocol, Investigation, Jurisdiction

D8 Accidental Death Resulting From Acetylene Cylinder Impact

Mukta Rani, MD, DNB, Department of Forensic Medicine, Maulana Azad Medical College, Bahadurshah Shah Zafar Marg, New Delhi, 110002, India; Avneesh Gupta, MD, Medical Examiner's Office, Wayne County, 1300 East Warren Avenue, Detroit, MI 48207; and P.C. Dikshit, MD, LLB, Anil Aggarwal, MD, and Vijay Dhankar, MBBS, Department of Forensic Medicine, Maulana Azad Medical College, Bahadurshah Shah Zafar Marg, New Delhi, 110002, India*

After attending this presentation, attendees will learn the scenario of occupational injuries in a developing country like India. This presentation will impact the forensic community and/or humanity by providing a better understanding of the blast effect from a low impact explosion and better recommendations for occupational safety.

Case report: A 34-year-old male welder sustained injuries resulting from the impact by the upper part of acetylene production and storage cylinder while examining the gas pressure. The valve (V) in this device had rusted, allowing the build-up of dangerously high pressure of acetylene gas. He went on infusing calcium carbide into the cylinder, until the rising pressure within it caused the explosion. In this explosion, the upper part (U) of the device blew out and struck him on the face. At the time of the incident, he was bent over the device, supposedly checking the apparatus. This caused his upper part of the body – including the face – to be exposed to the full blast of the explosion.

After the incident the upper part the cylinder along with the victim was found lying at a distance of about one and half feet from the lower container as shown in figure 3. The body of the welder was lying in a pool of blood as shown in figure 4. The body was shifted to the mortuary of Maulana Azad Medical College, Delhi for the autopsy.

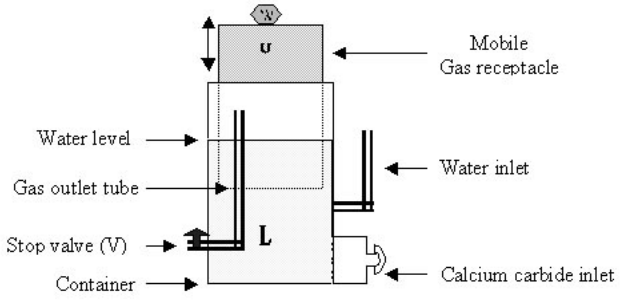

Figure 1. Schematic diagram of
The improvised acetylene tank

Autopsy findings: On examination of the body, dried blood was seen adherent to the head, face, neck, and chest. Blood was oozing out from both nostrils. Multiple abrasions were present over the right ear, face, front of neck, and upper chest with a black eye on the right side. Multiple lacerated wounds were present over the lower lip and chin (figure 5). There were multiple bruises over the face, front of neck, shoulder, upper chest (figure 6) and left buttock. There were multiple fracture dislocations of maxilla and mandible, along with loosening of upper incisors. There was transection of trachea, vessels and bruising of neck muscle above the thyroid cartilage (figure 7). There were bilateral sterno-clavicular and acromio-clavicular joint dislocations and multiple fractures of all the ribs accompanied by effusion of blood around. A contusion about 8x6 cm was present over the frontal area of scalp. There were fissured fractures of anterior cranial fossae of the base of skull. Brain showed contusion laceration of the undersurface of both frontal lobes. Sub-dural and sub-arachnoid hemorrhage was present all over the brain parenchyma. There were no lesions to the other internal organs and all toxicological analyses were negative.

The autopsy results showed that the death has been caused due to hemorrhagic shock and cranio-cerebral damage consequent upon injuries to the neck structures and head respectively. The injuries were produced by blunt force impact to head and neck resulting from the accidental impact of an acetylene cylinder.

In the present case, the examination of the cylinder revealed the rusting of several components of the cylinder – including the safety valve. The cylinder was country made and did not adhere to the specifications issued by Bureau of Indian Standards (BIS). It was in use for more than 10 years and service and repairs were pending. The rusting of the components decreased the free movement of the cylinder along with the rusted release valve. There was an increase in pressure of more than 15psi, resulting in degradation of acetylene and non-functioning of oxy-acetylene flame. Due to lack of knowledge the welder infused more chemical reaction to increase the supply of acetylene gas. The explosion occurred as he checked the gas pressure and increased it manually. Explosion of the cylinder led to the flying off of the upper part of the cylinder, which hit the welder on his head, neck and chest. The external injuries off the welder corresponded to the detached upper part of the acetylene cylinder.

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Acetylene, Cylinder Blast, Blast Effects

D9 An Evaluation of the Lethal Traffic Accidents in Crete During 1998-2004

Elena Kranioti, MD, Department of Forensic Pathology, University Hospital of Heraklion, Medical School University of Crete, Greece; Ersi Abaci Kalfoglou PhD and Munevver Acikkol PhD, Institute of Forensic Sciences Istanbul University 34303 Istanbul Turkey; and Manolis Michalodimitrakis MD, JD, Department of Forensic Pathology, University Hospital of Heraklion, Medical School University of Crete, Greece

Drug use is considered to be one of the most important contributors to traffic accidents. It has been shown by numerous studies that blood alcohol levels exceeding 0.1 g per 100 ml increases the crash risk. It is also very well known that many drugs like cannabis, benzodiazepines, and opiate like drugs such as heroin, morphine, methadone, and amphetamines impair driving skills. While the basic effects of drugs on performance can be expected to be comparable in different nations, the drug related accident risk may vary due to different driving habits, structure and density of traffic and so on. Therefore, it seemed to be interesting to study the situation in Crete, knowing that the fatal traffic accidents in Greece are more that 18,000 per year placing the country in the first place within the European Union.

In this study, the authors collected the data from the of the fatal traffic accidents that occurred in Crete during 1998-2004. They were classified as to their number, number of deaths per accident, the seasonal and monthly distribution (since there are serious seasonal fluctuations in the number of inhabitants during winter and summer time), the time and the rate during the week, and the age distribution of the deaths.

The authors concluded that the maximum number is reached in summer and on Sundays, the highest value being in September. The age distribution showed a maximum between 21- 30 years of age. The second part of the study was to correlate the values with the toxicological analysis outcome of the above-mentioned accidents. Alcohol, opiates, cannabinoids, and benzodiazepines were tested and compared with the parameters studied. The overall positive outcome was the observation of a general decrease in the fatal traffic accidents as compared to the last ten years

Forensic Toxicology, Driving, Crash Risk

D10 Statistical Distributions of Suicide in Tarrant County

Lauralee Harris, MPA, Mental Health Association of Tarrant County, 3136 West 4th Street, Fort Worth, TX 76107; and Nannapega Zachariah, PhD*, Tarrant County Medical Examiner's Office, 200 Feliks Gwozdz Place, Fort Worth, TX 76104*

After attending this presentation, attendees will understand a useful format for the Medical Examiner's Office to assist the community in development of suicide statistical information and demographics for epidemiological purposes and for prevention and education efforts.

This presentation will impact the forensic community and/or humanity by encouraging the forensic community to understand their importance in presenting accurate information and developing statistical reports to assist community efforts in suicide prevention and education.

Methods: All 523 cases of suicide examined by the Tarrant County Medical Examiner in the years 2000-2003 were reviewed. The study was conducted at the Medical Examiner's office, using the Medical Examiner's computerized records. Individual deidentified case data were analyzed by staff of the Health Intelligence Center of the Tarrant County Public Health Department using SPSS and Geographic Information System (GIS) technology. The U.S. Census 2000 was used for population rates. Suicide rates for the U.S. were obtained from the Centers for Disease Control and Prevention, and for Texas from the Texas Department of Health, Vital Statistics Department.

Results: The suicide rate has varied somewhat in Tarrant County over the four years of this study.

- Overall rates: 2000/8.3 2001/8.68 2002/7.99 2003/10.27
- Youth 24 & under rates: 2000/5.09 2001/3.72 2002/2.85 2003/3.71
- Adult over 24: 2000/10.4 2001/11.71 2002/11.11 2003/14.21
- Males are at 4.8 times the risk for committing suicide as females
- The highest rate per 100,000 of population is in males over the age of 75
- Although more white youth commit suicide, the highest rate is in black youth
- Some zip codes in Tarrant County have both a higher incidence of suicide and higher rate per 100,000 population than most other zip codes
- For adults there is little pattern between zip codes for the years
- For youth the suicide rates by zip code indicated some zip codes have higher rates each year

Implications:

- Periodic analysis of suicide data can assist the community in evaluating trends.
- Understanding trends can assist the community in developing public health education and intervention strategies to prevent suicide.
- It is critical that the Medical Examiner, law enforcement and medical facilities present information as accurately as possible regarding suicide.
- Medical Examiner investigative reports can be especially helpful in differential diagnosis between suicide and accidental death when intent may be unclear.
- ME reports are especially important when cause of death is substance related. Undercounts of the incidence of suicide may cause a community to underestimate the impact of suicide.
- It is especially important that supportive analytical instruments and tests, such as hair analysis be used to determine substance use. Many substances can lead to periods of severe depression even weeks after they are discontinued, and may not show on routine toxicology tests. A better understanding of the contri bution of substances, including prescription medications, is needed in the effort to prevent suicide.

Suicide, Suicide Rates, Tarrant County

D11 The History of the Scientific Working Group on Digital Evidence and the New Forensic Science Discipline for Evidence

Carrie M. Whitcomb, MSFS, National Center for Forensic Science, PO Box 162367, Orlando, FL 32816-2367*

After attending this presentation, attendees will understand the benefits of having an international certification program for many types of digital media based on the criteria and to describe the numerous positive outcomes of having such a program.

This presentation will impact the forensic community and/or humanity by stimulating a discussion in the community and to gain the benefit of ideas generated as this topic is discussed.

In the 1980s, investigators were encountering and seizing computers as evidence in their investigations. In the mid to late 1980's, forensic laboratories in Washington, DC were receiving cases that had computers along with other types of physical evidence. These laboratory submissions started a search for the answer to the questions: "What is the role of the forensic laboratory for computer evidence?" This topic of discussion continues today. The early history of forensic digital evidence involved an ad hoc group in the Washington, DC area, referred to as the Federal Crime Laboratory Directors. They meet two times a year to exchange information about their agencies and discuss topics of mutual concern. It was after two such meetings at that U.S. Postal Inspection Service Laboratory in Dulles, VA in early 1998 that, what is known today as the Scientific Working Group on Digital Evidence (SWGDE) was formed. SWGDE defined digital evidence as "information of probative value that is stored or transmitter in a binary form." SWGDE defined other terms related to digital evidence.

At the International Association of Forensic Sciences (IAFS) in Los Angeles at UCLA in 1999, the Executive Committee of SWGDE arranged for the first forensic science session in the U.S. related to digital evidence. Workshops by SWGDE regarding the establishment of a digital evidence section in forensic laboratories followed at the American Academy of Forensic Science thereafter. The American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB) recognized digital evidence as a sub-discipline in their accreditation program in 2003.

Currently, SWGDE has developed the first version of a "Best Practices" guide that is available at www.swgde.org along with several other final documents and draft documents for public review and comment. New challenges are continually facing the digital evidence examiners who must be able to forensically collect, preserve, store and examine various formats of digital evidence as the volume of data and new forms of technology increase exponentially. The scientific integrity must be maintained.

Digital Evidence, History, SWGDE

D12 The Rational for International Certification for Digital Evidence Professionals

Carrie M. Whitcomb, MSFS, National Center for Forensic Science, PO Box 162367, Orlando, FL 32816-2367*

After attending this presentation, attendees will understand the benefits of having an international certification program for many types of digital media based on the criteria and to describe the numerous positive outcomes of having such a program.

This presentation will impact the forensic community and/or humanity by stimulating a discussion in the community and to gain the benefit of ideas generated as this topic is discussed.

People, training, education and objects can be certified. Certification indicates that "X" has met criteria of performance standards established by a consensus of experts. Whether referring to a person who is a Board Certified Forensic Pathologist, or a certified brake installation on an airplane, basic criteria must been met that demonstrate a specified competency for the awarded certification. Professional certification evolves in response to external demands placed on a profession or a subset of expertise or internally from a need recognized within that community.

In the case of crimes related to digital evidence and the subsequent forensic examination of digital evidence, there is pressure from the courts and from international organizations, to establish standards and definitions for the international exchange of digital evidence. In the law enforcement and forensic science communities, it has become apparent to many that a coordinated effort is needed in this area. The establishment of international professional performance standards by the professionals who work in this field seems reasonable and necessary. Professional certification currently exists for several forensic science disciplines. The establishment of certification standards would help insure that crime scene experts who collect digital evidence, forensic examiners who examine the recovered digital evidence and the investigator who analyzes the digital evidence would all be applying the same principles and standards in their activities, written reports and in court testimony. The basic areas of 1) collection and preservation, 2) examination, and 3) analysis may be performed by one person or three separate individuals. However, the basic principles must be followed throughout. Professionals can easily list the knowledge, skills and abilities and attitudes (KSAAs) that are needed to perform the various tasks related collecting, preserving, examining and analyzing digital evidence. These KSAAs would form the basis for the certification questions and practical examinations. Ethics will be the cornerstone for the attitudes required.

International Certification, Digital Evidence Professionals, Competency Based Certification

D13 Digital Evidence Forensic Education: Computers, Forensics, and the Future

Mark M. Pollitt, MS, Digital Evidence Professional Services, Inc., PO Box 1309, Ellicott City, MD 21041*

After attending this presentation, attendees will learn about the history and present state of digital evidence forensic education and how it may evolve in the future.

This presentation will impact the forensic community and/or humanity by providing factual information about digital forensics to the forensic science community, help to build bridges between traditional forensic science disciplines and digital forensics, and provide a frame of reference for educators from both the computer and forensic science communities. The result will be better service to the general public and the capability to provide critical services in the Information Age.

As defined by the Scientific Working Group on Digital Evidence; digital evidence is information of probative value, stored or transmitted in binary form. The forensic examination of computer hard drives, tapes, and disks have been done for well over a decade. Initially the work was done by criminal investigators in the field and in their offices. With some support from the private sector, organizations and agencies began to develop training programs to teach both the technology and the forensic techniques. In this initial phase, the vast majority of digital forensics was done by people whose education and training was neither forensic science nor computer science.

As the volume and capacity of digital devices grew exponentially, the need for specialized training and education grew. Since digital evidence starts as physical evidence and the goals of a forensic examination are the same for traditional forms of latent evidence as digital evidence, crime _laboratories started to develop programs for the examination of digital _evidence. Many laboratories began their program by training scientists from traditional disciplines, such as chemists, document examiners, and engineers, in this new field. A new form of forensic laboratory came on the scene; it was the Regional Computer Forensic Laboratory, which focused entirely on the examination of digital evidence.

At the turn of the millennium, computer scientists turned their attention to the problems of computer security and infrastructure protection. It was clear that society's dependence on information, computers, and network communication needed attention. The Federal government established a pair of scholarship and capacity-building programs supported by the National Science Foundation and the National Security Agency, collectively called the Cyber Corps, to increase the quality and quantity of computer scientists that could be employed in the computer security and infrastructure protection. One of the tenants of this new focus on infrastructure protection was that after assets were protected, there needed to be a means to detect adverse activity and then to react to these events. Computer scientists recognized that digital forensics could play a very important role in the detection and reaction phases of infrastructure protection. As a result, traditional computer scientists became interested in digital forensics. One effect of this new attention was that traditional computer scientists began to study forensic science methods and techniques.

In 2003, digital evidence won acceptance as a forensic science with its acceptance as a discipline subject to accreditation by the American Society of Crime Laboratory Directors – Laboratory Accreditation Board. With this acceptance has come rapid adoption of many of the traditional forensic science features, including formal education. This occurred at exactly the same time as computer scientists participating in the Cyber Corps program were becoming interested in forensics.

In early 2003, a group was established, with the support of the FBI Regional Computer Forensics Laboratory Program and the University of Tulsa, which was comprised of faculty from a number of Cyber Corps colleges and universities, forensic science faculty, and digital evidence forensic practitioners from law enforcement and crime laboratories. This group has become known as the Computer Forensic Educators Working Group. In part due to this organization, colleges and universities offering digital forensic courses has grown dramatically and many are beginning to offer certificates and concentrations in digital forensics. Full degrees in digital forensics are not far in the future. It is remarkable that this is occurring at the same time that traditional forensic science educational programs are seeking accreditation.

This presentation will explore how these parallel histories might collide and how the resulting synergy can only benefit the entire forensic science community.

Digital Evidence, Forensic Education, Cyber Corps

D14 Identification of Known Files on Computer Systems

Douglas White; and Michael Ogata, National Institute of Standards and Technology, 100 Bureau Drive STOP 8970, Gaithersburg, MD 20899-8970*

After attending this presentation, attendees will learn about identification of known computer files and be able to implement automated processes to eliminate such files in their computer forensic practice.

This presentation will impact the forensic community and/or humanity by introducing one method of reducing the data in digital forensics cases.

The amount of data involved in digital forensics investigation can be greatly reduced by automated means by eliminating known files from computer systems. The method used to obtain the data reduction is based upon the National Institute of Standards and Technology (NIST) National Software Reference Library (NSRL) data set. The NSRL data set can be applied to several different operating systems and can be used with several off-the-shelf commercial software tools. In laboratory tests, data reduction up to 95% has been obtained, while in the field, rates of up to 80% have been obtained.

The National Institute of Standards and Technology (NIST) hosts a project that promotes efficient and effective use of computer technology in the investigation of crimes involving computers. The National Software Reference Library (NSRL) is designed to collect software from various sources and incorporate file profiles computed from this software into a Reference Data Set (RDS) of information. The RDS is a collection of digital signatures of known, traceable software applications.

Numerous organizations including law enforcement, government, and industry use the NSRL data set to reduce the amount of data involved in digital forensics cases. The NIST data is collected with the requirement of court admissibility. While a courtroom may not be the destination of the investigation, the possibility is not excluded due to this data set.

The RDS is a free resource. Instructions for obtaining the RDS will be given. Technical descriptions of the contents of the RDS will be briefly discussed. Methods to use the RDS to identify file "pedigrees" and application relationships will be shown.

Several commercial computer forensics software tools exist that leverage the information from the NSRL. Tips on use of these tools will be provided.

A collection of laboratory measurements of the application of the NSRL data set to known reference computer systems will be presented, to give the theoretical upper bound of data reduction capabilities. This will be followed by a presentation of similar real-world systems processed with the same methodology to show more realistic response.

Computer, File, Identification

D15 Validation Results From the European Project FEARID on Forensic Ear Print Identification

Ivo Alberink, PhD; and Arnout C. Ruifrok, PhD, Netherlands Forensic Institute, Volmerlaan 17, Rijswijk, 2288 GD, Netherlands*

After attending this presentation, attendees will understand quality issues concerning a standardized operating procedure for collecting ear prints.

This presentation will impact the forensic community and/or humanity by presenting validation issues concerning the strength of evidence of ear prints.

As part of the Forensic Ear Identification (FearID) research project, which aims at obtaining estimators for the strength of evidence of ear prints found on crime scenes, a sample of ear prints has been collected. The method of ear print collection will have critical consequences for the subsequent analysis and results.

The project has produced a report stating the standard operating procedure (SOP) for taking the prints. This describes in detail e.g. what equipment to use, when and how to clean surfaces of the equipment, how to lift the ear prints and how to instruct ear print donors. In this way it should be guaranteed that when using different equipment, investigators, locations etcetera, the circumstances do not influence the prints too much.

When lifting an ear mark from a scene of crime, an investigating officer will first dust the area of the print. After this a "lifter" will be used to extract the mark from the surface. In the Netherlands, to this end the medium Black Gel Lifter (BGL) is used mostly. Ear prints (marks) gathered thus are referred to as *second-generation* prints. In addition to this, there are methods of taking ear prints not via a surface but immediately off the ear, thus producing *first generation* prints. For the validation experiment, besides using the medium BGL, we also took prints using the first generation method referred to as Inkless Impression Kit (IIK).

Two fundamental issues concerning the design of the operating procedure for taking ear prints, and the applicability of the eventual results, are the following:

1. *Repeatability:* Are ear prints from the same individual, taken repeatedly under the same circumstances by the same operator sufficiently similar?
2. *Reproducibility:* Are ear prints from the same individual, taken repeatedly under different circumstances by different operators sufficiently similar?

The answers to these questions provide information about the quality of the procedure.

An experiment has been performed to investigate the above. In order to evaluate the outcomes of the experiment, features were needed to decide when two prints are "alike." We note that finding such features is the main topic of the project, so it was not clear beforehand which features are most appropriate.

Using both mean grey-value and anatomical measures for the comparison of prints, clear effects can be seen of country, donor, donor ear, operator and consecutive runs on the resulting ear prints when using the medium BGL. For the medium IIK operator and run effects are less when using mean grey-value and not significant when using anatomical measures.

Since it does not seem to be feasible to further adjust the procedure, we are currently exploring features that are less sensitive to country, operator and run effects.

Ear Print Identification, Validation, Operating Procedure

D16 Accurate Forensic Video Superimposition Through Computational 2-D to 3-D Multi-View Registration (Towards Computational Techniques for Image-Shape Based Cranial/Facial Comparison)

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The goal of this presentation is to build a rigorous mathematical formulation for scientific computational methods of Shape-to-Image comparisons, for shapes approximating human head/face; provide accurate Forensic Video Superimposition through Computational 2-D to 3-D Multi-View Registration; and to provide mathematical analysis of the sources and estimates of errors.

This presentation will impact the forensic community and/or humanity by providing new computational methods for Image-Shape based

Cranial/Facial comparisons, which can be used in the forensic process of Virtual Superimposition, with the critical shape (head/ skull) angles-position parameters estimated automatically, thus introducing the smallest possible error. In addition, this method enables comparison between individuals head/face captured on a video sequence, to a database of prior scanned 3-D head/face shapes for known individuals, thus enabling a Virtual Line-up comparison. Mathematical analysis of the sources and effect of error in 2-D to 3-D registration process, may help to establish the boundaries for the acceptance-rejection identification decisions.

Video Superimposition techniques are used by forensic scientists to assist in identification of unknown skulls, through comparison with ante-mortem photographs of individuals. The critical variables that determine accuracy of this comparison process are geometrical quantities: orientation, scale, and comparison features. There is no statistical or mathematical theory that estimates accuracy and error of the above experimental procedure. In fact it is not known if some features (landmarks) are more stable than other to be used in the matching process. If several photographic views are available, or a recorded video sequence of the individual in question exists, the straight forward and profile views are considered more reliable, since the oblique views are 'difficult to match'. Analysis of the superposition consists in estimating resulting concordance of anthropometric features and regions of the re-projected skull-to- photo blended image. Here, again, there are no rigorous criteria for estimating the degree of match. Rather, a qualitative comparison ranking is practiced to state the degree of similarity or dissimilarity between the shape of the skull and the photographic image examined. Thus the superimposition technique is mostly used as a non-quantitative exclusionary tool, and not for positive identification or rejection.

Recent advances in 3-D scanning technology introduced portable, and reasonably accurate 3-D laser scanning cameras that can be used to extract 3-D shape of objects, including skulls and human heads/ faces. This also opens a possibility to compare photographs and face/head shapes for living subjects, where the solid 3-D model will be used instead of the human skull. A mathematical matching procedure can be formulated to 'match' a single view, or a sequence of views, to the scanned model.

The author proposes to reformulate the problem of Video Superimposition as a 2-D to 3-D Registration task where single or multiple views of the same individual are registered to a set of a prior known solid head/face models. This registration process shall be invariant to orientation and scale, thus resolving this above-mentioned basic problem of manual Video Superposition. If only a single view is available, and if the comparison features to be matched are reduced to a set of 2-D and 3-D points, we apply relatively straightforward least-square algorithm. If a sequence of views (as in video) is available, we describe results of a novel multi-frame *coupled* algorithm that yields optimal mapping of all the available views (e.g. from video frames) onto the 3-D model.

The above registration process may yield optimal match (minimal optimization error) for several 3-D candidates' models. The question however remains: does the examined 3-D model "fit or misfit' the image view (or the sequence of image views)? The outcome of this will determine if possible identification or exclusion of the subject is obtained. To have some progress in this last question, a study of structure is proposed, rather than size of the error function. The proposed method will enable search/ comparison of the head/face images of individuals with respect to a database of 3-D face/head scans, thus making images of humans as useful as fingerprints databases are.

Image to 3-D Shape Registration, Virtual Line-Up, Automatic Computational Superimposition

D17 Extracting Forensic Information From Biometric Devices

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The goal of this presentation is to describe forensic information that can be extracted from biometric devices and methods for spoofing biometric devices.

This presentation will impact the forensic community and/or humanity by presenting an overview of the forensic value of data from biometric systems.

In the last decade, both industry and governments have started to contribute to ever larger projects on biometric devices. Terrorism has highlighted the need for better identification systems for people as well as improved systems for controlling access to buildings and countries. Another reason for investment in Research and Development in biometric devices is the massive growth in internet-based systems – whether for e-commerce, e-government or internal processes within organizations. Biometric systems (especially fingerprint scanners) are mass-market products at low cost, and can easily be integrated in consumer electronics, like PDA's. Systems using fingerprints, iris, hand scans, and faces are commercially available and routinely used at e.g., airports.

With conventional security systems, users may suffer from socially engineered attacks, as can be seen from the growing number of cases with fraud at ATM-machines. Biometric devices may provide a solution for this kind of crime, but biometric devices still can be 'spoofed.'

Commercial interest in biometric systems has grown rapidly in 2003 and 2004. If we look at the patent applications, the number of applications with the word "biometric" has grown from twenty per year in 2002, to thousands per year in 2003 and 2004. The manufacturers of biometric systems are becoming more aware of the problems with tampering, and solutions are provided how to avoid the possibilities to tamper with their systems. Some patent applications describe ways of detecting if persons are alive and if someone tampers with the systems.

The authors have tested several fingerprint systems and an iris system for possibilities of tampering, and it appeared to be easy if a person allowed to enroll into the system is cooperating. Some biometric features can also be copied without the person knowing that it has been collected (for example fingerprints).

Several other patents and information sources describe the method of computing a template used for the comparison. Depending on the implementation, it may be possible to reverse engineer the template, and try to compute a biometric feature. This way a biometric feature may be 'stolen,' and with it, identity theft may be committed.

It is clear from the above, that most biometric systems are not completely tamper-proof, especially if the equipment is unattended. When investigating evidence from biometric devices, the forensic examiner should consider the possibilities of tampering with the biometric systems, or the possibilities of unauthorized access, before drawing conclusions. If there are suspicions that someone tampers with a biometric system, one should look for e.g. silicon casts of hands or fingers, and examine log files of the biometric access devices. An overview of tampering with these systems shows how to enter biometric systems with photographs of faces, with copies of the fingerprints, with a contact lens for an iris system, or even using a latent fingerprint on the scanner, etc.

From a forensic perspective potentially even more information may be extracted from biometric databases. If the biometric data is stored in a database in a standardized way, it is possible to extract statistical data, and have more information on the uniqueness of biometric features.

Fingerprint, Biometrics, Tampering

D18 Photographic Comparison of a U.S. Army Camouflage Uniform Cap/Uniform, Using the Manufacturing Process, a Sample Study to Include Statistics

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After attending this presentation, attendees will learn about the photographic identification of the Army Woodland Pattern Camouflage Uniform based on random patterns introduced in the manufacturing process. This presentation will impact the forensic community and/or humanity by sharing the process and data used to compare U.S. Army camouflage uniforms.

This presentation will provide quantitative, scientific, and statistical data that supports the photographic comparison of military uniforms to the scientific community. This study was the base line for Army camouflage uniform photographic comparisons at the U.S. Army Criminal Investigation Laboratory.

Many times civilian subjects wear military camouflage uniforms in the commission of a crime that are subsequently captured on still or video images. From these images, a comparison can be made to the suspects clothing.

The ability to identify individual U.S. Army Camouflage Woodland Pattern Battle Dress Uniform (BDU) caps/uniforms from bank surveillance videos is very valuable. The overall goal is to provide local, state, and federal law enforcement officials with information that supports the comparison process, identification and subsequent examiner testimony.

The case that prompted this study involved a photograph of a soldier in a camouflage uniform and hat taken by a bank security video camera. While the soldier's face was not totally visible, and as such was unidentifiable, the camouflage hat the soldier wore was identifiable. Based on research, it was determined that the hat in question had a distinguishable pattern. After comparison of the submitted Known Hat to the Questioned Hat on the videotape image, the hat was subsequently identified as belonging to the suspect soldier.

In the past, the assumption has been that camouflage uniforms/hats or photos/videos of uniforms/hats from crime scenes could not be used for comparison because the uniforms/hats were considered non-distinguishable or unique. This is due to the fact that military uniforms are manufactured to government specifications with a standard pattern. A study was launched to determine if it could be shown that uniforms/hats bore individual characteristics and were in fact unique.

The study entailed an examination of the uniform manufacturing process. It was observed that individual uniform/hat pieces are randomly cut from large bolts of cloth and randomly sewn together. Even though the pattern is made to military specifications and repeats itself throughout the bolts of cloth, the randomness of the cutting and sewing appeared to create unique points of information. The next step involved conducting a sample study of hats. A total of 57,630 comparisons were conducted from the 340 hats that were examined.

In the final phase, professional statistical assistance was obtained to quantify the results in a reliable manner. The hat was analyzed in four component parts. The results of the study determined that the probability of all four component parts of one hat matching the four component parts of another hat is almost non-existent. As a result, each cap is distinctively individual and unique with the likelihood of an exact duplicate being almost non-existent. This also applied to other items of BDU camouflage clothing such as shirts, pants, and jackets.

This presentation will review the techniques used that can assist examiners conducting clothing comparisons other than camouflage uniforms.

Photographic Comparison, Camouflage Uniform, Manufacturing Process

D19 Counter Terrorism: Training and the Need for Training With a Multi-Agency Approach Using Traditional and Non-Traditional Methods

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After attending this presentation, attendees will understand the need to gather trainees and instructional staff from agencies not normally associated with criminal justice training and will understand the importance of practical based training over theory based learning.

The main impact will be on the use of non-traditional training methods, agencies, and equipment supported by novel design of training aids to support realistic training scenarios. This presentation will impact the forensic community and/or humanity by giving the attendee a greater understanding of the complexities of recovering physical evidence from these types of scenes. The attendee will also gain an insight into multi agency training using equipment not normally found in a forensic training environment.

Modern technology has the potential to be used in a training environment to supplement traditional training. However, this paper will demonstrate that by using modern technology coupled with practical scenarios students will have a greater understanding of the stresses involved in working in a counter terrorist related situation. The student would be able to recognize particular sights and smells that are prevalent at counter terrorist related explosions. During this presentation the attendee will gain an understanding of the need to make training as realistic as possible using high quality technological training aids and computing systems to support the training scenario.

The attendee will gain an understanding of the importance of communication at these complicated and complex scenes and the need for the free passage of information unrestricted by departmental bureaucracies. By using methods and equipment normally found in a military environment the attendee will learn that by cooperating with agencies that were previously thought to be unsuitable for collaboration training, better results will be achieved with potential for departmental financial savings and better quality training.

By their very nature, terrorists do not tend to use traditional military tactics when designing an attack. They are not revolutionaries, meaning that it is not unusual for attacks to come from areas that have previously thought to have been deemed as "safe areas." Their cause is often obscure or unknown to the world at large. However, given the current world crisis, known revolutionary groups are now adopting terrorist tactics to give meaning and substance to their cause. If the terrorist operates "outside the box" then so must law enforcement agencies in their intelligence and evidence gathering operations. This cannot be achieved without high quality training that is also provided "outside the box" and well-designed multi agency and technology supported training can achieve this.

Training, Counter Terrorism, Technology

D20 Synergies of Practice: Clinical Forensic Nursing and Quality Management

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After attending this presentation, attendees will be able to identify selected factors derived from an analysis of hospital sentinel events that justify a role for the clinical forensic nurse as an adjunct to the quality management system within a healthcare setting.

This presentation will impact the forensic community and/or humanity by demonstrating research findings which validate that many of the adverse or sentinel events that occur within the hospital setting can often be prevented, recognized more readily and managed more efficiently utilizing the unique perspective and expertise of the clinical forensic nurse. Cost savings will be realized by more timely apprehension and custody of perpetrators, reduced hospital financial liabilities associated with adverse events, and decreased risks to health and safety of hospital patients and workers who may be endangered by offenders.

This poster will present examples of how clinical forensic nursing personnel can directly contribute to the management of forensic cases within the hospital setting. Examples will illustrate the distinct value of nursing actions and thought processes of the clinical forensic nurse who is well indoctrinated within the realms of forensic science and hospital quality management.

Evidence identification, collection and preservation are vitally important to the escalating numbers of forensic investigations inherent within the health care systems. Urgent needs exist in emergency departments, clinics and in-patient areas where nurses are expected to recognize forensic implications within routine patient care scenarios and to possess the expertise to manage and secure the appropriate forensic evidence. The majority of law enforcement and investigative personnel are not trained to navigate a complicated hospital unit, nor do most comprehend the language and social structure within medical facilities. The clinical forensic nurse (CFN) is invaluable, as an interpreter of sentinel event details, serving both law enforcement and hospital administration that must conduct retrospective investigations as a component of their institution's risk management and quality assurance programs. Nurses who are facile in the forensic sciences and who maintain current knowledge of the legal and justice systems are invaluable resources for hospitals and have become the critical link between law enforcement and healthcare facilities.

Veterans Affairs, Office of the Inspector General, designed a feasibility study to determine synergies of practice between clinical quality management and forensic nursing. This study included 1,000 case reviews over an 11 year period of known adverse patient events. Forensic implications emerged prominently including patient abuse or neglect, suicide, assault, homicide, medication delivery system tampering, medication errors, and medical equipment or device tampering. Results showed that utilizing the vital link between forensic nursing and Quality Management may in itself greatly facilitate patient safety and reduce hospital liability. The early recognition of adverse events and prompt insertion of clinical forensic nursing expertise will minimize both time and resources typically expended for the investigation and resolution of these scenarios. In some instances, serial acts of perpetrators will be curtailed, thus saving lives and reducing further sentinel event occurrences.

The CFN, working in synergy with risk managers, performs essential functions to enhance safety within the hospital. The identification of forensic cases, preservation of evidentiary sources, and collaboration with law enforcement are vital elements of the overall investigation and root cause analyses of sentinel events. The CFN makes unique contributions that ultimately improve patient safety as well as the efficiency and effectiveness of quality management initiatives within a healthcare setting.

Synergy, Clinical Forensic Nursing, Quality Management

D21 Field Sampling and Analysis Methods for Arson Investigation

Laura M. Conner, BS, and Kenneth G. Furton, PhD, Florida International University, University Park, Department of Chemistry and Biochemistry, Miami, FL 33199*

After attending this presentation, attendees will be briefed on new methods for sampling from a suspected arson scene.

This presentation will impact the forensic community and/or humanity by demonstrating new and more efficient methods of sampling will improve analysts' ability to successfully investigate suspected arson cases.

Arson is a serious crime resulting in hundreds of deaths and billions of dollars in property damage per year. Separation of these accelerants from fire debris can be difficult and inefficient. This study examines the performance of a commercially available instrument that uses dynamic headspace concentration to remove possible ignitable liquid residues from debris and store them in an adsorbent filled tube. A pump draws air from a heated debris chamber into the tube. The volatile compounds in the debris will adsorb to the material. The pre-packed tubes contain charcoal or polymer beads as an adsorbent. Use of this instrument in the field potentially eliminates the need to transport large volumes of debris to the laboratory. Traditionally, debris is collected in paint cans and need to be stored until they can be analyzed. Twenty of the tubes used in this instrument can easily be carried in a shirt pocket. Compounds are removed from the adsorbent by solvent desorbtion and can then be analyzed using gas chromatography/mass spectrometry.

Much interference occurs in arson debris samples. Extraction solvents and background, pyrolysis and combustion products from the material can complicate the process and lead to false positive or negative results. The data analysis methods used are intended to help confirm or exclude the presence of an accelerant in a suspected arson sample, despite these interferences. The spectra are examined for the characteristic patterns of known accelerants. Care must be taken in this process as interfering substances and fire conditions may obscure some of the data.

Samples have been collected and tested to show the efficiency of the portable system both in the presence of a complex debris matrix, such as carpet and padding, and without. Experimental accelerants used include diesel fuel, lighter fluid and a simulated arson mixture. The simulated arson mixture, or SAM, is made up of a range of alkalines and various aromatics encountered in common accelerants. The substances chosen cover the volatility range of common ignitable liquid residues in order to express any inefficiency in the collection range of the portable sampler.

This instrument has demonstrated ability to concentrate small amounts of accelerants spiked onto a matrix. Also, electronic noses are evaluated for their ability to detect the presence of accelerants in specific areas of a scene. These small battery operated instruments give a reading of the amount of VOC's present in air. In this way, they can be used to scan a scene for areas of interest. Accelerant detecting canines can be used for the same purpose. However, canines can be limited in their operating time and ability to work in hazardous scenes. These instruments, while possibly not as accurate as canines, can be inexpensive and do not require a highly skilled operator. The instruments were studied for their abilities to detect various types of compounds. Substances such as diesel fuel, lighter fluid, and a SAM mixture were tested with and without the carpet and padding matrix. Interfering substances can cause difficulties with these types of instruments. However, when used as a preliminary indicator of where to sample, they have shown to be useful.

Arson, Adsorption, Sampling

D22 Proper Storage of Tape Evidence to Prevent Phthalate Interferences

Maureen J. Bradley, PhD, Preston C. Lowe, MS, Diana M. Wright, PhD, and Marc A. LeBeau, MS, FBI, Laboratory Division, 2501 Investigation Parkway, Quantico, VA 22135*

The goal of this presentation is to inform the forensic community about the potential for phthalate migration from vinyl document protectors to the adhesive of tape evidence. Alternative substrates for processing tape evidence will be presented.

This presentation will impact the forensic community and/or humanity by making the forensic community aware of the potential for a false disassociation of two tapes being compared if phthalate plasticized substrates are used to store tape evidence. Alternative substrates will be presented.

Forensic laboratories are frequently tasked with the examination of tape evidence to establish a possible evidentiary link between a suspect and a particular crime, or between different crimes. Tape associated with the commission of a crime may have been used as a gag or bindings, to seal packages or threatening letters, or in the construction of an improvised explosive device. The sequence of examinations conducted within the laboratory is dictated by the probative value of a given examination and to minimize the potential for loss of valuable evidence. The sequence for tape examinations within the FBI Laboratory is: processing for trace evidence, such as hairs and fibers; processing for latent fingerprints; and finally, physical and chemical comparison or characterization of the tape components.

Tape evidence is routinely submitted as a tangled mass, in strips from ligatures and/or gags, or adhered to various substrates. Historically, when tape evidence was processed for collection of trace evidence or latent fingerprints, it was separated and laid out on vinyl document protectors. This material was convenient, provided a clean surface for the tape to adhere, provided an area to write the item identifiers, and allowed for easy removal of the tape for subsequent examinations. However, upon chemical examination of the adhesives of several tape specimens, it was discovered that the phthalate-based plasticizers used in the vinyl (PVC-based) document protectors migrated into the adhesive. This proved to be problematic when comparing questioned tape specimens, which had been adhered to document protectors, to suspect sources of tape, which had not.

This presentation will demonstrate several case examples where differences were noted in the pyrolysis-GC/MS adhesive data of tape specimens being compared. Different phthalates were detected in the pyrograms of various questioned tape adhesives that were not present in the suspect sources. All other parameters measured for the tape specimens (width, thickness, FTIR of adhesive and backing, and SEM/EDS of adhesives) were comparable. Further examinations revealed that the phthalates present in the adhesives of the questioned tape specimens could be accounted for as a component of the vinyl document protectors the tapes had been adhered to. The migratory nature of phthalate-based plasticizers is well established in literature. Although accounted for, analysis of each vinyl document protector requires additional sample preparation and instrumentation time. Alternative substrates to vinyl document protectors will also be presented.

Tape Evidence, Phthalate Plasticizers, Contamination

D23 A Novel Approach to Searchable Fiber Databases

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After attending this presentation, the forensic science community will learn about a searchable database that will aid in fiber analysis and comparison, as well as provide a training tool to colleges and universities that have a specific focus on trace evidence.

This presentation will impact the forensic community and/or humanity by providing a powerful tool for any crime laboratory or agency that performs routine fiber analysis. Colleges and universities who focus on trace evidence analysis will also find use in the database as an informative teaching aid.

This poster will present the combined efforts of ChemImage Corporation and Microtrace to develop a novel searchable fiber database. This database was designed for the purpose of providing forensic laboratories with a multidimensional program for fiber analysis and comparison as well as to provide colleges and universities with a complete educational tool. The database contains a multi-tiered searchable spectroscopic database of over 2000 fibers, including digital images, visible absorbance spectra, fluorescence spectra, dispersive Raman spectra and FTIR spectra. Fiber characteristics such as generic class, manufacturer, trade name, color, cross section type, denier, and delustrant are also included as text searchable fields.

The fiber database is unlike any other in that the digital images and the Raman, fluorescence and absorbance spectra were collected using a single instrument platform, the CI TRACE™ Raman Microprobe Chemical Imaging Microscope System (ChemImage Corporation, Pittsburgh, PA). The CI-TRACE™ is designed to apply the combined power of light microscopy, Raman spectroscopy and Chemical Imaging for materials identification and structural characterization. The CI-TRACE™ can acquire brightfield and polarized light microscopic images, as well as dispersive Raman spectra, widefield visible reflectance/absorbance and fluorescence chemical images of samples. The ability to search in a multi-tiered approach depending on the various spectroscopic techniques in addition to optical representation of the fibers searched separates this search method from all existing software.

Through the use of an electro-optic imaging spectrometer, chemical images are recorded as a function of wavelength. Therefore, each pixel in the image has a corresponding spectrum associated with it. An average absorbance or fluorescence spectrum is generated for the fiber by averaging every spectrum associated with every pixel that represents the fiber. This differs from conventional microspectrophotometry methods in that only one dataset is needed to acquire millions of spectra simultaneously, eliminating the need for numerous spectral data collections to encompass the variation along the length of a fiber. This can be done quickly and efficiently, in one step using ChemImage's highly specialized software package. The dispersive Raman spectra are generated by exciting the fiber with a 532 nm, 200mW maximum power laser. The FTIR spectra were collected on a Bruker Vector 33 microscope.

Spectra of the collected fibers can be saved in a variety of spectral formats including .spc file formats; therefore, spectra collected on other types of instruments can be used to search against the database raw spectra. The user also benefits from an easy to use spectral software portion that allows spectral labeling, overlays and report generation.

As a teaching aid for colleges and universities, this database contains tutorials on general fiber examination, while also providing in depth descriptions of optical and polarized light microscopy, as well as Raman, FTIR, visible absorption and fluorescence spectroscopies. A description and tutorial on chemical imaging is also included.

Fibers, Database, Spectroscopy

D24 Novel Uses of Botanical Evidence for Forensic Investigations

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The goal of this presentation is to present unique examples of botanical evidence for use in crime scene investigations so that investigators can learn of the potential opportunities to utilize forensic botany.

This presentation will impact the forensic community and/or humanity by demonstrating additional ways to use botanical evidence in crime scene investigations and generally to make people aware of the unique contributions of forensic botany and its potential.

Awareness of the ways in which plants and plant parts can play in forensic investigations has increased greatly in recent years, and crime scene investigators are making more use of botanical expertise. However, it is important that more crime scene investigators become aware of the forensic potential of botanical materials. Bock and Norris began studies of

plant cells in digestive contents and have demonstrated their usefulness in determining time of death (Bock et al. Identifying Plant Food Cells In Gastric Contents For Use In Forensic Investigations: A Laboratory Manual, U.S. Dept. of Justice; Bock and Norris 1997 "Forensic Botany: An Under-Utilized Resource," *Journal of Forensic Sciences* 42: 364-367). Later, the authors extended their observations to comparison of fresh fecal material associated with a rape-homicide victim and stains on the suspects clothing, again using the presence of specific plant cells associated with distinct food types (Norris and Bock 2000 "Use of Fecal Material to Associate a Suspect with a Crime Scene: Report of Two Cases" *Journal of Forensic Sciences* 45: 184-187; Norris and Bock 2001 "Method for Examination of Fecal Material from a Crime Scene Using Plant Fragments" *Journal of Forensic Investigation* 51: 367-377).

Reported here are some recent uses of forensic botany that extend to other applications. The first case involved plant taxonomy (identification of species by examination of unique features of the plant). Identification of an unusual strain of Bermuda grass (the Almond strain) from the Emerald Bay Golf course on Grand Bahama Island found on a suspect's clothing linked him to the golf course crime scene. Each golf course on the island is characterized by the use of different strains of grass. The second example is the use of diatoms (microscopic unicellular aquatic plants) to compare stomach contents of a drowning victim to different water sources. Each water source has unique diatoms present and typically differs from other nearby sources. The microscopic analysis linked the victim to a different source than where the body was found indicating the victim was partially drowned in the first source (a fountain) and then the child's body was thrown into the second water source where he ingested some additional water before dying. When the child's mother was presented with this evidence, she confessed that she was responsible. A third case is a 30-year-old cold case involving comparison of plant material in fecal material that has been desiccated for many years. Investigators had saved clothing from the victim and the major suspect. Although this case is still under investigation, the authors describe the detailed procedure necessary for preparing such samples for microscopy and comparison of the results.

In addition to these actual investigations, a new method under development based on microscopic analysis of isolated wood cells that may provide a way to identify tiny wood fragments associated with suspects and link them to crime scenes will be reported. Traditional wood identification requires relatively large pieces of intact wood to identify the species of tree from which it arose. However, the question has been asked on occasion if it is possible to identify the small fragments or splinters found in association with a suspect and determine if they might match a larger source found at a crime scene. It was previously assumed this was not possible. Wood largely consists of dead plant cells of several types (fibers, tracheids, vessels, parenchyma). Furthermore, one type of cell (e.g., fibers) may vary in appearance from species to species and in relative abundance. Analyses to date suggest that microscopic characterization of the cell types including careful physical measurements may be a promising approach for dealing with small wood fragments.

Forensic Botany, Microscopic Techniques, Homicide

D25 Assessment of Silicon Polymer Composites for the Extraction of Trace Herbicides: A Tool for Environmental Forensics

Stephanie K. Bell; and Piero Gardinali, PhD, 11200 Southwest 8th Street, Miami, FL 33199*

The objective is to present the use of silicon polymer composites as a new material for passive sampling. This presentation will impact the forensic community and/or humanity by presenting a new material for passive sampling in order to extract trace herbicides from environmental deployment sites.

Herbicides are found in ground water, freshwater, and saltwater environments and have shown potential for long-range transport throughout sensitive ecosystems. In the U.S. herbicides account for 75% of all pesticides used to control unwanted vegetation. Herbicides found in aquatic environments originate from both agriculture as well as urban landscapes and are easily transported between compartments via water runoff. Due to this, water analysis is the preferred tool to assess their occurrence in the environment. Atrazine and Irgarol are two common types of triazine-based herbicides found in freshwater and saltwater environments respectively. Atrazine is the most commonly used pesticide in the U.S. It is easily detected due to its ability to persist in soil and its water mobility. Atrazine has been found to have environmental effects at levels far lower than that deemed safe by the EPA. Irgarol is an algicide used in formulating antifouling paints for boats and vessels. Irgarol is primarily used to inhibit the growth of copper resistant fouling organisms such as algal slimes and growth of seaweed. It leaches slowly and therefore causes coastal water contamination.

This study introduces the use of silicone polymer composites (PDMS, Fe-PDMS) as a passive sampling media to pre-concentrate analytes found in the environment. Advantages of their usage are based on their capabilities for on-site deployment or through pre-concentration of small volume samples. The composite samplers are assessed for their adsorption/absorption properties by performing lab experiments with the two model compounds, Irgarol 1051 and Atrazine, and by analyzing environmental water samples impacted with the herbicides.

The initial concentration of both Irgarol and Atrazine was 1 ppb. The concentration of the herbicides was monitored by SPME-GC/MS and showed depletion over time. For PDMS, the concentration of Irgarol was reduced by 83.5% after 48 hours of extraction. Water samples containing triple the amount of composites exhibited an increased depletion of the Irgarol concentration with a reduction by 95.5%. Results for Atrazine were similar to that of Irgarol, however the depletion rates were substantially lower. After 48 hours, the PDMS pellets reduced the concentration of Atrazine by only 63.8%. This study was also conducted using magnetic Fe-PDMS composites. Fe-PDMS composites will allow for easy retrieval of the samplers from environmental deployment sites by magnetic filtration. After 24 hours of extraction with the 2:4 Fe-PDMS composite pellets, the concentration of Irgarol and Atrazine were depleted by 49.5% and 55.3% respectively. Mass balance experiments showed that between 60% and 80% of the herbicides could be successfully recovered from the exposed composites by simple solvent extraction with hexane.

This study proved the ability of PDMS and Iron-PDMS as passive samplers for environmental applications. Parameters such as surface area, Fe-PDMS ratios and agitation rates greatly influence the concentration capacities. Application to the environmental samples is already underway. One of the major disadvantages of the approach is the long equilibration times and the structural dependency for heavily functionalized analytes.

PDMS Composites, Passive Sampling, Environmental Forensics

D26 The Comprehensive Masonic CHIP Program (Child Identification): A Comprehensive Forensic Tool

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Learning Objective: To present to the forensic community the comprehensive Masonic CHIP (Child Identification Program) Program, featuring Toothprints®, now operational in 13 states, being implemented in 17 additional states, and approved in 13 additional states, and being considered in Mexico and the 13 Provinces of Canada.

Text: The Masonic CHIP Program is now recognized as the most comprehensive child recovery and identification program in the country, and is hailed by the recovery officials of the National Center for Missing and Exploited Children, as well as law enforcement, dental, forensic, and prosecution authorities alike.

A child is reported missing every 43 seconds in the United States according to the National Crime Information Center (NCIC) and the

National Center for Missing and Exploited Children (NCMEC). Alarmingly, the NCMEC receives diagnostic photos in only 1 of every 2 missing children's cases! The need for a comprehensive recovery and ID kit readily available is paramount when children are lost, missing, or abducted.

The Masonic CHIP Program provides at no cost to parents:

1. A 3-minute TV-quality videotaped interview with the child
2. Fingerprints
3. A Toothprint® with salivary scent tracer and DNA
4. A DNA cheek swab

The core of the program is TV-quality videotape of the child. Videotape captures mannerisms, expressions, speech patterns, profiles of the child, and gives immediate leads to law enforcement officials tracking missing children. If a picture is worth a thousand words, then a videotape is worth a million; it's easily transportable, can be taken on vacation, or given to grandparents if they become caretakers for any period of time. Videotape can be easily integrated into the AMBER alert system which is now online nationwide. America's Missing Broadcast Emergency Response System (AMBER) can reach millions quickly, and has saved more than 100 children to date. The videotape portion also offers a strong forensic component. Because children are asked to give "their biggest smile" during the interview, the alignment, shape, color, and spacing of teeth can be used to make a positive forensic identification. If skeletal remains need to be identified, a photographic superimposition technique can be used to overlay the videotape onto a skull via use of computers to make a positive forensic identification.

Fingerprints are taken, which are invaluable in tracking lost, missing, or abducted children. Fingerprints are seldom used for identification. They are critical and essential in investigation, tracking and for prosecution purposes.

The third component of the program is Toothprints®. It adds a very strong recovery and forensic aspect to this program. A Toothprint® records individual tooth characteristics, tooth position within the arch, upper and lower teeth relationships, gum contour and anatomy, as well as marginal outlines of individual restorations and dental sealants. Every Toothprint® is unique, even identical twins can be easily differentiated by their Toothprints®. Seventy (70%) percent of American children are now cavity-free and filling-free and thus have literally blank dental records reported to the NCIC when lost or missing.

Saliva on the Toothprint® wafer serves as a DNA sample for at least 3 years, but more importantly, serves as a scent tracer for recovery bloodhound dogs which can easily track saliva scent/skin cell scent. Bloodhounds typically track individual skin cells falling from humans at a rate of 100 cells/minute. Bloodhounds can distinguish even identical twins apart by smelling their scent. Children are taught to leave a "spit trail" if lost in the woods; or if age appropriate, leave their saliva, fingerprints, and hair behind if abducted. Recovery, identification, and prosecution gain much with such evidence.

The fourth component of the program is the DNA cheek swab which will provide DNA material for both mitochondrial and nuclear DNA matching for more than 20 years when properly frozen in a home freezer.

Last October, the American Dental Association passed a Resolution asking all State Dental Associations to join with community child ID programs on a complimentary basis to keep American children safe. To date, the Masonic CHIP Program has ID'ed more than 192,000 children in the Commonwealth of Massachusetts; and 43 Public School systems have adopted the program for all students grades K – 12. Last year 258 CHIP events were conducted in 142 communities in the Commonwealth. The program is free; the organizers keep no ID records - all ID materials are given to the parents. Parents can elect to participate in any of the four components of the program. Children from birth to college-age may participate.

CHIP offers maximum peace of mind for parents, community leaders, and the children themselves, while giving comprehensive materials to rescuers and forensic scientists.

Masonic CHIP Program, Toothprints®, Child Identification

D27 Debunking a 'Snuff Film' by Locating Its Source

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After attending this presentation, attendees will be briefed on an approach to systematically searching the web and digital databases to determine the provenance of digital data.

The examination of web-derived content is increasingly common in the evaluation of digital evidence. This presentation will impact the forensic community and/or humanity by providing one example of a systematic approach to determining the provenance of such data.

Hypothesis: There are multiple facets to the examination of image and video data; often examination of the content of the data is sufficient, but determination of the provenance may be of equal importance.

Methods: A putative snuff film was presented to a medical examiner office, and an evaluation was requested to determine if further investigation was required. Examination of the content of the video was performed which demonstrated it to be contrived. In addition, the provenance of the video was in question. It was suspected that this was downloaded from the web. To answer this question, a structured search strategy was developed and employed; involving conventional search engines, commercial and open databases, and automated agents (often called "spiders" or "avatars"). The examination of content was presented in a paper in a previous AAFS meeting. This presentation concentrates on search strategies and evaluation of provenance separate from examination of the video or metadata itself.

In order to evaluate the provenance of such a video, it is necessary to examine web sites devoted to this kind of imagery. Numerous discussion groups exist in which these videos are critically discussed by aficionados, many of whom are as critical of content as are experts in content analysis. Chat rooms exist on the internet in which these videos are a topic of discussion. Multiple versions of the same video may be present. In cases where the video is old, it may be that the data has been removed from the net, and it is necessary to locate and search archives of deleted web pages. In some cases, these videos may have been discussed in the news or other non-web media, in which case a search of media databases may be appropriate.

Results: The search revealed multiple discussions of the video in question, including an interview with the producer, the location of the film company that produced the video, the date the video was produced, the motivation of the video, and previous forensic evaluations of the video. The search also provided other examples of both contrived snuff film and examples of footage of real killings. One of the videos downloaded by an intelligent agent during this search was in turn later submitted for evaluation by another agency as yet another possible homicide. In this latter case, the video was real footage of a real homicide, taken in Chechnya. Thus, a single comprehensive search, if the data is appropriately archived locally, may provide a shortcut for later cases.

Impact: Putative snuff films and related imagery are not only more numerous, but also more widespread than ever before. They occasionally cause consternation to local law enforcement when they are perceived as possible real footage. This is particularly true when real footage is integrated into the contrived video. Examination of the video itself, metadata, and searching for the provenance of the data provides different data, each of which may be useful in the investigation.

Snuff Film, Digital Video, Image Analysis

D28 A Presentation of JLab: Restoring Selected Examples of Corrupt JPEG Data

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The goal of this presentation is to impart knowledge of a tool for the analysis of JPEG files and the restoration of corrupt JPEG data. Development of the JPEG toolbox named JLab was commissioned by Bundeskriminalamt, Germany, and it is distributed free of charge for police purposes.

This presentation will impact the forensic community and/or humanity by demonstrating that in special cases, the use of JLab will make it possible to recover pictorial evidence from digital data with little work, which before JLab was nearly impossible or would have required a great deal of effort.

Corrupted JPEG files that originated from investigative proceedings and reached the image enhancement service of the German Bundeskriminalamt (BKA) caused the BKA to commission the development of a software tool for the analysis and restoration of partially damaged JPEG files. This tool called JLab is now available for forensic applications. During this presentation the functionality and features, the structure, the input, and output, and the restrictions of JLab will be exemplified by means of selected sample images.

At the moment JLab's analysis and reconstruction capabilities are limited to JPEG/JFIF files (JPEG File Interchange Format) with DCT (Discrete Cosine Transform) and Huffman coding for practical reasons. This type of compression is by far the most commonly used at present. The program runs on computers with the MS Windows operating system. JLab combines the "viewer" and the "hexeditor" functions. In four sub-windows it displays three views of a JPEG data stream: a structural view, a hexadecimal view with a simultaneous ASCII interpretation, an image view and an additional preview which is especially useful while modifying large images. The views are linked together so that one can perform a combined analysis and/or restoration of structural elements and image areas.

The program can handle several JPEG data streams in a single file, e.g., a large JPEG image with a small JPEG thumbnail included, like those for instance, which Adobe® Photoshop® produces. Since JLab provides a detailed representation of the complete JPEG structure, one might be able to draw conclusions about the history of the image from both the comments and those inputs, normally not displayed, that are specific to applications involved before. Even if other viewers do not accept a JPEG file, JLab can recognize whether it contains any structures, which conform to JPEG and, at the least, can display the contents in the hexadecimal and ASCII formats.

The quantization tables and the Huffman tables are among the most important parameters of the compression procedure. Instead of faulty or missing tables, standard tables and tables from correct sample files may be used. Databases from different tables can easily be created and extended. Tables that are currently being analyzed can be compared with those from the database on the basis of a brief characterization, so that similar tables can be found quickly. The manual repair of tables and the restoration of damaged marker data require an exact knowledge of the JPEG standard.

The underlying principles and the handling of JLab will be discussed in detail during a live presentation showing examples from two categories:

- JPEG test images with artificially generated defects
- Damaged JPEG images from actual police investigations.

Restrictions preventing JLab from a successful restoration normally turn out to be due to extensively corrupted data like the lack of major parts of the Huffman table, the availability of only very small data fragments or some classes of errors that generally apply to the entire image data.

The outlook will give a statement about the possible future of JLab and present ideas about other developments, e.g. concerning the JPEG2000 standard.

JPEG Images, Data Corruption, Image Data Analysis and Restoration

D29 Analysis and Visualization of Defective Digital Image Data

Stefan W. Ott, Bundeskriminalamt, KI 22, Wiesbaden, Hessen D-65173, Germany*

After attending this presentation, attendees will understand how to deal with digital image data, which are rejected, misinterpreted, or shown incompletely by standard image viewers, with emphasis on the JPEG file format.

This presentation will impact the forensic community and/or humanity by demonstrating the use of advanced tools for image data analysis and restoration, and how this extends the capabilities of forensic examinations to cases where no other method has a chance to recover the original visual information. This represents an important advantage in areas where image information is crucial for evidence and the risk of trying to destroy the data is high, e.g. in child pornography.

The introduction will sum up the main limitations of standard image viewers, give some typical reasons for the appearance of defective image files, and emphasize the importance of the JPEG standard. Some examples of visualizations of defective image files produced by standard viewers, compared with the results of thorough analysis and restoration, will be used to illustrate the potential gain.

An overview of useful tools will be given, including hex editors, graphic file format descriptions and analyzer tools, reconstruction software for image memory cards, scanner for image file signatures, image processing software with import functions for raw format, and so on. The capabilities and limitations of the different tools will be described and the missing functionality will be derived from a list of requested features.

Examples like AVIs with MJPEG, video surveillance data and fragments of JPEG streams, will illustrate the methods to identify and process case data where only moderate knowledge is required for successful recovery and restoration such as a single obvious wrong parameter in the file header or a false file extension. Additionally, these examples will demonstrate how hopeless cases, e.g. those where strong cryptography is involved, only small fragments are available or compressed data has been badly corrupted are recovered.

A relatively detailed examination of the structure of a JPEG stream, the important elements and their role in the decoding process will lay the foundation for a successful application of the JPEG toolkit JLab. For details the audience will be referred to the literature. Examples are demonstrated with screenshots of JLab-Sessions. The distribution policy of JLab will be explained and the use of JLab will be encouraged. A live demonstration with JLab will be given by Bernd Rieger in his contribution "A Presentation of JLab: Restoring Selected Examples of Corrupt JPEG Data."

The problem of evidential proof will be discussed. The goal of the operation is not the perfect reconstruction but the correct visualization of the available image data. The conclusion will show that a perfect solution will never exist, describe the current state-of-the-art in image data analysis, and the plans for the further development of image data analysis tools.

Image File Analysis, Defective Image Files, Image File Restoration

D30 Analysis of an Image Anomaly in the Space Shuttle Columbia Accident, Part 1: Authenticating the Camera Source

Richard W. Vorder Bruegge, PhD, FBI, Forensic Audio, Video and Image Analysis Unit, Building 27958A, Quantico, VA 22135; and Peter Goldie, PhD, Lightbinders, 2521 Harrison Street, San Francisco, CA 94110*

After attending this presentation, attendees will understand one means used to authenticate a digital camera as the source of a specific digital image.

This presentation will impact the forensic community and/or humanity by demonstrating to the forensic community one of the many

ways forensic scientists are conducting analyses of digital evidence, and will see how forensic image analysis is a field with a broad application.

The presentation will describe the analyses used to confirm that five (5) digital images depicting the Space Shuttle Columbia (STS-107) during its atmospheric reentry on February 1, 2003 were taken with a specific camera. One of the digital images examined in this case included an anomalous feature some thought might be related to the accident, either as a cause of the accident, or as documenting the breakup of the shuttle. A description of the analysis used to determine the source of that anomaly is included in a separate presentation ("Part 2").

On February 1, 2003, the Space Shuttle Columbia (STS-107) was scheduled to return to Earth after an extended stay in orbit. The flight path of the shuttle would span the entire width of the contiguous United States early in the morning, with a path that began in northern California, across the western U.S. to Texas, and then across the southern U.S. before a landing in Florida. Tragically, seven lives were lost as Columbia broke up over Texas.

Although the cause of the accident was ultimately identified as due to a debris strike on the left wing of the shuttle during the ascent phase after launch, in the early weeks after the accident the true cause was unknown and multiple avenues of investigation were pursued. One such avenue included the analysis of a digital photograph taken during the reentry by one of the authors (Goldie), which depicted an anomalous feature extending from (or toward) the path of Columbia as it crossed over northern California. After receiving a description of the image from the author, NASA dispatched a former shuttle astronaut to take possession of the digital camera and flash card on which the images had been captured, as well as a compact disk containing the images downloaded from the flash card. These items then were delivered to the FBI for the purpose of (1) authenticating the image as having originated from the specific camera and (2) analysis to determine the source of the anomaly, if possible.

The image authentication consisted of multiple parts. First, the files contained on the flash card were downloaded and compared to the image files contained on the compact disk to verify that the images were exact copies of one another, differing only in file names. Next, metadata associated with each image file was examined to determine if it was consistent with the questioned camera (NIKON COOLPIX Model 880), as well as with the exposure and focal length settings expected for the images in question. Likewise, the image size (in pixels) and output type (JPEG) were verified as being consistent with the questioned camera. It was likewise observed that the five Columbia images were originally assigned sequential file names when recorded on the flash card. Goldie reported that no subsequent images were acquired on the camera following the re-entry images, and test images captured in the laboratory using the questioned camera were found to be sequential, and continuous with the Columbia images. All of these factors were found to be consistent with an origin in the questioned camera.

Finally, an analysis of the anomalous image itself was conducted to identify artifacts consistent with malfunctioning detectors ("bad pixels") within the camera's CCD chip. A total of fifteen (15) such artifacts were identified in this analysis. All of these artifacts were likewise observed in the other four images of Columbia captured on February 1. Test images recorded with the questioned camera were found to contain all of the "bad pixels" seen in the February 1 images. For images the size of the Columbia images, the chance that any two images could share all fifteen anomalies at the same pixel locations through random chance was calculated to be less than one chance in 10-to-the-97th power.

A further examination was conducted to depict the presence of artifacts, which might indicate that the "anomalous" image was the product of intentional image manipulation. No such artifacts were observed, therefore it was determined that the Columbia images were authentic images recorded using the questioned camera.

Image Analysis, Image Authentication, Pixel Defects

D31 Analysis of an Image Anomaly in the Space Shuttle Columbia Accident, Part 2: Determining the Source

Richard W. Vorder Bruegge, PhD, FBI, Forensic Audio, Video and Image Analysis Unit, Building 27958A, Quantico, VA 22135; and Peter Goldie, PhD, Lightbinders, 2521 Harrison Street, San Francisco, CA 94110*

After attending this presentation, the forensic community will understand the procedures used to assess anomalies in images and learn something about photogrammetry.

This presentation will impact the forensic community and/or humanity by providing the forensic community with a better understanding of the importance of imaging, image processing, and photogrammetry. The ability to utilize images in forensics will be further underscored.

The presentation will describe the analyses used to assess the source of an anomaly contained within an image depicting the Space Shuttle Columbia (STS-107) during its atmospheric reentry on February 1, 2003. This anomalous feature was thought to be related to the accident, either as the initiating cause of the accident, or as a real effect documenting the breakup of the shuttle. A description of the analysis used to authenticate the image as having originated with a specific camera is included in a separate presentation ("Part 1").

On February 1, 2003, the Space Shuttle Columbia (STS-107) returned to Earth along a flight path that crossed northern California prior to an intended landing in Florida. Tragically, seven lives were lost as Columbia broke up over Texas.

Although the cause of the accident was ultimately attributed to a debris strike during launch, immediately after the accident the true cause was unknown and multiple avenues of investigation were pursued. One such avenue included the analysis of digital photographs taken during the reentry by one of the authors (Goldie). One of these photos depicted an anomalous feature extending from the path of Columbia as it crossed over northern California.

The photographs had been taken using a NIKON COOLPIX 880 mounted on a lightweight, but professional grade, tripod. The weather conditions were partly cloudy, low level clouds below 500m with occasional gusts up to 20 kmph. The photographs were taken between 5:52-5:54 a.m. PDT, with an exposure time of 8 seconds each.

The resolution of the images is insufficient to make out any details of the shuttle itself. Instead, the photographs depict the plasma "plume" created by Columbia as it heated and ionized the upper atmosphere at approximately 70 km altitude. This plume would appear brightest at the leading point of Columbia's passage, and would fade to extinction after 1-2 minutes. Therefore, in a long exposure photograph, one can divide the plume into three primary components: (1) The plume which already existed within the camera field of view at the beginning of the exposure and which would continue to fade during the exposure; (2) a bright point light-source traversing the scene during the exposure (representing the transit of the shuttle across the frame); and (3) superimposition of the residual plume with the initiating hot-point source, as a result of camera or spacecraft motion. Recognition of these three components is critical to the ultimate analysis in this case.

The FBI was asked to examine this photo and provide an assessment of the anomaly and its possible origin. In addition, NASA simultaneously sought advice from other facilities and experts, including experts knowledgeable in upper atmospheric physics, to assess potential natural causes.

The examination of the anomaly consisted of several parts. First the characteristics of the anomalous image and the anomaly itself were catalogued and described. These include the size, shape, luminance, and color characteristics of the anomaly and plume of plasma left behind Columbia as it crossed the field of view. The characteristics of multiple stars in the background were also catalogued in this step. A variety of image

processing techniques such as brightness and contrast adjustments, unsharp mask, image rotation, and uni-directional image resizing ("vertical exaggeration") were used to improve the visibility of features within the image. When examined in this manner, it became apparent that the image anomaly displayed a sinusoidal pattern.

A photogrammetric analysis was conducted to calculate the size of the anomaly in both image space (at the camera's focal plane) and object space (at the position of the shuttle). Finally, the characteristics of the anomalous image were compared with the other images of Columbia's reentry taken immediately before and after this image using the same camera.

Once all of these observations and measurements had been taken, it became apparent that no outside source needed to be invoked for the anomaly. In addition, the special panel convened by NASA was unable to find corroborative evidence to support the alternative theories (high altitude lightning/ geomagnetic storm, triboelectric spacecraft charging, seismic motion). The simplest explanation for the anomaly was that it represented the product of camera vibration. Limited tests conducted in the laboratory demonstrated that primary features of the anomaly could be recreated.

Image Analysis, Photogrammetry, Digital Image Processing

D32 Progress Report on the Study of Photographic Technology Used to Document Footwear Impressions

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After attending this presentation, attendees will understand the issues involved in photodocumentation of footwear impressions and preliminary indications regarding the ability of digital photography to render suitable images.

This presentation will impact the forensic community and/or humanity by helping the impending transition from traditional silver halide to digital photography.

As digital photography grows and the availability of traditional silver halide film subsides, the question of the technology used to photograph footwear impressions becomes more and more important. This study will examine the effect that photographic technology has on the examiners' ability to evaluate footwear impressions from photographs.

Recently digital cameras have come on the market that are purported to be, "as good as film," and while this is primarily advertising hype, practical experience as well as laboratory testing have shown that they are indeed quite good. In addition, printer technology is now available that should be able to render images adequate to the task of at least most footwear examinations. They have very subdued dot patterning, high resolution, and sufficient print size for the application. They are also priced within the range of most forensic laboratory budgets. At the same time as these new products have come on the market, film industry sources indicate that film sales down some 20% in each of the past two years.

The same test impressions will be photographed using four cameras: 35 mm film, 120 film, 6 mega pixel digital, and 12 mega pixel digital. All film prints will be made using traditional film printing and photographic paper. The digital prints will be made using modified silver halide photography (FUJIFILM Pictrography 4000 printer) and an inkjet printer modified for increased resolution but restricted to black and white only. Exemplar photos will all be made using medium format film photography. Questions will be included to allow stratification of the sample based upon the experience levels of the respondents. Samples will be sent to approximately 100 examiners, each receiving a half replicate. Results will be evaluated using traditional statistical techniques. The results of a limited-sample pretest will be shown.

In preparation of this test a number of experts in the field of footwear examinations have been consulted to establish the tasks that respondents will be asked to perform. The responses will require the use of a Likert scale, and a five-point scale has been developed which should help reduce the standard deviation of the responses and not compromise validity. The experts also helped to assure that the approach to creation of the test samples is representative of the more stringent requirements that examiners encounter. Quality management experts from the U.S. Navy have assisted with the design of the experiment and will assist with the analysis of the data.

Footwear, Digital, Photography

D33 Crosscorrelation-Based Pulse Suppression for Forensic Audio Analysis

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After attending this presentation, attendees will learn about a new method for improving audio, specifically how to increase the clarity of audio signals affected by a class of interference consisting of repeated pulses.

This presentation will impact the forensic community and/or humanity by informing the community about forensic audio analysis and different methods for improving the clarity of speech in law enforcement recordings.

A goal of forensic audio enhancement is to combat additive background interferences in a desired signal to assist in forensic analysis and presentation in legal cases. In this presentation, the authors introduce a new software-based approach that runs on a personal computer to enhance speech. This software increases the clarity of audio signals affected by a class of interference consisting of repeated pulses. Algorithm is based on pulse detection through crosscorrelation with a prototype pulse followed by pulse scaling or subtraction.

Surveillance recordings in law enforcement are typically made using a variety of equipment. The proliferation of cell phones has carried over into the law enforcement arena and subsequently a large percentage of surveillance recordings involve cell phones. Interference between recording equipment and the transmitters in cell phones creates noise. This noise is often heard as a pulsing similar to that from a lawn sprinkler and thus is often referred to as "sprinkler pulses." This pulsing gets recorded along with the speech and seriously diminishes speech intelligibility and increases listener fatigue. Removing this particular class of pulses without damaging the speech is the subject of this presentation.

Most current algorithms for removing impulse-type noise require very short duration pulses, typically a few milliseconds, are susceptible to random wideband noise, and result in holes in the time waveform. Standard algorithms also require that the pulses be largely deterministic in nature. The authors have developed a technique to detect and suppress sprinkler pulses, which are, on the other hand, typically relatively long in duration and contain a random component. These pulses have a characteristic signature, being low frequency and deterministic at the beginning and end of the pulse but wideband and random in their mid-region. The low frequency component at pulse edges is consistent enough from one pulse to the next so that a matched filter can be used as a detector. The authors' new approach allows sprinkler pulse durations on the order of 20 ms, is robust, and avoids temporal holes. The method also provides the audio analyst with easily adjustable parameters for a detection threshold, suppression pulse duration, and suppression level.

The steps in the pulse suppression algorithm are as follows:

1. Select initial prototype pulse
2. Crosscorrelate and detect pulses
3. Refine prototype pulse by averaging detected pulses
4. Crosscorrelate and attenuate pulse over pulse duration
5. Adjust detection threshold interactively

Pulses that change over time are also allowed by performing a time-varying average in Step 3. The most effective means of removing the pulses is to apply pulse scaling after detection. First, pulses are detected and then suppressed. Therefore, suppression occurs only during pulses but speech during pulses is also suppressed. To counteract the speech suppression, perceptual continuity is exploited to improve intelligibility. Application of the algorithm to real-world signals results in significant noise suppression and improved word perception. Due to the presence of a random pulse component, less successful results using a pulse subtraction method where a prototype pulse is subtracted has been observed.

Future work in this area may include examining the possibility of reconstructing the speech lost when a pulse is suppressed. The pulse duration is short enough that in most cases it should be reasonable to perform such a reconstruction. Another possibility is the use of a multiband pulse-suppression scheme.

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Digital Evidence, Audio Enhancement, Speech Processing

D34 Science and Mathematics Education for Crime Scene Technicians and Crime Scene Reconstructionists

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The goal of this presentation is to initiate a discussion of the minimum educational qualifications in mathematics and natural science that should be required of crime scene technicians and crime scene reconstructionists. After this presentation, attendees will have a better idea of the minimum educational standards in mathematics and natural science that crime scene technicians and crime scene reconstructionists should have.

This presentation will impact the forensic community and/or humanity by promoting the discussion of the educational qualifications of crime scene technicians and crime scene reconstructionists, an area of concern that has yet to be explicitly addressed by technical working groups or professional societies.

Over the last few years technical working groups (TWGs) and scientific working groups (SWGs) in a number of forensic science disciplines have established minimum educational qualifications for practitioners of these disciplines. Some consideration should also be given to the educational qualifications of crime scene technicians and crime scene reconstructionists. What minimal levels of competence in mathematics, physics, chemistry, and biology should persons employed in these roles have attained, either in high school or college? The answers to these questions would be useful for high school and college guidance counselors and for high schools and colleges creating courses in crime scene processing and crime scene reconstruction. The International Association for Identification (IAI) has published guidelines for a three-level certification of crime scene technicians/analysts. Crime scene technicians (level I) are expected to have completed a minimum of two crime scene related courses; crime scene analysts (level II) are expected to have completed a minimum of four crime scene related courses; and senior crime scene analysts (level IIIB) are expected to have completed a minimum of six crime scene related courses. The IAI requirements do not address the issue of the minimal mathematics and natural science knowledge that crime scene technicians or crime scene analysts require to perform their basic functions.

Crime scene processing requires meticulous documentation of the scene of a crime through note taking, sketching, and photography. Rigorous laboratory course work in natural science is a useful introduction to disciplined note taking. A course in physical optics is a useful introduction to photographic optics. An introductory chemistry course provides an adequate basis for understanding the chemistry of crime scene processing (such as latent fingerprint development and tire and shoe impression enhancement), while an introductory biology course provides an adequate basis for understanding the handling of biological evidence (such as blood and other body fluids).

Crime scene reconstruction requires a somewhat different set of skills than crime scene processing. Texts on bloodstain pattern analysis and shooting incidents require a grasp of basic algebra, basic geometry, and basic trigonometry. Calculus (although it is the basis of classical kinematics) is not required. Nor are matrices and vectors required. Mastery of the deductive reasoning process used in mathematical proofs also has considerable value for crime scene reconstructionists. The most important scientific discipline for crime science reconstructionists is physics. Traffic accident reconstruction, bloodstain pattern analysis and shooting reconstruction all require a thorough grounding in classical physics. One of the authors (E.R.) has worked with the Department of Physics of The George Washington University to create an undergraduate forensic physics course. This course would cover topics relevant to crime scene reconstruction: basic kinematics (including conservation of linear and angular momentum, coefficient of friction, projectile trajectories), fluid dynamics, electromagnetism, physical optics, and molecular physics.

Archaeology has great potential value for both crime scene technicians and reconstructionists. Crime scene technicians collect physical evidence, while archaeologists collect material culture remains. Crime scene reconstructionists reconstruct events that occurred over a short time span, while archaeologists reconstruct events that occurred over years, centuries, or millennia. Archaeologists approach the documentation of their sites in much the same way as crime technicians and crime scene reconstructionists approach the documentation of crime scenes. Most colleges and universities have Departments of Anthropology that offer introductory and advanced coursework in archeology. They also offer archaeology fieldwork courses. In Great Britain some universities have degree programs in forensic archaeology or offer forensic archaeology concentrations. Many Departments of Anthropology also offer courses in physical anthropology with laboratory work in human osteology.

The Information Technology Age has affected crime scene investigation and crime scene reconstruction. Computer-assisted design (CAD) crime scene/accident scene diagramming programs are increasingly being used by law enforcement agencies, after precise measurements have been acquired by sophisticated tools like Total Station or photogrammetry techniques using a perspective grid and reverse projection. Computer generated simulations/animations and reconstructions are frequently used in court as demonstrative visual aids for the jury. Digital imaging, with the possibility of enhancing marginal images with Photoshop® and similar software programs, may end the use of traditional film cameras. As a consequence of these developments, crime scene technicians and crime scene reconstructionists should have significant course work in digital photography and computer-assisted design.

Crime Scene Technician, Crime Scene Reconstruction, Education

D35 An Equivocal Death Investigation With Staged Crime Scene: Death Classified as Undetermined Manner

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The goal of this presentation is to present to the members of the forensic community the complications involved in an equivocal death

investigation and the significance of the medicolegal findings in the police investigation. Why it is essential that police, prosecutor's and medical examiners work as a team.

This presentation will impact the forensic community and/or humanity by illustrating an alleged hanging and how the crime scene and medical evidence coupled with the victimology and inconsistent statements of the parents refutes any suicide theory. The audience should appreciate the importance and significance of the medical examiner, the police, and prosecution working as a team to reveal the truth and see that justice is done for the deceased.

Equivocal death investigations are those inquiries that are open to interpretation. There may be two or more meanings and the case may present as homicide, suicide, or accidental death. The facts may be purposefully vague or misleading as in the case of the "Staged Crime Scene."

In this case, an 11-year-old female was found hanging in her bedroom from a bedpost by means of a thick rusty metal chain, which had been wrapped several times around the top of the bedpost and connected to a blue colored metal hasp (described as a carabineer) that was connected by an "S" hook to a red colored leather dog collar, which was around the neck of the victim. The victim was fully clothed and was wearing eyeglasses perched on the end of her nose.

The police investigated the case as a suicide. Many of the parents' statements were inconsistent and revealed discrepancies in the chronology of the event. The father of the victim was eventually asked to take a polygraph test.

The medical examiner advised the authorities that medical examination of the child revealed sexual trauma to both the vagina and the anus of the 11-year-old consistent with penetration. The Medical Examiner also felt the death was suspicious for homicide.

The police questioned the father, who had failed the polygraph test. He eventually confessed to sexually assaulting his daughter but denied that he killed her. Police and Prosecution authorities believed that the victim had committed suicide because of his actions. The prosecutor's office advised the medial examiner that the case should be ruled a suicide, which was consistent with their prosecution theory.

The medical examiner refused to label the death a suicide and requested outside review of the findings. Three out of four consultants agreed with the medical examiner that the case was more consistent with homicide then suicide. The presenter concluded that the scene had been "staged" to make the death appear to be a suicide. This conclusion was based on the contradictory and inconsistent statements of the parents, the family history, the suspect's inappropriate past behavior, the victimology, which was not consistent with suicide, the intricate configuration of the ligature, and the incomplete police investigation. The medical examiner ruled the death Undetermined Manner.

The importance of the evaluation of victimology in determining the factors in an Equivocal Death Investigations as well as the importance of comparing autopsy findings with police investigation and the reconstruction of the crime scene are indicated.

Equivocal Death, Staged Crime Scene, Undetermined Manner

D36 The Police Detective in the United States: A Retrospective and Prospective Analysis of Crime Detection and Criminal Investigation

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Attendees will learn what the best research and literature reveals about the historical development of the role and activities of detectives in U.S. police agencies. How that role and those activities have changed over time, and what the future holds for detective work in the light of changes in policing and the forensic sciences, will be discussed. The challenge of "new" crimes and new approaches to detectives' investigative modes will provide the participant with a historically grounded perspective with which to consider the direction of detective work.

This presentation will impact the forensic community and/or humanity by providing perspective on the use, value, and role of forensic evidence as those have evolved over time in the work of police detectives.

As the historian Marc Bloch has pointed out, "Misunderstanding of the present is the inevitable consequence of ignorance of the past." Or, as expressed in different words by Eddie in the movie, *Barbershop* – "You can't get respect unless you know your history."

It is within this context that the history and the role of the police detective is examined in society. Detectives of today essentially "get no respect," partially because of the misconceptions that prevail about them in the media, in society, and, indeed, even amongst police officers themselves. By focusing on the historical development of the police detective, a better understanding of their current role is gained and, more importantly, the ability to chart a course for the future of the detective and the police criminal investigation process.

In this paper the authors address four fundamental questions. The first is: "Where Are We Today?" In response, a brief overview of crime, the agencies responsible for investigations, and the current role of detectives are given. The second question, "How Did We Get Here?" is answered by reviewing pertinent literature and research assessments regarding the changes over time in the detective's role; the authors combine this account with material drawn from the policing, forensic science, and fictional detective literature. The third question: "Where Are We Going?" is answered by an examination of what is really known about the current situation extrapolated to where detective work seems to be headed. The fourth question, perhaps the most important, is: "Where Do We Want to Go?" Here, the authors draw upon lessons learned from the history of detective work to project what will be necessary in order to deal more effectively with the crime-related investigative challenges of the future.

In addressing the issues of interest most criminal behavior is conceptualized as a process consisting of a continuum of five temporal phases. There is first a crime Planning phase. This is followed by an Action phase, the time in which the crime is committed. After the Action phase, there is an Escape phase, during which the offender leaves the scene of the crime. The offender then enters a Fugitive phase, the time period between crime commission and when the offender is apprehended or the statute of limitation for the crime expires. Additionally, in many types of crime, there is a Disposal phase, in which the offender disposes of the fruits of the crime (i.e., sells stolen property, consumes illegally purchased drugs, etc.).

The conceptual framework of the crime continuum model can be expanded for different types of crime by describing each phase of an offender's activities in terms of time (the amount of time an offender may spend in each phase for various types of crimes) and space (types of spatial areas such as a home, neighborhood, or workplace in which the offender may spend time). Additionally, the various sources of crime information (people and things) that might be available within the time frames and spatial areas of each crime phase can be inferred. Because it is information and its availability, quality and susceptibility to useful processing that is, at core, the driving mechanism for investigative activity, the stages of the conceptual model permit an examination of future prospects.

The presentation is closed with an overview of "new" challenges for the detective. An example is costly and socially devastating "political" crime, such as espionage and terrorism. Reactive bureaucracies will be forced to expand investigative goals and activities to include prevention and detection of crime, aside from merely reacting to it. Although detectives will always be expected to respond to reported crimes, their style and efforts will have to be expanded and enhanced in order to include proactive seeking of information, in both overt and covert ways. In many ways, this change is a completion of a circle from the present to the past in the world of the detective.

Detectives, Policing, Criminal Investigation

D37 The Rarity of Unusual Dispositions of Victim Bodies: Staging and Posing

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After attending this presentation, attendees will understand the various positions in which killers leave victim bodies and the reasons why they leave them that way.

This presentation will impact the forensic community and/or humanity by identifying the rarity of the unusual dispositions of victim bodies by killers and assisting forensic scientists recognizing an unusual body disposition when they come across it. This is especially important in staging cases, because when staging is not recognized, it will lead the investigation in the wrong manner.

The act of leaving a victim's body in an unusual position is a conscious criminal action by an offender to thwart an investigation, shock the finder and investigators of the crime scene, or give perverted pleasure to the killer. The unusual position concepts of posing and staging a murder victim has been documented thoroughly and have been accepted by the courts as a definable phenomenon. One staging case and one posing case are outlined to reveal characteristics of those homicides. From the Washington State Attorney General's Homicide Investigation and Tracking System's database on murder covering the years 1981-2000 (a total of 5,224 cases), the relative frequency of unusual body dispositions is revealed as a very rare occurrence. Only 1.3% of victims are left in an unusual position, with .3% being posed and .1% being staged. The characteristics of these types of murders also set them apart. Compared to all other murders, in staged murders the victims and killers are, on average, older. All victims and offenders in the staged murders are white, with victims being disproportionately white in murders with any kind of unusual body disposition. Likewise, females stand out as victims when the body is posed, staged, or left in other unusual positions. Whereas posed bodies are more likely to include sexual assault. Often in serial murders, there is no evidence of either in the staged cases. Last, when a body is left in an unusual position, binding is more likely, as well as the use of more "hands on" means of killing the victim, such as stabbing or cutting weapons, bludgeons, ligatures, or hands and feet.

Staging, Posing, Murder

D38 Wrapping a Carcass in a Sheet - The Influence on Insect Succession During Summer and Winter in Central South Africa

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After attending this presentation, attendees will understand the importance of a possible delay in insect succession due to the presence of a sheet in the colder months of the year.

Forensic entomology is a relatively new field in South Africa. The authors are members of the only research group active in crime scene analysis and field research to that effect. Unfortunately with the high level of violent crime in the country, any information and support in the solving of these crimes is urgently and desperately needed. As most of the forensic entomological applications are often associated with the poorer impoverished section of the population, the need is even greater. As the only way to expand research is through international support, attendance at this congress may allow the authors work to become known, and support offered even if it is only simple information exchange.

This presentation will impact the forensic community and/or humanity by expanding the support to other researchers in the field.

A homicide case, south of Bloemfontein, in central South Africa during 2002, lead to the question of the influence the wrapping of a body has on insect succession. Using pig carcasses, experimental trials were designed and conducted in four consecutive seasons at the experimental site on the western campus of the University of the Free State, Bloemfontein. In this presentation, the results from only two trials will be discussed.

The experimental site consisted of a 26 ha grass field interspersed with trees. Six carcasses were divided into three sample groups *viz* (i) daily, (ii) after five days, (iii) after ten days, each with a clothed carcass and an unclothed carcass wrapped in sheeting. Two additional unwrapped carcasses, one with clothes and one without, were sampled daily as controls. A 100 day trial during the winter months in 2003 (average daily temperature of 9ºC) and a 50 day trial in the summer in 2004 (average daily temperature of 20ºC) were conducted. The first insects to utilize the carcasses were adult Diptera. In the summer these were dominated by two species, *Chrysomya marginalis* and *Chrysomya albiceps*, with *Lucilia* spp. (*Lucilia cuprina* and *Lucilia sericata),* Muscidae *(Hydrotaea capensis* and other Muscidae spp.) and Sarcophagidae spp. present. In winter, there was a change in the dominant species present. These were *Lucilia* spp., *Chrysomya chloropyga* and *Calliphora vicina*, with few individuals of *C. marginalis*, *C. albiceps*, Muscidae (*H. capensis* and other Muscidae spp.) and Sarcophagidae spp. also present. However, during the winter months significantly fewer adults visited the carcasses.

In the summer months, oviposition was not delayed by the presence of wrapping or clothing. The adult Diptera were observed pushing through the smallest spaces to gain access to the carcasses, even if this resulted in wing damage or death when they failed to find an exit. In the winter months, oviposition was delayed by five days on the unwrapped carcasses and by nine days on the wrapped carcasses. In winter the carcasses remained acceptable to Diptera for an extended period. Oviposition continued up to 60 days after placement, whilst in the summer oviposition occurred within the first 3 days.

In summer, *C. marginalis* and *C. albiceps* maggots were dominant, with a low numbers of Sarcophagidae spp. In winter, no *C. marginalis* or *C. albiceps* maggots were found although the adults were recorded. Muscidae adults were present during both seasons, but no maggots of this family were recorded. Because of the short oviposition time during summer the maggots were of a similar age at any time, while the extended oviposition that occurred during winter resulted in different instar groups, often the same species, present at any time. The presence of the sheets in both seasons did allow the maggots to move more freely on the surface of the carcasses, especially in summer, when the maggot masses were much larger then in winter. The skin on these carcasses remained moist and was more easily consumed, while on the unwrapped carcass (especially the unclothed one) the skin dried out, becoming an unacceptable maggot food source. Less skin remained on the wrapped carcasses after the maggots migrated to pupate.

In either season, clothing and/or wrapping apparently had no influence on the Coleoptera community. However in the winter months, Dermestidae (*Dermestes maculatus*) larvae were found while dipteran maggots were still present on the carcasses. They were present when the carcasses were still moist and a fair amount of tissue remained. In summer, they were only present after maggot–migration and little tissue remained, although the wrapped carcasses still retained some moisture. Cleridae (*Necrobia rufipes*) and Histeridae spp. were present in both seasons.

Significant maggot mortality was associated with the wrapped carcasses in the summer trial. All dead maggots were found underneath sheets soaked with decomposition fluids. The maggots were usually found along the back of the carcasses, which were facing east towards the rising sun. The fluid soaked sheets may have restricted the free flow of air, causing a significant increase in temperature and build up of metabolic heat generated by the maggot masses, or perhaps excessive build up of noxious gasses and insufficient oxygen flow.

Wrapping, Entomology, Succession

D39 The Current Status of the ABMDI Certified Medicolegal Death Investigator in the United States

Steven C. Clark, PhD, Occupational Research and Assessment, 124 Elm Street, Big Rapids, MI 49307; Julie A. Howe, MBA*, Saint Louis University, School of Medicine - Division of Forensic Pathology, 1402 South Grand Boulevard, R512, St. Louis, MO 63104-1028; and Steve Nunez, c/o Julie Howe, Saint Louis University, School of Medicine - Division of Forensic Pathology, 1402 South Grand Boulevard, R512, St. Louis, MO 63104-1028*

After attending this presentation, attendees will show the affect of ABMDI certification for medicolegal death investigators. This presentation will impact the forensic community and/or humanity by providing an understanding of the current status of the ABMDI certified medicolegal death investigator in the United States. The participant will be able to discern the affect of ABMDI certification on the job status for medicolegal death investigators and insight into future employment trends.

The creation of the American Board of Medicolegal Death Investigators (ABMDI) in 1998 established for the first time standardized criteria for the profession of medicolegal death investigation in the United States. Since 1998, over 700 individuals have met the criteria established by the ABMDI Board and Advisory Council to become Registered Medicolegal Death Investigators. The purpose of this study was to develop a profile of the current status of certified medicolegal death investigator, their professional responsibilities, and work environment, potential benefits of certification, and also to provide insight into the future direction of the profession.

Beginning in the fall of 2004, a national survey instrument was developed by the ABMDI to collect data pursuant to the study's objectives. The survey consisted of a number of questions in the following categories: Demographic Information including job title, years experience and salary; Employment Status, including caseload and case types investigated; Case Management Activities including documentation, standards followed and technology used to conduct investigations, as well as various professional job requirements, such as prerequisite skill requirements for employment, professional development activities, continuing education, and in-services to maintain employment and/or take advantage of promotion opportunities. In addition, questions were posed to determine if any interagency (law enforcement) interactions had changed since the achievement of certification.

The survey population consisted of each certified member of the ABMDI, both registry (Diplomats) and board certified (Fellow) levels. Since all members were included in the survey, no sampling methodology was employed. The survey procedures included pre-survey mail out notifications, followed by both hardcopy and electronic survey deployment via the U.S. mail and the Internet to all members. Non-respondent follow-up consisted of notification and re-deployment of the survey. The non-respondent follow-up process was repeated four times, once every 14 days, after which telephone follow-up of all non-respondents was conducted to ensure the highest response rate possible.

The results of the survey will establish a benchmark for the profession of medicolegal death investigation; its current status and future viability. All major data categories will be correlated to the achievement of the ABMDI certification in attempts to validate the efficacy of certification to the population of medicolegal investigators in the United States. Results will be useful for educational program planners at agencies employing medicolegal death investigators, educational institutions preparing medicolegal investigators, and associations providing in-service, training or continuing education activities for the next generation of medicolegal death investigator, as well as current investigators seeking information about the advancement within the profession and individuals contemplating career opportunities in the field of medicolegal death investigation.

Medicolegal Death Investigator, Standardization, Employment

D40 Forensic Autopsy Performance Standards - The Effect on Death Scene Investigation

Steven C. Clark, PhD, Occupational Research and Assessment, 124 Elm Street, Big Rapids, MI 49307*

After attending this presentation, attendees will be able to identify the medicolegal death investigator's role in the performance of the forensic autopsy. If the proposed NAME forensic autopsy performance standards are adopted and followed by the performing pathologist, this presentation will impact the forensic community and/or humanity by demonstrating how the medicolegal death investigator may have a significant role to play in the successful implementation of the standards and the resulting forensic autopsy.

Beginning in March of 2003, the National Association of Medical Examiners (NAME) formed a subcommittee within their Inspection and Accreditation (I&A) committee to investigate the possibility of developing organizational standards for the performing of the "forensic" autopsy. The members of the subcommittee, know as the NAME Standards Committee, were nominated by the I&A committee members and selected by the NAME President based on; jurisdictional size, system type, and the willingness to participate in the year long study.

The initial literature review focused on the identification of existing practice standards for forensic pathologists and the establishment of a membership profile to determine survey-sampling procedures. Based on the diversity of the membership, the committee determined that the methodology required to create a set of "acceptable" forensic autopsy standards would require an "open" research approach that encouraged comment and discussion both within the committee, as well as the general membership. A census, rather than sampling strategy, would be used in attempts to involve the entire NAME membership in the process.

From the existing materials reviewed, four data gathering instruments were developed and administered to members of the committee to begin the process of identifying the essential components of the forensic autopsy. These initial survey instruments were completed by 16 (80%) of the standards committee members at the annual NAME meeting in September 2003. The data collected was used to develop the first set of "performances" associated with the forensic autopsy. Those performances edited into performance objectives and presented to the committee at the next meeting held in Atlanta, December 2003.

After multiple revisions, refinements and reorganizations by several of members via emails and third draft for the performance standards were ready for full committee review in February 2004. After another round of revisions the committee approved the content of the standards document for release as a survey. Using a five-point Likert scale ("strongly agree to strongly disagree") each member would be asked to indicated their level of agreement on 177 survey items. Both electronic and hardcopy version were developed and then deployed to all general and emeritus members in April 2004.

In late March, a postcard announcement was sent to all members informing of the pending survey and its importance. The following week the first of four electronic deployments of the survey began followed by non-respondent telephone contacts. Data collection stopped on June 3, 2004 with a total of 465 (60.3%) surveys returned. All survey data were compiled and presented to the committee final review and consideration at a 3-day meeting in Atlanta, June 7-9.

Of those returned, 438 (90.5%) were from members and 73 (9.5%) were from emeritus members. Members from 48 states and six countries participated in the research, with California and Florida have the highest number of respondents (50), and 38 (90.4%) of NAME accredited offices participated. Members listed as board certified in AP/CP/FP made up 61.2% (254) of all respondents, while participant work experience averaged over twelve years. Of the 177 performance standards presented in the survey, 169 (95.4%) received an average rating between 4.0 (agree) and 5.0 (strongly agree), and one item (0.06%) having a median score

below 5.0. Overall, agreement (strongly agree and agree) on the survey was 89.9%. There were 21 (11.8%) of the performance standards that at least 10% (46) individuals disagreed with (disagree and strongly disagree). Of the total, 4.15% of the responses were rated as "unsure," while 1.2% received no response. In addition, over 2,200 comments were logged and categorized for committee review.

Summary: While reviewing the data presented for each standard (descriptive statistics and respondent comments), the committee debated the merits of each performance standard. To maintain the consensus methodology, the committee was reminded that if any one member did not agree with a specific standard, it would be removed. Based on review of the data and much discussion, 21 requirements were edited, four standard titles were modified, one new title was created, and 16 performance tasks were removed. The final set of proposed forensic autopsy standards consists of nine sections, 31 standards, and 153 performance tasks.

Forensic Autopsy, Standards, Death Investigation

D41 "The Most Dangerous Game" - The Case of a Double Homicide

Robert J. Morton, MS, FBI NCAVC, FBI Academy, Quantico, VA 22135*

This presentation is designed to highlight a unique homicide and the problems related to crime scene assessment, and the advantages of utilizing a "cold case" homicide unit. This presentation will impact the forensic community and/or humanity by highlighting the benefit of an accurate crime assessment, which can allow an investigation to focus on the most probable motives for an offense and limit the suspect pool, enhancing the probability of the successful identification of a suspect.

Crime scene assessment is one of the most important steps in homicide investigation. The ability to discern possible motives from interpretation of a crime scene is paramount to the successful identification of a "pool" of potential suspects. The quicker an investigation can focuses on a single line of investigation, the more likely a single suspect can be identified.

The FBI's National Center for the Analysis of Violent Crime (NCAVC) is routinely consulted by federal, state, and local authorities in a variety of cases of bizarre and repetitive violent crimes, especially homicides. NCAVC assistance was requested by local authorities in regards to a case involving the shooting deaths of two hunters who were found in a wooded area of public lands. The victims were both shot in the back with the shotgun belonging to one of the victims. Both victims had been hunting and each was armed, one with a shotgun, the other with a muzzle-loading rifle.

The initial investigation focused on the drug connections of one of the victims, who was engaged in selling drugs. The investigation did not establish any direct connection between the victims. The police contacted a local law enforcement agency to conduct an assessment of the crime scene and provide a "profile." Their opinion was that this crime was either a revenge killing or a thrill killing. The investigation floundered for 10 years.

The case was re-opened as a cold case, and the investigators reviewed the entire case. Based upon their review, they began to focus on other possible motivations. The cold case investigators contacted the FBI's NCAVC for a crime scene assessment and an opinion as to motive. NCAVC's assessment was that the motive for this crime was not robbery, revenge, or a drug killing but proprietary and was based upon the location where the killings took place.

The investigators had been suspicious of the man who owned the land adjacent to the public land where the victims were found. He was also the person who had found the shotgun used to kill both victims. He was overly protective of his property and had in the past threatened people on the public lands with a weapon. He was also a former law enforcement officer.

A thorough follow-up investigation revealed the subject was unaccounted for at the time this crime took place, and he had made several inconsistent statements regarding his whereabouts. The subject also misrepresented his activities during the time the crime scene was being conducted, and he had taken several acquaintances to the exact crime scene without having been at the scene. Investigators focused their efforts on an individual who provided the subject's alibi at the time of the murders.

After the convening of a Grand Jury, the subject was indicted and charged with the murders of both hunters. The trial resulted in a guilty verdict.

This case highlights the benefit of an accurate crime assessment, which can allow an investigation to focus on the most probable motives for an offense and limit the suspect pool, enhancing the probability of the successful identification of a suspect.

Crime Scene Assessment, Cold Case, Homicide

D42 Tractor Man: The Nation's Capitol Held Hostage

James J. McNamara, MS, FBI NCAVC, FBI Academy, Quantico, VA 22135; and Mary B. Collins-Morton, BS*, FBI Washington Field Office, 601 4th Street, Northwest, Washington, DC 20535*

This presentation is designed to highlight the many components of a dangerousness assessment done in support of a post 9/11 critical incident negotiation through the presentation of an unusual case. This presentation will impact the forensic community and/or humanity by highlighting the difficulties faced by law enforcement and professionals from related disciplines in dealing with dangerousness assessment, including determining future dangerousness, locating indicators of suicide, and preventing the hasty use of deadly force.

Critical incident dangerousness assessments are, by their very nature, complicated and emotionally intense because of pressure from the political establishment, media, community, and family members. Investigators and professionals from related disciplines face many challenges because of the lack of clear and convincing on-site evidence pertaining to the offender's true mind-set, motivation and capabilities. On March 17, 2003, Dwight Watson had a legal permit to distribute literature describing the plight of the nation's tobacco farmers. When approaching the Washington Monument, Watson veered his John Deere tractor into a shallow pond at Constitution Gardens near the monument and began a 47-hour standoff with law enforcement. He claimed to have weapons, including "organophosphate bombs" in the tractor with him. The incident began on the same day that the Department of Homeland Security elevated the terror threat level to Code Orange, a heightened state of alert that preceded the beginning of the American led assault on Iraq on March 20.

Four Federal law enforcement agencies responded including three SWAT teams, three bomb technician teams, two negotiations teams, the FBI's Evidence Response Team and HAZMAT team. The NCAVC responded in support of the negotiation component. Federal, state, and local authorities in a variety of violent crimes including threat assessments and dangerousness assessments, routinely consults the FBI's National Center for the Analysis of Violent Crime (NCAVC). Initial information indicated that Watson was violent, possibly suicidal, and hence very dangerous. There was conflicting preliminary investigative background information on the offender regarding violent acts and suicidal tendencies.

The NCAVC team initiated investigative leads to clarify Watson's background, life situation, and any factors that could contribute to a suicidal state of mind. The NCAVC analyzed the results of investigative leads and conducted on-site interviews of Watson's family members who had traveled to the scene. The NCAVC provided on scene commanders with a dangerousness assessment that stated Watson was not a risk for future violence and would surrender himself by his self-imposed deadline of March 19. A tactical assault was not warranted.

During the two day standoff there was an array of political media and public pressure to utilize a dynamic tactical response to assault Watson's position and end the standoff, thus eliminating the huge disruption to the nation's capitol. On March 19 Watson turned himself over to police custody. Watson had a dummy hand grenade and several cans of bug spray with him in the tractor. He did not have any weapons, ammunition, or other dangerous items or material in the tractor. A subsequent search of the tractor conducted by bomb technicians and the FBI HAZMAT team could find no materials posing credible threat.

The issues in this case highlight the difficulties faced by law enforcement and professionals from related disciplines in dealing with dangerousness assessment, including determining future dangerousness, locating indicators of suicide, and preventing the hasty use of deadly force.

Suicide, Dangerousness Assessment, Suicide

D43 The Corrosive Effect of Blood Regarding the Forensic Identification of Fired Projectiles

Timothy P. Scanlan, MSFS, Jefferson Parish Sheriff's Office Crime Laboratory, 3300 Metairie Road, Metairie, LA 70001*

Attendees will be briefed on the proper collection and storage of projectiles collected from the bodies of shooting victims so that the corrosive effect of blood does not destroy the microscopic markings used in forensic firearms examination

This presentation will impact the forensic community and/or humanity by demonstrating that blood has a corrosive effect on projectiles. In addition, it will establish a method of collection and storage that prevents this destruction, so that forensic firearms evidence is not lost.

The goal of this presentation is to present to the forensic community, particularly surgical personnel and forensic pathologists, a study that demonstrates the destructive nature of blood in prolonged contact with projectiles and how this contact hinders forensic identification of the projectiles.

This presentation will review a portion of a study conducted for the purposes of a Master's Thesis. This study examined if blood hampers forensic firearms examiners' efforts to connect a projectile to other projectiles or a particular firearm. Because bullets are often recovered from victims of shootings, blood may be left on the projectile or the projectile may be stored in a container with blood. The main objective of this study was to determine if this blood destroys the microscopic markings used by forensic firearms examiners in classifying and identifying bullets. An additional objective of this study was to begin to understand what component or components of blood play the greatest role in the damaging of bullets. The final objective of this study was to determine if desiccants or a particular storage method could prevent or lessen the damage caused by blood.

This study focused on blood's effects on recovered evidence bullets. In particular, the problem to be examined involves projectiles that are recovered from a victim of a shooting. As it can be inferred, blood first contacts the projectile as it enters the body. The location of this entry is referred to as the entrance wound. The bullet may pass completely through the body, leaving through an exit wound. Many times, the bullet will remain in the body. This study will focus on those projectiles that remain in the body and that are completely surrounded by blood and bloody tissue. These projectiles are usually removed from the body by a surgeon or a forensic pathologist. After a projectile is recovered from the body of the victim, body fluids (specifically blood) may remain on the specimens. It has been observed that the microscopic markings used to identify these projectiles are not present or are present to a lesser degree on these specimens.

The methodology of this study was based on the above factors and the observations of forensic firearms examiners. This study focused on copper jacketed projectiles that are removed from a patient in a hospital or morgue setting. It was structured to recreate evidence, as it is seen in the crime laboratory. A semiautomatic firearm was shot into a recovery medium to obtain the projectiles for this study. Three test fires were obtained and stored as a reference sample. The reference sample was used as the standard in all microscopic comparisons. Additional test sets were created where the copper jacketed projectiles and other materials were placed in a specimen cup that was sealed until the time of comparison. The materials placed in the specimen cup differed depending on the desired variables. The projectiles were removed every fifteen days and subjected to microscopic examination and comparison to the reference set of projectiles.

As a result of these experiments, it was determined that blood does damage projectiles and that this damage hinders a forensic firearms examiner's analysis. This damage increases over time, consuming the identifiable markings of the projectile. In addition, both lysed red blood cells and serum play a role in the destruction of the bullets. It appears the damage was caused by the concert of materials that make up whole blood. Although no correlation can be made between the addition of desiccants and the slowing of the destruction to the bullets, proper collection and storage was determined to stop the corrosive effects of blood. To ensure that this damage does not occur, it is recommended that the projectiles be rinsed with water before they are placed in a storage container. If trace material must be recovered from the bullet, filter mechanisms can be added to this process.

Firearms Examination, Projectiles, Blood

D44 Performance Characteristics of Two ELISAs for Preliminary Test of Urine Specimens From Patients Under Flunitrazepam Treatment

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Following the establishment of a two-step protocol [1] for high-volume analysis of urine specimens to detect flunitrazepam (FZ) exposure, this study compares the performance characteristics of two commercially available ELISA kits and ascertains corresponding cutoffs suitable for the immunoassay/GC-MS testing strategy.

This presentation will impact the forensic community and/or humanity by facilitating the development of an effective approach for high throughput detection of flunitrazepam exposure through the commonly adapted two-step immunoassay-GC/MS test strategy.

In an earlier study [1], the authors have demonstrated that Cozart Flunitrazepam Metabolite Micro-Plate EIA (Cozart Bioscience Ltd., Oxfordshire, UK), but not other general-purpose benzodiazepines EIA (such as TDx, Beckman, CEDIA, Cobas Integra, EMIT II Plus), can be effectively used for the preliminary test of urine specimens for FZ exposure. With FZ-specific ELISA from Immunalysis Corp. (San Dimas, CA) now readily available, its performance characteristics are examined and compared to the Cozart product adapted in the earlier study. Neogen Corp. (Lexington, KY) has also marketed FZ-specific ELISA. However, it was not included in this study because calibration standards needed for producing semi-quantitative data were not available. A total of 144 urine specimens collected from 11 patients were studied to compare the performance characteristics of these assays. The resulting data were also evaluated to ascertain corresponding cutoffs suitable for the two-step immunoassay/GC-MS testing strategy. The concentrations of 7-amino-FZ in all specimens were first determined by GC/MS. These specimens were then diluted by a factor of 1, 5, 10, or 20 to bring the concentration of 7-amino-FZ in these specimens to the dynamic range of the immunoassays (50 ng/mL or less).

Shown in Figures 1A and 1B are correlation plots of the GC/MS data against the data derived from Cozart (A) and Immunalysis (B) reagents, respectively. The correlation of the two set of immunoassay data is further shown in Figure 1C. Resulting correlation parameters derived from Figures 1A and 1B are listed in Table 1.

Figure 1. Correlation of GC-MS data against ELISA data derived from Cozart (A) and Immunalysis reagents and correlation of ELISA data derived from these two manufacturers.

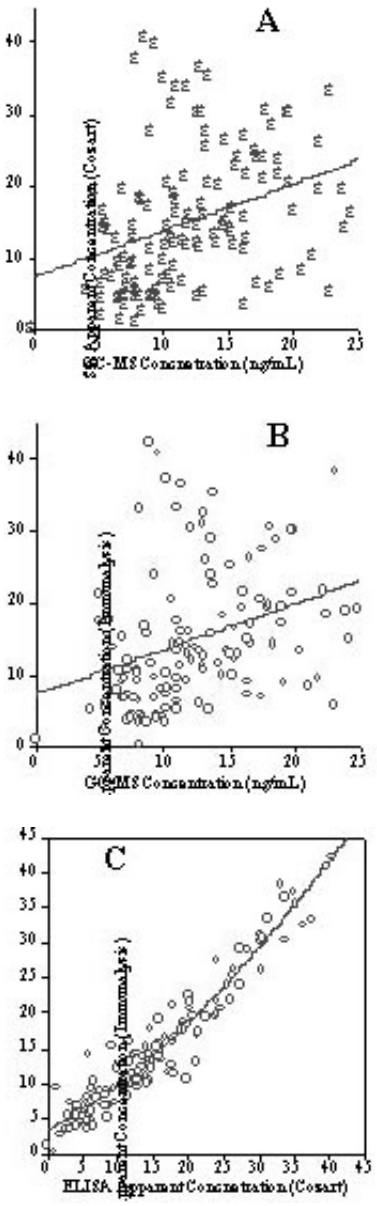

Table 1. Immunoassay-GC/MS data correlation parameters derived from data generated by two FZ-specific ELISA reagents

Manufacturer	Correlation equation	Correl. coef.	Immunoassay 7-amino-FZ concn. (y) corresponding to 6 ng/mL GC/MS concn (x)
Cozart	y = 7.247 + 0.6465 x	0.1176	11.1 ng/mL
Immunoanalysis	y = 8.294 + 0.5795 x	0.09837	11.8 ng/mL

Data shown in Figure 1 and Table 1 suggest: (a) the performance characteristics of these two ELISA are very similar, with the Immunoassay product generating slightly higher responses (Figure 1C and last column of Table 1); (b) if all specimens are diluted by a factor of 5 before testing and 10 (or more precisely 11) ng/mL is adapted as the cutoff (corresponding to 50 ng/mL in the undiluted specimen) for the preliminary test, those tested positive are likely to contain 6 ng/mL (or 30 ng/mL in the undiluted specimen) 7-amino-FZ as determined by GC/MS. With both ELISA calibration optimized at the 0–25 ng/mL range, 5-fold specimen dilution and 10-ng/mL cutoff may work well for both products. The corresponding GC/MS may then be set at 30 ng/mL (undiluted specimen).

It was also noted that both ELISA are free from interference by many drugs (and their metabolitrs) that were prescribed to the patients in combination of FZ. These drugs include bromazepam (Lexotan), triazolam (Halcion), alprozolam (Xanax), clonazepam (Rivotril), venlafaxine HCl (Efexor), glibenclamide (Daonil), haloperidol (Haldol), zotepine (Lodopin), chlorpromazane (Wintermno), trihexyphenidyl (Artane), carbamazepine (Tegretol), lithium (Camcolit), and amlodipine basylate (Norvasc).

1. Wang P-H, Liu C, Tsay W-E, Li H-H, Liu RH, Wu T-G, Cheng W-J, Lin D-L, Huang T-Y, Chen C-H: Improved Screen and Confirmation Test of 7-aminoflunitrazepam in Urine Specimens for Monitoring Flunitrazepam (Rohypnol) Exposure; *J Anal Toxicol* 26:411-418; 2002.

Need Key Words

D45 Detection of *Canis familiaris* Signature Odor Chemicals in Human Remains Using Derivitization/SPME/GC/MS

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After attending this presentation, attendees will understand the importance of analytical analysis of canine work. This presentation will impact the forensic community and/or humanity by proposing to identify the components of human decomposition that human remains canines alert to while conducting search and recovery missions. The results of this experiment can be used as a means of establishing reliability standards for such canines and validating the work that they do. The goal of this project is to help validate and improve upon the reliability standards associated with human remains detection canines.

Detector dogs have successfully established themselves as an invaluable aid to law enforcement and forensic officials. For over thirty years, the United States has sought the help of canines for such purposes as narcotic and explosive detection. While it is generally accepted that canines possess a superior sense of smell due to their abundant olfactory receptors, what it is that they smell and how they are able to distinguish between scents, for the most part, is still a mystery. For forensic purposes, it is extremely important to be able to scientifically validate the work of canines. One way to accomplish this is by successfully determining to which compounds the detector dogs alert.

The focus of this study will be on human remains canines (a.k.a. Cadaver Dogs). These dogs are specially trained to alert to the scent of human decomposition. As such, when they are employed it is crucial that they consistently alert to human remains as opposed to being distracted by the surrounding environment. Distractions can come in many forms including sewage, decaying vegetation, and other decomposing animals. Consequently, it is vital that the odor of human remains is characterized and therefore distinguished from that of other scents, especially other mam-

malian remains. In an effort to accomplish this, a comparative study of decaying pigs and cows has been conducted.

The canines used for this study are actively employed and certified by the Miami Dade Police Department. Weekly field tests with the suspected compounds, human samples, and animal samples were conducted. In an effort to avoid conditioning the canines to any confounding variables, the searching procedures have been established and are implemented by the handler. In addition, some experiments were blind (where the handler was not aware of the presence or absence of a sample) and some were not. This was done to help assess the amount of influence (and subsequent bias) the handlers imposed upon their canine partners. Field tests have shown a complete lack of interest in varied forms of cow remains and distracters including human sweat and perfume. Conversely without fail, they have alerted to assorted forms and quantities of human remains including dried blood. Additionally, a high percentage of alerts were contributed to such standard chemicals including dimethyl-disulfide, butyric acid, and hexanoic acid.

The dynamic process of human decomposition culminates in the breakdown and release of an array of biological compounds. Several studies have been conducted to gain insight into the process of human decomposition and separate studies have been conducted on human remains canines. However to date, information on which decomposition chemicals the cadaver dogs alert to is not available. For this study, approximately fifteen compounds have been the focus and they were subsequently broken down into the following five categories: biological amines, alcohols/cresols, indoles, methyl sulfides, and organic fatty acids.

In order to identify and quantify the chemical composition of the samples, headspace analysis by solid phase microextraction/gas chromatography/mass spectroscopy (SPME/GC/MS) was conducted on both a DB5-MS column and a Fatty Acid Methyl Ester (FAME) column. Due to the nature of the compounds present in human remains (highly polar to highly basic) derivatization is needed on the standard column. An on-fiber method containing chloroformates for the basic amine components and BFTSA for the polar acidic counterparts is currently being optimized for the standard column. However, the use of the FAME column is being investigated as an alternative to the manual derivatization process. The method developed allows for the rapid detection of odor signature chemicals emanating from decomposing human remains and is helping to identify the dominant chemicals used by cadaver dogs to reliably locate human remains.

Human Remains, Animal Remains, Canine Scent Identification

D46 DNA Extraction of Desiccated Contact Lens Using the Medium Chelex® 100

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After attending this presentation, attendees will understand that Chelex® is a viable means for extraction of amplifiable DNA from desiccated contact lenses. This protocol is preferred over an organic extraction method such as phenol/chloroform as it is a faster, less hazardous extraction protocol, using a single tube thereby greatly reducing the potential for introducing laboratory contaminants.

This presentation will impact the forensic community and/or humanity by demonstrating that dehydrated contact lens may be collected and used as a source of evidence in order to link a suspect or victim to a crime scene. Because only one person, which is not always the case with a toothbrush or hairbrush, uses contact lenses for example, no mixtures would be encountered giving way to a positive identification that does not require further testing to resolve a potential mixture of genotypes.

The study performed during the Ronald E. McNair summer research program, (supported by USDE grant # P217A030070) will be presented on this poster. It will be demonstrated that exposure time of a soft contact lens to the ambient environment, for up to 72 hours, will not significantly affect the ability to extract, amplify, and type DNA as tested at the D1S80 locus. This poster will also demonstrate that Chelex® is a viable means for extraction of amplifiable template. This protocol is preferred over an organic extraction method such as phenol/chloroform as it is a faster, less hazardous extraction protocol, using a single tube thereby greatly reducing the potential for introducing laboratory contaminants.

Because crime scenes, areas of mass disasters, and unmarked graves sites are unpredictable, evidence recovered at such locations can also be unpredictable, creating a need for the forensic science community to look at unusual matrices as potential sources of DNA used for identification. The DNA found on such substrates may be limited in both quality and quantity making it necessary to subject extracts from the matrices to PCR prior to analysis. A recent report demonstrated that amplifiable DNA was successfully isolated from contact lens fragments using the phenol/chloroform method (Wickenheiser & Jobin, 1999). To study the comparative effectiveness of other, less hazardous DNA extraction methods on DNA left on desiccated contact lens, this pilot study was conducted.

A total of three brands of contact lenses (Acuvue®, Bausch & Lomb and Focus Dailies®) were donated by five volunteers and subjected to a dry environment for either 24, 48, or 72 hours. Buccal scrapings were performed on each individual in order to establish a reference genotype for D1S80. The DNA from both the reference samples and the lenses were extracted using Chelex®, the D1S80 alleles were then amplified and typed using a vertical polyacrylamide gel on an ABI Prism 377XL DNA sequencer.

The preliminary results indicate that an inverse relationship exists between exposure time and quality of DNA recovered: as the "dry" exposure time increases, the DNA quality decreases. Genotypes identified from three out of the five desiccated lens (exposure times of 24 and 48 hours) matched the alleles for their corresponding buccal sample. DNA was recovered from the remaining two lenses (dry for 48 and 72 hours) but appeared to be severely degraded and could not be typed. The successful typing of the three lenses indicates that the Chelex® protocol is an adequate method for extracting DNA.

In order to resolve the difficulty in the recovery of DNA from some of the samples, the preservation and storage of the lenses needs to be enhanced in order to eliminate any continual degradation of the DNA. Although the procedure used was relatively successful, it may be helpful to incorporate an additional step to purify the DNA prior to PCR such as filtration purification (i.e., Microcon YM100).

The results obtained demonstrate that dehydrated contact lens may be collected and used as a source of evidence in order to link a suspect or victim to a crime scene. Because only one person, which is not always the case with a toothbrush or hairbrush, uses contact lenses for example, no mixtures would be encountered giving way to a positive identification that does not require further testing to resolve a potential mixture of genotypes.

This is the initial study undertaken by the researcher, with further, in-depth study being planned using the 13 loci used by the forensic community.

Contact Lens, DNA Extraction, Chelex

D47 Rearing of *Chrysomya megacephala* (*Diptera: Calliphoridae)* at Different Population Densities

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Attendees will learn that larger densities of *C. megacephala* will result in smaller and lighter puparia and adults. Also, larger numbers will result in increased mortality in the larval stage. This presentation will impact the forensic community and/or humanity by providing additional information on insects used as forensic indicators.

Chrysomya megacephala and *Chrysomya rufifacies* are the primary invading Diptera species found on decomposing carcasses and corpses throughout O'ahu, Hawaii. These two species are in the family Calliphoridae, which are commonly known as blowflies. *C. megacephala* and *C. rufifacies* are found during the first, second, third, and fourth stages of decomposition. These two species both feed on flesh and tissue. When their food source is depleted or larval development complete, larvae will leave the carcass for pupariation. *C. megacephala* larvae feed only on corpses and carcasses, while; by contrast, the *C. rufifacies* larvae feed on the corpse or carcass, prey on other larvae, and sometimes cannibalize its own species. There has not been a significant amount of research on interactions between these two species, even though they are frequently found on corpses in large numbers. Frequent occurrence of these larvae makes them a very important part of solving deaths in Hawaii. Does the density population of *C. megacephala* have an effect on the rate of development? The hypothesis is that large densities will result in smaller and lighter puparia and adults. It is believed that large numbers will result in increased mortality in the larval stage. Can *C. rufifacies* display cannibalistic or predatory behavior when the food source is limited? From previous work (Goodbrod & Goff 1990), the hypothesis of this study is that *C. rufifacies* is both predatory and cannibalistic.

In order to test these questions, it was necessary to establish colonies of larvae by collecting a large number of eggs. Larvae were separated into individual containers at specific densities of 100, 150, 200, 250, 300, and 400 larvae/12.5g of beef liver. Then the cultures are replicated a total of 6 times. Larvae were reared in Tupperware containers with a hole cut out of the top and covered by organza material. The organza material permits airflow. They were supplied with a limited food, 12.5g of beef liver, and given a few drops of water everyday using a transfer pipette to keep the liver moist. Puparial and adult stages lengths and weights were recorded. Two colonies were established with a 50/50 ratio of *C. megacephala* and *C. rufifacies*. This was done to observe the survival of larvae of the two species when in competition for a limited food source. There were not many trials of these because a limited amount of *C. rufifacies* was recovered from the host. Mortality was calculated based on puparial development and adult emergence.

In all six cultures initiated at first instar, the weights ranged from .010g to .032g. The lengths ranged from .543cm to .788cm. In all six cultures initiated at second instar, the weights and lengths were slightly larger. This could be because these larvae fed on the host a little longer than the first instar larvae. The greatest weight, in all of the second instar cultures was .037g and the smallest was .016g. The shortest length was .598cm and the longest was .800cm. The 100 puparia densities were larger in length and weight because there were fewer larvae feeding on the constant food source. The 400 puparia densities were the smallest because there were a great number of larvae feeding the 12.5 grams of beef liver.

The weights and lengths increased as the population became less dense. When the mortality rates were averaged between the three cultures and then divided by the density number the results verified the hypothesis. Rearing of *C. megacephala* in pure cultures at six different density dependent populations displayed a direct relationship between density versus length and weight of the larvae. The survival rates decreased at the greater densities. Puparial and adult lengths and weights decreased as population densities increased. Within the cultures reared with the *C. megacephala* and *C. rufifacies*, the *C. rufifacies* showed cannibalism and also was predatory on *C. megacephala.* USDE grant number P217A030070 supported this research.

Chrysomya, Diptera, Population Density

D48 Canine and SPME/GC/MS Detection of Microbial Volatile Organic Compounds Emitted From *Stachybotrys chartarum, Penecillium chrysogenum* and *Aspergillus versicolor*

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After attending this presentation, attendees will understand the process of mold detection by the identification of microbial volatile organic compounds. This presentation will impact the forensic community and/or humanity by educating the forensic community on the work being done on validating mold detection processes via canine and SPME/GC/MS analysis.

Indoor mold growth is a serious problem all over the world. Mold exposure has been linked to acute and chronic adverse health effects and even death in humans and animals. These adverse health effects vary depending on the levels of exposure and the strength of one's immune response, but may include vomiting, hemorrhaging, chest pain, nephritic congestion, and necrosis of tissues. Certain molds even have carcinogenic potential. Mold spores are airborne particles, which can travel into virtually any environment and are often deposited indoors. The growth of mold is dependent on humidity, temperature, and a supply of nonliving organic material, which serves as a nutrient source. When adequate conditions exist, mold is able to flourish, often undetected. As it grows, mold produces several types of secondary metabolites, namely antibiotics, mycotoxins, and microbial volatile organic compounds (MVOCs). Mycotoxins are the most toxic of the fungal secondary metabolites, but are generally non-volatile, as they are relatively large molecules. The volatile secondary metabolites, MVOCs, are emitted from flourishing molds, and may be species-specific. It may be possible to detect fungal growth down to the species level based on the composition of the microbial volatile organic compounds emitted from a culture.

Law-enforcement agencies, forensic scientists, and the military have used canine detection for many years throughout the world. Canis familiaris, or domesticated dogs, have been specially trained to detect a variety of target compounds emitted from the source via olfaction, whether it be ignitable liquid residues, volatile compounds from explosives, or degradation products from human remains. Canines display an ability to discriminate between similar or partial odor signatures, so it is important to know the complete volatile composition of what is being detected. The advanced olfactory system canines possess allow them to detect compounds down to the parts-per-billion level, significantly past the point where human olfactory capabilities fail. This study is researching what target compounds are being emitted from three problematic species of molds: *Stachybotrys chartarum*, *Aspergillus versicolor*, and *Penecillium chrysogenum*.

Cultures of *Stachybotrys chartarum*, *Aspergillus versicolor*, and *Penecillium chrysogenum* were obtained from ATTC in Manassas, Virginia. Samples of each species were grown in vitro and purified in the laboratory. *Stachybotrys chartarum* was grown and purified on corn meal agar; *Apergillus versicolor* and *Penecillium chrysogenum* were grown and purified on potato dextrose agar. All samples were cultured in triplicate. Headspace analysis was conducted using solid phase microextraction/gas chromatography/mass spectrometry to determine the specific odor signatures of the volatile metabolites for each species. Species-specific mold drywall training aids were obtained from a local canine training facility and headspace analysis was conducted using solid phase microextraction/ gas chromatography/mass spectrometry as well. Sample extraction conditions were optimized by varying the fiber types, the time of sample exposure, and the amount of sample being analyzed.

This study aims to address the effect of varying concentrations of molds and length of time molds are allowed to grow on the odor signatures obtained via SPME/GC/MS analysis for both the pure mold cultures and the inoculated drywall training aids. Also, by contrasting the spectra obtained from SPME/GC/MS analysis of the headspace of the pure mold cultures and the drywall-inoculated training aids, it could be determined what compounds specifically the canines are being trained to detect, thereby enabling a critique/validation of the training process which canines are undergoing today in the mold detection industry.

Microbial Volatile Organic Compounds, Canine Detection, SPME/GC/MS Detection

D49 Mitochondrial DNA-Based Identification of Family Calliphoridae and Sarcophagidae

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The goal of this presentation is to present to the forensic community the implementation of mitochondrial DNA methodologies and sequence data from population samples of a calliphorid and sarcophagid species in Hawaii.

This presentation will impact the forensic community and/or humanity by providing the sequence data from sarcophagids and calliphorids from Hawaii, which will be entered into GenBank so that the forensic community may have population samples from this location to aid in quick identification of these species for estimation of postmortem interval.

Forensically important insects collected on a decomposing body offer a unique opportunity to estimate time of death (or postmortem interval, PMI) if the species can be positively identified. Many adult carrion-flies are easily distinguishable, but the larvae are not. The most common flies to inhabit a human corpse in Hawaii are blowflies from the family Calliphoridae and fleshflies from the family Sarcophagidae. Sarcophagid flies have many characteristics that make them ideal forensic indicators. However, their utility is limited because it is difficult or impossible to determine the species of a sarcophagid larva (Wells Pape and Sperling 2001). The same holds true for calliphorid species in different developmental life stages. Identification of the immature blowfly larvae is more difficult and sometimes impossible (Schroeder Klotzback 2002).

The rationale for this study follows the work of Wells and Sperling et al (2001) by providing an alternative method to using morphology in identifying indistinguishable larvae by use of mitochondrial DNA (mtDNA) sequence data and phylogenetic analyses. The collection of his work throughout the years and the work of other scientists has produced a useful database providing sequences to different arthropod species. The database, however, is limited to species common on the mainland and continental regions. Since the Hawaiian Islands are the most isolated archipelago in the world, with regular species likely introduced from Asia, Australia, the U.S. mainland and other Pacific Islands, the array of sarcophagids and calliphorids in Hawaii is slightly different than in any of these individual locations. As Hawaii blowflies and fleshflies represent populations different from their ancestral (Asian, Australian, etc.) ones, sequences for a given species in Hawaii may likely differ from those reported thus far. Adding sequence data from such flies found in Hawaii, will be useful to compare these with already published sequences, especially if the sequences for a given species differ from previously reported ones. Therefore, the study is assuming that mtDNA regions will be similar but not identical from species in different locations and that isolation of mtDNA from larvae will be relatively straightforward.

In this pilot study, an organic extraction of mtDNA was made with single flies and single larva of Chrysomya megacephala and Sarcophaga ruficornis. Specific fragments of the cytochrome oxidase subunit one (COI) region of the mitochondrial DNA were amplified using polymerase chain reaction (PCR). Locations of primers used in this study were taken from Wells and Sperling et al 1999 – CI-J-2183 and CI-N-2659. Amplified sequences were obtained and sequenced at the Biotechnology CORE facility at the University of Hawaii Manoa Campus using two Applied Biosystems 377XL DNA Sequencers. Analysis of sequences were compared to Wells and other published sequences accessible online using the BLAST search engine of the National Center for Biotechnology Information. For each pair of species example, the amplified fragment was approximately 523 base pairs long in C. megacephala and approximately 498 base pairs long in S. ruficornis. Sequences are currently being analyzed, and a full report will be presented in the poster. Initial study indicates between 53 and 58 nucleotide changes between C. megacephala and S. ruficornis in this region. Sequences from the Hawaii specimen of C. megacephala were very similar but not identical to previously reported Chrysomya megacephala from Australia or South Africa, having 7 nucleotide differences. Preliminary sequence analysis and searches in GenBank with S. ruficornis indicated the closest relatives were Chrysomya norrisi and Lucilia adisoemartoi having 41 nucleotide differences each, from both species. Results obtained aid in the quick identification of sarcosaprophagous arthropods in estimation of postmortem interval (PMI). Mitochondrial DNA is a successful and valuable tool in the application of forensic science. This research was supported by USDE grant #P217A030070.

Mitochondrial DNA, Calliphorids, Sarcophagids

D50 Evaluation of Plastic Microdevices for Isolation of Sperm Cells From Sexual Assault Evidence

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After attending this presentation, attendees will learn the advantages and disadvantages of using plastic microdevices for isolation of sperm cells from sexual assault evidence as compared to glass microdevices and conventional differential extraction.

This presentation will impact the forensic community and/or humanity by exciting the forensic community with the possibility of improved analysis time, separation efficiency, and purity in a disposable microdevice that has the potential for integrating multiple processing steps. The prospect of dramatically reducing the rape kit backlog will be especially appealing.

Differential extraction, the conventional method for isolating male and female fractions of DNA from sexual assault evidence, is a time-consuming sample preparation step in forensic DNA analysis. The goal is to develop a means to reduce the time associated with isolation of the male and female DNA fractions, while maintaining or improving the recovery and purity. The means through which it is proposed the goal is achieved by the use of microfabricated glass and plastic devices for separation of male and female cells.

The brief record that exists for miniaturization of analytical processes on microchip platforms has demonstrated reductions in analysis time (versus conventional methods) with no loss of analytical capability. Microchips also provide the potential for integrating multiple processing steps in a single device and automating the processes. Since differential extraction is only one of a sequence of processes required for forensic DNA analysis, replacing it with a microdevice method provides a distinct

advantage in the path toward integration of multiple sample preparation steps (DNA extraction, DNA quantitation, and PCR amplification) on a single device. In addition and not insignificantly, microchips can be designed to accommodate parallel processing of both the male and female DNA fractions.

The centrifugation and filtration steps associated with conventional differential extraction prevent its direct translation to the microchip format. Thus, a novel method for obtaining isolated male and female fractions of DNA on a microfabricated device was developed and involved separating the sperm cells from mixtures of sperm and epithelial cells as would be recovered from sexual assault evidence. The DNA from each cell type can then be extracted independently, allowing separate male and female DNA fractions to be obtained.

The separation or "cell sorting" developed exploits differential physical properties between the two cell types such as buoyant density, size, shape, and proclivity for adsorption to the microchannel surface. In an etched glass microchannel sperm cells could be transported to an outlet reservoir while the epithelial cells were retained in an inlet reservoir by application of a volumetric flow rate of approximately 1 nL/sec, or about 1.6 sperm/sec, provided by a mechanical pump. Experiments employ digital video microscopy to visualize the cell separation and demonstrate the purity and efficiency of the process.

The use of plastic microfluidic devices was explored in an effort to make lab-on-a-chip technology more affordable, and to provide the possibility of disposable devices. Disposable, single-use devices are of interest in forensic applications because they eliminate cross-contamination between samples. The cell separation and free DNA separation techniques developed for glass microfluidic devices were tested on plastic microfluidic devices. Initial tests indicated that plastic devices were sufficient for this purpose, but experiments were carried out to determine the cell separation efficiency and purity.

Here the characterization of plastic microdevices with respect to cell separation efficiency and purity is presented. The purity of the fractions was assessed not only through digital video microscopy but also by short tandem repeat analysis, the method used for genetic identification in forensic analysis. Each fraction should show a single-donor DNA profile if the cell separation is successful. More realistic samples that have lower numbers of sperm and have been dried over a set aging period were also introduced. Any additional techniques developed for the glass microdevices have also been translated to the plastic microchips.

Microfluidic Device, Vaginal Swab, Sexual Assault

D51 Reduction or Elimination of Observed Reproducible Artifacts in the AmpF*I*STR® Identifiler® PCR Amplification Kit

Natasha E. Coyle, PhD, Mitra S. Reynoso, MSc, Dana K. Zugg, BA, Kathy Wang, MSc, Sally L. Shen, BSc, Darci E. Whitley, BSc, Lin Lin Huang, BSc, Chu-An Chang, PhD, John R. VanCamp, PhD; and Grace M. Lee, PhD, Applied Biosystems, 1001 Lincoln Centre Drive, Foster City, CA 94404*

After attending this presentation, attendees will have an increased understanding of the continual efforts of Applied Biosytems to improve the quality of their products used by forensic community at a technical level.

This presentation will impact the forensic community and/or humanity by demonstrating how the forensic community will benefit from an understanding of both the steps taken to improve the performance of the AmpF*I*STR® Identifiler® PCR Amplification Kit, and the subsequent studies to validate the kits produced with the updated manufacturing procedure.

This presentation will discuss the reduction or elimination of observed VIC® and PET® artifacts in the AmpFISTR® Identifiler® PCR Amplification Kit, and the subsequent validation study of the updated kit. The Identifiler® kit is a STR multiplex assay that amplifies 15 tetranucleotide repeat loci and the gender determining marker, Amelogenin in a single PCR amplification. Loci are genotyped using the Identifiler® Allelic Ladder after running samples on an ABI PRISM® Genetic Analyzer. The Identifiler® kit is widely used in both forensic and paternity applications.

Within the Identifiler® Kit, a VIC® dye labeled artifact was observed at approximately 120 bps, within the range of the D3S1358 loci. PET ®dye labeled artifacts were observed between the Amelogenin and the D5S818 loci at approximately 110 to 130 bps. These artifacts were reproducible and could be detected as labeled alleles or off ladder alleles (OL Alleles) during data analysis. In order to reduce or eliminate these artifacts, modifications were made in the manufacturing process of the Identifiler® Kit (PN 4322288) effective from lot number 0310018 onwards. These modifications reduced the artifacts observed in analyzed samples amplified with the PET® dye and VIC® dye labeled primers, without compromising the performance of the Identifiler® Kit.

In order to address the PET® dye artifacts, a modification in the manufacturing process of the PET® primers was introduced, which importantly, did not alter the PET® dye primer sequences. Non-nucleotide linkers, which enable reproducible positioning of the alleles to facilitate inter-locus spacing, are used in primer synthesis between the primer oligonucleotides and the dye. The PET® dye artifacts were observed to be correlated with the use of a particular non-nucleotide linker and therefore it was possible to diminish the appearance of the artifact by using a different non-nucleotide linker during synthesis of the PET® dye labeled primers.

In order to address the VIC® dye labeled artifact, an additional step was introduced into the purification process of the VIC® dye labeled primers. This resulted in the significant reduction in the observation of VIC® dye artifacts.

For the Identifiler® Kit produced with the updated manufacturing steps (lot number 0310018 onwards), validation studies were performed according to the DNA Advisory Board's "Quality Assurance Standards for Forensic DNA Testing" and the Scientific Working Group on DNA Analysis Methods "Revised Validation Guidelines: (July 10, 2003)" (Forensic Science Communications July 2004, V. 6, No.3). These studies specifically addressed sensitivity, stability, reproducibility, precision, and accuracy. In each instance the Identifiler® kit produced with the updated manufacturing steps performed comparably to the previous Identifiler® kit.

These minor modifications to the manufacturing process of the Identifiler® Kit, which were introduced in response to customer feedback, either significantly reduced or eliminated the observed reproducible artifacts. This facilitates the use of the Identifiler® kit for forensic casework involving mixed specimen samples and has led to an overall increase in customer satisfaction.

STR, Genotyping, Identifiler®

D52 Postmortem Multi-Slice Computed Tomography of Laryngeal Lesions: Forensic Applications

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The goal of this presentation is to provide a description of postmortem laryngeal lesions diagnosed by multi-slice computed tomography. This

presentation will impact the forensic community and/or humanity by providing an example of routine application of the multi-slice computed tomography in forensic sciences.

Background: Multi-slice computed tomography (MSCT) is uncommonly used in forensic pathology. This imaging technique was recently improved by technological innovations and has become an essential tool in the management of many pathologies. MSCT allows two or three-dimensional reconstructions, which can be helpful in traumatic pathologies.

Purpose: To evaluate the possible role of MSCT and elaborate a new imaging semeiology in forensic evaluation of laryngeal lesions.

Technique: Thirty-three forensic cases with laryngeal lesions were examined with a sixteen-detector rows CT (Sensation 16, Siemens). Manners of death studied were homicide, suicide, and accident. Anonymity of the deceased was preserved by wrapping corpses in two radiologically artefact-free body bags. Two-and three-dimensional post-processing (SSD (Surface Shaded Display) or VRT (Volume Rendering Technique)) were made in all cases. Image interpretation and reconstruction were performed by board-certified neuroradiologists and radiologists. In 22 cases, findings were verified by autopsy made by board-certified forensic pathologists who were blinded to image results. All three body cavities (cranium, thorax and abdomen) were examined. All these autopsies were made because of a judiciary decision. A retrospective correlation between imaging and autopsy results was performed in order to improve postmortem-imaging semeiology.

Results: Eight cases of laryngeal traumatisms were diagnosed. Causes of death in those cases were suicidal hanging (n=6 cases), suicidal gunshot wound (n=1 case) and accidental motor vehicle accident (n=1 case).

Different laryngeal abnormalities were found: fractures of both thyroid cartilage laminae, isolated fracture of one superior thyroid cartilage horn (distal or inferior thirds of the superior horn), isolated hyoid fracture of one greater horn, isolated luxation between one greater horn and hyoid body, combined fractures of the hyoid bone and thyroid cartilage. No fractures of the cricoid cartilage, or cervical spine were demonstrated.

Forensic vital signs such as air embolism, subcutaneous emphysema, haemorrhage at fractures sites, and pulmonary aspiration were diagnosed.

Radiological pitfalls were encountered; some of them can be misinterpreted as fractures or laryngeal lesions and consequently have to be known by radiologists. The synchondrosis between the greater horn and the body of the hyoid bone may easily simulate a fracture. The heterogeneous calcification of the thyroid cartilage may mimic a lamina fracture. The incomplete and heterogeneous calcification of posterior extremities of the greater hyoid horns may also simulate a fracture. Cartilago triticea are potentially confusing points that may encounter in the assessment of possible fractures of neck structures. They may undergo calcification or ossification and may simulate fractures of the upper ends of the superior cornua of the thyroid cartilage.

Three-dimensional reconstructions were helpful, especially in cases of anatomical variations. One variation in the anatomy of the superior cornua of the thyroid cartilage was diagnosed: the bilateral medial deviation of the superior cornua, which is known to increase throughout life. The authors found a case of stylo-hyoid ligament calcification. Three-dimensional reconstructions are more useful than two dimensional in the assessment of laryngeal lesions and anatomical variation of the thyroid cartilage.

Conclusion: Autopsy is the gold standard examination for the determination of causes of death. Nevertheless, it seems that MSCT has a great potential in forensic sciences. It is much more sensitive than classical X-rays in the diagnosis of bone or cartilaginous traumatic lesions. Furthermore, it allows a non-traumatic diagnosis of soft tissues and organs lesions, with no risk of lesions destruction. Even if it is not question of substitution, MSCT must be considered as a complementary technique, as far as it is performed by a radiologist with a good knowledge of medicolegal issues.

Computed Tomography, Postmortem, Larynx

D53 A Computer Program for Calculating Forensic Population Study Parameters of STR Loci

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The goal of this presentation is to provide a program to help calculate a wide range of forensic population parameters and a FPP (false positive parentage) rate. This presentation will impact the forensic community and/or humanity by making the population study more efficient and provide an easy way to evaluate the false positive parentage rate to avoid false identification, especially for DNA database operation.

The computer program (STRstatistics 2005.1) is presented, which is capable of calculating a wide range of commonly used forensic population study parameters. These include: p value of G-tests for HWE proportion; the number of types of a particular allele; the occurrence frequency of alleles, expected and observed heterozygosity (H); polymorphism information content (PIC); power of discrimination (PD); probability of a match (PM); power of exclusion (PE) for trio and duo paternity tests; typical paternity index (PIt) and typical power of exclusion (PEt). The evaluation of data by these means is frequently a requirement in forensic practice, particularly when examining a new population.

At present, there are limitations to the computer programs that are available for forensic population studies, such as locus by locus handling (rather than batch handling), limited sample volume, and data format transformation. Many other genetic processing related computer programs were not designed exclusively for forensic evaluation of population study and therefore only provide analysis for a few forensic population parameters, therefore requiring additional calculation tools to be used. The STRstatistics 2005.1 program runs on the basis of the initial STR data such as that directly imported from Applied Biosystems Genotyper® software as well as an Excel format or by manual addition. Microsoft® Excel® Macros and built-in functions controlled by Visual Basic language written by the authors was used to handle the Hardy-Weingberg test and other forensic calculations. The application requires only that the users post or import their 15 STR genotypes from a population onto a Microsoft® Excel® worksheet, then press the hot key to activate the Macros. The allele frequency and forensic parameter table will be generated ready for publishing or for use as a population database. The program is capable of handling data of 1,000 individuals and 15 loci simultaneously, from which the informative forensic parameters will be tabulated automatically. The "STRstatistics 2005.1" Microsoft® Excel® template contains several worksheets. The "ori STR" worksheet provides brief instructions for using the template, and describes some limitations of the template. The genotype data for 15 STR loci, which comprises 30 columns with 2 columns for each locus, may be pasted onto the "ori STR" worksheet. Up to 40 alleles for each locus are acceptable. Genotypes containing text alleles (e.g., nc or 9.x) or with more than 2 alleles will be treated as in text (nonnumeric) mode and ignored in the auto-run program analyses. The final results table is produced as "publish tab" but can be modified manually by users to meet the required formats for publication. The program is freely available to any forensic scientist interested. Please e-mail requests to the corresponding author.

Forensic Science, STRs, Population Study

D54 Justice Delayed But Not Denied - The Evidence Solved the Case

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Attendees will gain a greater understanding of the importance of the proper preservation and secure custody of items that may someday be evidence in violent crime investigations, even many years later.

This presentation will impact the forensic community and/or humanity by providing a greater understanding of the value of teamwork between the many disciplines that work together to solve cases and prosecute the guilty, as well as offer hope to those who seek justice.

Like many young people in New Zealand, Sandra wanted to travel abroad before she settled down in her career as a nurse. She started out on her solo trip in the state of Virginia then hitchhiked to Panama City, Florida. Her next destination was to be a youth hostel in New Orleans where she would renew her visa then travel to Colorado. She rose early on November 10, 1981, packed her belongings and walked to the highway to hitch a ride. She was picked up quickly by a black male in his 30s. Sandra was not familiar with the dangers of hitchhiking and did not realize they were headed in the wrong direction. The man turned off of the interstate in a rural area in Leon County and told her he wanted to drop off a package at a friend's house. Sandra asked him to stop the car so she could stay near the highway to get another ride. He kept driving and assured her it would be a quick stop. He turned down the first road he came to and appeared to be looking for an address. When he got to the end of the road, he turned around and drove his car deep into a wooded area. It quickly became clear that the subject intended to rape her. She tried to resist and escape but she was struck repeatedly. After the sexual assault, the subject tried to strangle her with the straps of her overalls. The last thing she remembered was kicking the windshield with her foot and seeing it crack. When she woke up, she was alone and bleeding. A broken tree limb and a cement slab that was covered with her blood were lying next to her head. She held her hands over her bleeding face and managed to make it more than 600 feet back to the road. A passing car slowed down and the driver said he would go and call the sheriff. The deputies and paramedics arrived quickly and the victim was transported to the hospital. The author was summoned as the lead detective was told the victim was probably not going to make it. Hinman was directed to go to the hospital and get as much information as possible before she died. An experienced detective is used to seeing horrible injuries but this case was different, the victim was alive. Her face appeared to be broken in half and most of her teeth were smashed off at the gums, but she was awake and she was talking.

In the days that followed the attack, the author returned to the hospital to question Sandra on a daily basis, but there was little more she could tell. When Sandra left for New Zealand all the only evidence was a composite of the offender, a positive identification from an automobile book that the car was an Oldsmobile, Tornado and several bags containing evidence of the crime.

Eventually, all leads went cold. As the years passed, the author thought often of the New Zealand girl. As the author's advanced career, Hinman wondered whether scientific advancements and/or additional subsequent training and experience could be used to solve her case. It was believed that the offender would most likely commit other violent crimes.

Fortunately, the original crime scene investigation had been thorough and the evidence documented and preserved. Knowing the recent enhancements in DNA technology and Databases, the crime scene evidence was transferred to the FDLE crime lab for reexamination, in October 1999, 17 years after the crime had been committed and before DNA analysis was available to Law Enforcement. It was not surprising when Mr. Dave Coffman, the DNA Database supervisor for FDLE notified the author that a CODIS hit had identified Willie Oliver as a DNA match to the evidence that was submitted for the New Zealand girl. Further investigation tied Oliver to the crime, supporting the DNA identification.

Through the professionalism, hard work, and dedication of everyone involved in every stage of this investigation, Willie Oliver was finally successfully prosecuted and convicted by a jury of his peers in Tallahassee in July 2004.

Violent Crime, Profiling, DNA Database

D55 Predictive Interdiction Analysis on the Southwest Border of the United States

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After attending this presentation, attendees will have an understanding of the current methods and techniques used by the United States Border Patrol in their mission to safeguard America's frontline. Attendees will also be introduced to innovative computer programs that enable agents to do their job more efficiently.

This presentation will impact the forensic community and/or humanity by demonstrating the use of geospatial technology to predict interdiction points and routes used by alien smugglers after a border incursion.

The International Border that separates the United States from Mexico has long been a conduit of illegal activity into the United States. In the wake of 9/11, directors and decision makers have explored ways to control the daily influx of undocumented aliens seeking passage into the United States. This research study examines the operational use of Geographic Information Systems and computer-aided tracking systems to thwart future incursions through our borders. This study develops a terrain analysis model, which is integrated with the Border Patrol's Sensor System. The Geographic Information System then predicts the travel times and routes used by alien smugglers based on the terrain analysis model and preexisting trail structure.

Undocumented Aliens, GIS, U.S. Border Patrol

D56 They Would Have Survived With Fastened Seat Belts! Should Restraint Systems be Installed in Minibuses and Coaches?

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Attendees will be presented with results of the examination of this accident in question as well as the studies of Schuller, who examined the injuries caused by passengers who were thrown against victims sitting in front of them. This presentation will emphasise the demand for restraint systems in minibuses and coaches.

Every year, especially during winter or summer holiday, bus accidents are the subject of newspaper headlines in Europe. Although bus accidents are rare, they attract the interest of many people because often many victims are to be deplored.

Year by year security standards of minibuses and coaches as well as the qualification of bus drivers are discussed. In the European community the absence of standardization of technical equipment in busses and training of bus drivers are deplorable. For this reason the *Commission of the European Communities* presented a "Proposal for a directive of the European Parliament and of the Council" to increase the security of minibuses and coaches. In all member states of the European Community, passenger cars have to be provided with restraint systems, whereas, the installation of these systems in minibuses and coaches is only required by law in a few member states.

The requirement for obligatory use of safety belts in all vehicles is based on studies of "ECBOS" *(ECBOS, Enhanced coach and Bus Occupant Safety* - http://www.dsd.at/data/home.htm). ECBOS found out,

that *"annually, an average of 150 passengers travelling in coaches and minibuses are killed and more than 30,000 persons are injured in road accidents throughout the European Union*."

The majority of mechanisms leading to fatal injuries were:

- Passengers were thrown around within the confines of the vehicle.
- Passengers were ejected from the vehicle through broken windows.

In summer 2003 the circumstances of a bus accident on the "Autobahn" near Halle were examined. In the early morning in August 2003 the bus drifted slowly to the right side, broke the guardrail of the autobahn, overturned on the side and slipped 200m. Although the confine of the bus was not seriously distorted five passengers (two teenagers and three senior citizens) died at the scene of the accident and 19 victims (including the bus driver) were seriously injured.

The autopsy performed in the Institute of Forensic Medicine lead to the following results:

- Three passengers died of suffocation caused by thorax compression, two passengers died of intrathoracic hemorrhage, one in combination with rupture of the brain stem.
- Damage to the clothes as well as abrasions of the skin of the victims proved, that the victims were ejected from the vehicle and overrun by the sliding bus.
- They all could have survived this accident with fastened seat belts.

These results as well as the studies of Schuller place emphasis on the demand for restraint systems in minibuses and coaches.

Restraint Systems, Busses, Thorax Compression

D57 Complete and Partial Decapitations in Suicidal Hangings: Two New Cases

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After attending this presentation, attendees will understand that suicidal hanging is one of the most common methods used in masculine suicides and the second one for women. In a few rare cases, hanging leads to a beheading. Two new cases are presented to illustrate this rare eventuality.

This presentation will impact the forensic community and/or humanity by reviewing literature, which demonstrates that hanging / beheading is exceptional. The promoting factors would be falls from high points, complete hangings, use of thin stretchable links and heavier bodies. These circumstances are rare, and in the authors' opinion an autopsy should be systematically performed to assess the forensic context.

First case (Clermont-Ferrand): the body of a 57-years-old man was found near a railroad, beheaded after a precipitation from a high bridge owned by the French railway society. The height was estimated from 8.80 meters to 10 meters; the weight of the body was about 80 kg. The subject is suspected to have jumped off the bridge with a twined nylon rope tied up around his neck. This rope was 5 meters long and 1.6 cm large. The head and his body were separated from a distance of about 1 m. They were both found under the bridge surrounded by multiple tracks of blood on both ground and walls.

The autopsy showed two different edges of section (head and neck) separated by a left circular abrasion in relation to the rope stretch. The position of the knot and its progression towards the head were clarified by investigations. Nylon fibers found on both sides of sections were strictly identical to those belonging to the link.

Second case (Montpellier): the body of a 35-years-old man with a thin corpulence was found hanged to a beam situated 3 meters from the ground; the feet were hardly touching the ground. In the surroundings, no suspect evidences were found to assess a criminal hanging. After having taking the body down, it turned out that the cephalic extremity was quite close to being removed from the body. It was shown that the head was still connected to the body by some posterior muscles of the neck. The examination found no traces of violence. The autopsy revealed signs of gaseous embolism, signing the vital origin of the beheading. The section of the cervical wound found very fine lines corresponding exactly to the distance between the different strands of the rope, confirming its action during hanging.

Beheading, Hanging, Suicide

D58 Hanging by a Hair: Animal-Derived Trace Evidence in Criminal Investigations

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The goal of this presentation is to build awareness in the forensic community that animal-derived trace evidence can play a significant role in criminal investigation. Identification of individual animals with animal hairs, using DNA tools and databases existing today, can show a compelling link between a victim and a suspect.

Pets are ubiquitous and leave their biological traces everywhere. This presentation will impact the forensic community and/or humanity by raising awareness of the power of new methods for identification and hence broaden the tools for the investigation of crime scenes. Rather than presenting this talk in the DNA section, it is important that the first and second responders to a crime scene (crime scene teams and trace evidence examiners) hear about these cases firsthand.

Microscopic examination has long been the only tool for establishing a "match" for animal hairs found at crime scenes. DNA identification of hairs, using microsatellites and mitochondrial DNA, provides more precise identification and may be useful in linking a suspect to a victim or crime scene.

Animal hair from pets is a common finding in crime scene investigations. In the cases described, observant investigators collected animal hairs as evidence. Matching those hairs to the pet of the suspect or victim, however, required specialized analysis. The physical similarity of animal hairs, while useful, is often not conclusive. Hairs from the same dog or cat can vary depending on hair type (guard or fur hair) and body location. DNA analysis of animal hairs provides a more accurate means of identification and, using DNA information databases, provides an estimate of the significance of a DNA match. Like humans, animal hairs can be tested with species-specific microsatellites and mitochondrial analysis (Mt haplotyping). The following cases are examples of mitochondrial typing of animal hair trace evidence:

In 2002, 8-year-old Danielle van Dam was abducted from her home in San Diego. Her body was recovered days later in a remote area. The police suspected the van Dam's neighbor, David Westerfeld, and searched his home and motor home, where they thought Danielle was murdered. Among other important evidence, investigators collected short dog hairs on the carpet of the motor home and in the lint trap of Westerfeld's dryer. The hairs were a violet-hued gray, a color unique to the Weimeraner dog breed. The van Dam's owned a Weimeraner dog, and indicated that Danielle frequently cuddled with the dog before bedtime. A DNA match, using mitochondrial analysis, was found between the van Dam's dog and the hairs from the alleged crime scene. Although the mitochondrial haplotype was fairly common (9%), the findings did not exclude Westerfeld as a suspect and aided prosecutors in their case.

In 1987, 10-year-old Amy Schulz of Jefferson County, Illinois was abducted, brutally sexually assaulted, and murdered. A number of black

dog hairs were recovered from Amy's clothing as well as a single human pubic hair. Cecil Sutherland, a resident in the town, was later arrested. Sutherland owned a black Labrador Retriever. The hair evidence could not be used, as the DNA techniques available at the time required other sample types. Sutherland was convicted of Amy's murder in 1989 but the conviction was overturned. In 2003, prosecutors re-opened the case and mitochondrial analysis was performed on the human hair and the dog hairs. The DNA from the human hair included Cecil Sutherland and the DNA from the dog hairs included his dog. In June 2004, Cecil Sutherland was convicted of first-degree murder a second time and requested the death penalty.

In crime between strangers or non-family members, such as abductions, the utility of animal hairs as evidence should be obvious. However, important animal-derived evidence may be found even in crimes between acquaintances or family members. In 2002, Andrew Rich pleaded guilty to voluntary manslaughter of a friend, John Helbe in Johnson County, Iowa. Rich had stolen an ammunition box from Helbe and, when found by police, it contained a single dog hair matching a dog owned by Helbe. Compelled to account for possessing his friend's ammunition box, he plea-bargained.

For years, trace evidence examiners have relied on the microscopic similarity of animal hairs to use them as evidence. DNA typing of hairs opens new possibilities for linking suspects to crime scenes or victims. Pets can be identified, occasionally with the precision provided by microsatellite testing. Although mitochondrial typing cannot be used as a unique identifier, a mitochondrial inclusion can be valuable in developing a case or as "another piece of the puzzle" at trial. Pets leave hair everywhere; it is up to investigators to evaluate its relevance and shape its significance with appropriate questions. Trace evidence examiners should assist their crime scene teams by raising awareness of this new evidence resource.

Animal Hair, Trace Evidence, DNA Typing

D59 New Developments From the National Clearinghouse for Science, Technology, and the Law

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Attendees will gain knowledge of the forensic science information resource guide compiled by the Clearinghouse, as well as numerous continuing education tools and training materials the Clearinghouse is working on.

This presentation will impact the forensic community and/or humanity by informing the forensic community of the current (and future) projects at the National Clearinghouse for Science, Technology, and Law so they can become involved in ongoing continuing education and training and utilize the existing resource guide and reference collection as appropriate.

New challenges for expert witnesses and the legal community have arisen due to recent developments in science and technology. New technologies and methodologies, as well as fields long considered established, such as latent print identification and tool marks are facing increased scrutiny. Given this explosion of scientific evidence litigation, scientists, law enforcement, laboratory personnel, judges, and lawyers are overwhelmed by the amount of information required to educate them to meet these legal challenges.

Until now, judges, lawyers, scientists, and law enforcement personnel did not have one source that allowed them to navigate all the existing case law, journals, reports, proceedings, and other resources necessary to conduct effective investigations and litigation. The *Resource Guide for Users of Science and Technology* was created to fill an information need specifically relating to legal issues implicated by the use of new technology in criminal and civil justice. Supported by a joint cooperative agreement between the NFSTC and NIJ (#2000-RC-CX-K001), the project developed a comprehensive searchable database from a variety of sources covering a wide range of topics. The database provides information on topics such as bloodstain pattern analysis, body scans/retinal scans, digital image enhancement, entomology, expert witness malpractice, fingerprints, questioned documents, smart cards, trace evidence, and tool marks. The Resource Guide covers existing court rulings, pending court cases, scientific and legal articles from applicable sources, relevant information from books, current and pending legislation, conference proceedings, university and continuing education courses, and pronouncements from professional organizations. The NFSTC/NIJ project produced a searchable CD. The information contained in the Resource Guide will be included in and expanded upon in the online resource being developed by the National Clearinghouse on Science, Technology and the Law at Stetson University College of Law. The Clearinghouse is supported by a grant from the National Institute of Justice (#2003-IJ-CX-K024).

In addition to the development of the online resource, the Clearinghouse is building partnerships with law schools, professional associations, and federal agencies, sponsoring a forensic science/science and technology seminar series, convening Community Acceptance panels at the request of NIJ, sponsoring the National Conference on Science, Technology and the Law with various forensic science and legal organizations, developing training modules with an emphasis on distance education, and building a reference collection of law, science and technology literature available through interlibrary loan to other institutions.

Science, Technology, Law

D60 A New Method to Assist in the Rapid Identification of Unknown Bodies Utilizing a Nationwide Database of Specialized Forensic Data

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The goal of this presentation is to familiarize the non-dentist attendee with a new computer program to assist in the rapid identification of unknown bodies utilizing a nationwide database forensic data. The attendees will be introduced to a client/server-based system that securely links to a national database of forensic odontological data to assist in possible identification.

Following this presentation the attendee will understand the model for establishing and linking multiple law enforcement institutions to access and utilize forensic odontological data and the importance of collecting this data during a missing persons or unknown body forensic investigation.

The linking of local forensic databases to a national or international database has created a powerful tool in the rapid identification of unknown bodies. Database of fingerprint or DNA information has matured over the last 20 years and have provided invaluable in assisting in this identification. Unfortunately, both have some severe limitations. Fingerprints require that fingers are present and that the body has not decayed to the point of making the print unreadable. DNA information is far more reliable but is limited by the difficulty in creating an antemortem or postmortem database and currently requires a specialized laboratory and far more time to perform reliably. Forensic odontological data is easy to obtain and easy to utilized but there is currently no available system that can link local officials to a national or international database.

Dr. James McGivney's WinID8 dental identification program has been the gold standard used by forensic odontologist's for many years for mass disaster. Its usefulness has been well documented but is limited to

local crime scenes. Query Analyzer for WinID8 (QA For WinID8) has been designed from the ground up as a client/server based system to selectively match local data to a national or international database allowing for the creation of worldwide clearinghouse for forensic data. Its algorithms make extensive use of the filters, which in computer jargon are referred to as queries, and are designed to reduce the number of possible matches by eliminating "unexplainable discrepancies." Because of the universality of the Standard Query Language (SQL), the method QA for WinID8 uses to filters information, it allows for an easy method to bridge with other database programs. This filtering is done automatically by QA For WinID8 and therefore does not require any knowledge of the SQL.

The purpose of this presentation is to familiarize the non-dentist in the use of this program and to aid them in setting up a nationwide database of odontologic data. It will describe a mechanism whereby local law enforcement agencies will have the capability to attempt to find possible matches of unknown bodies or missing persons with antemortem information against a national database. Finally by presenting this lecture in the General Section it will emphasis the importance of obtaining this information as standard operating procedure when local law enforcement officials collect evidence for a missing person or when attempting to identify an unknown body.

Computer Program, Forensic Identification, Mass Disasters

D61 Development of a Child Fatality Review Database for Maryland: A Practical Application of Forensic Medicine and Public Health Partnership

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After attending this presentation, attendees will understand the rationale for and methods employed by a forensic medicine-public health partnership in developing a statewide child fatality review database.

This presentation will impact the forensic community and/or humanity by helping members of the forensic community recognize the importance of their professional contributions to CFR as well as the benefits of using partnerships to create data systems and data sharing opportunities.

Multidisciplinary child fatality review (CFR) teams can make important contributions to understanding of sudden and unexpected child deaths, and aid efforts to prevent both unintentional (*accidental*) and intentional child injury (child abuse, shaken baby syndrome, etc). Although medical examiners and forensic investigators frequently contribute information and make valuable professional contributions to CFR teams, they have been slow to assume an advisory or coordinating role in the initiative. In Maryland, which has a statewide medical examiner system and an unfunded legislative mandate to establish CFR teams in all counties, the potential of partnership to enhance the quality of data available to CFR teams is being explored. This presentation will discuss the conceptual development and structure of the database.

Although much attention is paid to the development of data collection protocols for CFR, less attention has been given to the management, retrieval, and analysis of data. The quality, timeliness and accessibility of data determine their utility for systems improvement and development of prevention efforts (including policy). In developing a data system for Maryland, the State CFR Team and its Data Advisory Committee prioritized data content and data systems criteria. Data content criteria included: asking the right questions, identifying modifiable risk (and protective) factors, integration of multidisciplinary perspectives, data validation and completion, collection of CFR team management and decision making data, potential for analysis and application. Data system criteria included: protecting existence and sustainability of the database, limiting costs, limiting duplication of data collection, minimizing hardware and computer expertise required by each county, simplifying data sharing, maximizing potential to customize reports by county, data timeliness and protecting confidentiality.

The database is housed in the Office of the Chief Medical Examiner (OCME), because the partnership believed this to be the agency for which collection of high quality data on child death is a critical professional function. In addition, it is an agency that interacts on a regular basis with many agencies and organizations involved in child death investigation. OCME was in the process of building a new data system and had a strong record of partnership with public health and research organizations.

A core team was established to guide development of the database. This team includes the chief medical examiner; an assistant medical examiner with expertise in pediatric pathology, child abuse and CFR; the chief forensic investigator, a public health professional with expertise in CFR, injury prevention research, and policy development; a database development expert who is a Microsoft Certified Systems Engineer and active fire-fighter/EMT, and two graduate computer science students.

Database variables were developed using review of national CFR data recommendations, the literature on child death and injury, archived CFR case report materials, as well as state and local CFR team input. The database was created using a widely accepted standard of SQL Server (Microsoft Windows SQL). It utilizes a standard web-based client and a single-server base with multiple thin-net clients (who do not need individual hardware) to allow the counties of Maryland to access data for deaths occurring in their counties. For subpoena protection, the CFR database is a stand-alone component of the OCME data system. Case identification is in real-time but detailed OCME data (toxicology, autopsy findings, etc) are transferred into the CFR database later in the investigation. CFR teams may access these data during case reviews and are able to enter their additional review data directly into the CFR database. To facilitate use of data, pre-programmed child fatality reports - that can be customized for individual counties – are available as part of the database. To promote data accuracy and completion, extensive use is made of variable lists and directory trees. The database is designed to be user-friendly, and accessible via the internet, while addressing ethical challenges such as the preservation of confidentiality. Confidentiality is protected by using SQL authentication user-names and passwords; administrative protocols provide additional access control. The system is currently being pilot tested by a local CFR team in a large metropolitan county.

Database, Child Death, Partnership

D62 Alternate Light Source (ALS) for Examination of Stains on Multi-Colored Textile

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After attending this presentation, attendees will understand the procedure for examining stained textiles with an alternate light source (ALS); understand the results of examining stained areas on dark multi-colored carpet; and understand the advantages and disadvantages of using an ALS to locate stains. This presentation will impact the forensic community and/or humanity by demonstrating to forensic scientists types of stains on textiles that are detectable using an alternate light source.

The purpose of this presentation is to present the results of an experiment that evaluated the use of an ALS for locating sixty stained areas on dark multi-colored carpet. The examination was conducted with both direct and oblique white light at 30 cm and five different wavelengths using

a 400-watt ALS with direct illumination at distances of 10 cm (3.94 in), 20 cm (7.87 in), and 30 cm. (11.81in).

An important factor in conducting crime scene investigations is locating trace evidence. To facilitate searching for trace evidence, investigators use an ALS. Trace evidence, such as physiological stains, may be common on textiles. However, the investigator may also locate stains from other origins. Once a stain is located it may be collected, analyzed and identified.

Sample pieces of carpet measuring 91.44 cm (36 in) by 91.44 cm (36 in) were marked into grids 15.24 cm (6 in) by 15.24 cm (6 in) for staining. Sixty common products were selected to stain the carpet to determine their visibility with an ALS. Each section was stained and marked for identification with a known product. The stains were allowed to dry for two hours before testing and then separated into two groups for analysis. Thirty were food products and thirty were nonfood products. The detection levels were noted if the product absorbed or fluoresced light and made the stain visible.

The stains were illuminated with direct white light, oblique white light at 30 cm (11.81 in), 365 nm UV with no filter, 365 nm UV with yellow filter, 415 nm with orange filter, 415 nm with red filter, 445 nm with orange filter, 445 nm with red filter, 515 nm with orange filter, 515 nm with red filter, shortpass 540 nm with orange filter, and a shortpass 540 with red filter at three distances. The stains were examined at distances of 10 cm (3.94 in), 20 cm (7.87 in), and 30 cm. (11.81).

Of the sixty stains examined, 25% (15) were visible in direct white light and 23% (14) were visible in white oblique lighting. Of the thirty food product stains examined, 40% (12) were visible in direct white light and 30% (9) were visible in white oblique light. Of the thirty nonfood product stains examined, 10% (3) were visible in direct white light and 16% (5) were visible in white oblique light. Considering the combination of light wavelengths and filters used to examine the sixty stains, the 365 nm UV light with no filter at a distance of 10 cm (3.94 in) and 20 cm (7.87 in) located the most stains. This combination located 26% (16) of the stains. Of the thirty food stains examined at a distance of 30 cm (11.81in), no stains were visible with the following combination of light wavelengths and filters: 415 nm light with an orange filter, 415 nm light with a red filter, 515 nm light with an orange filter and a shortpass 540 nm light with a red filter.

In conclusion, of the sixty stains examined, 50% (30) that were not detected by direct or oblique lighting also were not detected by any combination of light wavelengths and filters. When separated into food and nonfood stain categories, 56% (17) of the food stains that were not detected by direct or oblique lighting also were not detected by any combination of light wavelengths and filters. 46% (14) of the nonfood stains that were not detected by direct or oblique lighting also were not detected by any combination of light wavelengths and filters. Therefore the 365 nm UV light with no filter at distances of 10 cm (3.94 in) and 20 cm (7.87 in) performed best in detecting non-physiological stains on multi-colored carpet. Even though the ALS may be more preferable for locating physiological stains it can be useful in locating some food and nonfood product stains.

Alternate Light Source, Trace Evidence, Stains

D63 The Invisible Sentry: The Use of Radiation Imaging for Border Control

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After attending this presentation, attendees will understand security measurements with X-rays; technique, possibilities, and risks.

Security at airports, international borders, and government buildings are of general concern. Although measurements imposed may have consequences for individuals and society; they are little known. Techniques using ionizing radiation are explained. They are used with and without consent of the persons concerned. There is a conflict between the necessity of security on one hand, and the protection of privacy on the other. This presentation will impact the forensic community and/or humanity by informing the forensic community about new technical developments, their possibilities, problems, and risks.

At international borders and at internal control points, governmental control agencies are using x-ray and gamma rays to inspect and control not only persons, but also goods and the systems that transport them. Radiation systems employed range from conventional industrial x-rays through accelerators with 5 to 10 MeV energy through gamma ray units using sealed sources of cesium 137 or cobalt 60. Transmission (fluoroscopic) images and analysis of forward and backward radiation scatter are used. Transparency or fluoroscopy images show the object in question in superimposition upon its container and other contents. Computed tomography used for luggage inspection produces a digital image without superimposition. The identification of chemical components is possible by means of analysis of scatter radiation. The addition of a color palette by computer manipulation aids in identification of specific substances.

Explosives, transported in luggage or other carriers, can only be identified indirectly or suspected on transmission images. Double imaging or scatter systems, particularly if color can be added, can provide direct identification. Illegal transport of protected species can be detected by similar methods. Narcotics can be detected by radiologic inspection of luggage, where even a visual inspection might fail.

Sophisticated integrated systems for examining vehicles and their contents have been developed. Moving as well as stationary vehicles can be examined. Imaging systems for large vehicles and their contents have been developed elsewhere. Even China is producing a fluoroscopic system with a fixed detector and a movable source.

There are special restrictions and uses in some locations. In Germany exposure of food by x-rays or gamma rays is not allowed. The unit in the Port of Hamburg is operated so as to prevent the direct radiation exposure of people. Pamphlets and Internet information available from some manufacturers suggest they do not bother to prevent direct radiation exposure of human beings, such as truck drivers or passengers. Furthermore, the exposure of the equipment operator often is not discussed. New operators of the detection devices look for density where there should be voids, motion where there should be stillness, symmetry where there should be symmetry, and ominous silhouettes, particularly of weapons.

The body packer or mule smugglers carry drugs across borders in specially constructed packages to be carried hidden inside the body in the rectum, vagina or alimentary canal. The rectum and vagina are too easily accessible for search and discovery by manual means, so the alimentary canal has become the favored internal receptacle. The early drug packages were fairly primitive, using one or more layers of latex in the form of condoms, the finger of surgical gloves, or even toy balloons. Almost inevitably air was trapped between the layers of the latex, and these telltale crescentic shadows were easily detected by routine radiography or fluoroscopy. Those early packages were also susceptible to rupture or leakage with sometimes fatal results.

Smuggling of contraband materials on the body rather than inside has required a pat-down strip search, or body search. The recent development of backscatter imaging provides an excellent method of hands-off body search for external contraband. This system is capable of detecting metals (inorganic) materials such as wires of a bomb, gun, blades, etc., and can also detect plastic (organic) materials such as explosives and drugs. The radiation dose is low, comparable to a few minutes flight at 30,000 ft. in a commercial aircraft. In the United States individuals are given a choice of simply standing in front of the imaging device fully clothed, or undergoing a pat-down (in either case conducted by a member of the same sex). The suspect must consent to the search by radiation. It is said never to be used in secret in the United States. In other countries, there are reports that similar devices are used on unsuspecting travellers.

X-Ray in Airport Security, Detection of Explosives, X-Ray Exposure

D64 The Value of Comparison Mason Jars in Fire Debris Analysis

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Attendees will learn about the usefulness of comparison of mason jars in fire debris analysis. This presentation will impact the forensic community and/or humanity by demonstrating how routine analysis of comparison jars has provided this laboratory with a means for establishing background levels of ignitable liquids in Mason jars and a further context for understanding the significance of trace level identifications of ignitable liquids in case items.

The recommended packaging for fire debris at the Centre of Forensic Sciences is glass Mason jars. Since 1998, this laboratory has also recommended the submission of an unused comparison Mason jar for analysis to account for the storage and handling of the jars used to collect case items. A review of 651 cases from 2001 to 2003 was conducted to assess the usefulness of comparison Mason jars in headspace fire debris analysis.

An ignitable liquid was not identified in a comparison Mason jar above a trace level in any of the 651 cases reviewed. This laboratory defines a trace level as response greater than the analytical limit of detection (approximately 0.1µL of gasoline in a 1L glass Mason jar) and at a level near but above that of any background contributions from the debris material. A trace level of ignitable liquid vapor was identified in the comparison jar(s) of 57 cases (8.8%), including gasoline in 50 cases, medium petroleum distillate in 6 cases, and medium isoparaffinic product in 1 case. The percentage of cases in which a trace level of ignitable liquid was identified in a comparison jar has decreased over time from 13.7% in 2001, to 5.9% in 2002 and to 4.5% in 2003.

Cases were further reviewed when positive case item(s) (i.e., above trace) and a comparison jar were stored in the same box at the laboratory prior to analysis (146 of the 651 cases). This was done to address the possibility that trace levels of ignitable liquid vapors could cross-transfer between jars during storage. The comparison jar was negative in 105 of these cases, positive for the same class of ignitable liquid as the strongly positive item(s) in 39 cases, and positive for a different class of ignitable liquid than the strongly positive item(s) in 2 cases. In 16 of the remaining 505 cases, cross-transfer during storage at the laboratory could not account for the positive comparison jar result as it was stored in the same box as only negative case items and/or items in which only trace levels of ignitable liquids were identified.

Ignitable liquids were not identified in a comparison jar above a trace level in any of the 651 cases reviewed. Regardless of comparison jar results, when an ignitable liquid is identified at a trace level in a case item at this laboratory, a cautionary note has routinely been included in the report. This note emphasizes to investigators and the courts that when an ignitable liquid is identified in a case item at a trace level, the possibility that it is unrelated to the cause and spread of the fire should be considered. Routine analysis of comparison jars has provided this laboratory with a means for establishing background levels of ignitable liquids in Mason jars and a further context for understanding the significance of trace level identifications of ignitable liquids in case items.

Fire Debris, Packaging, Comparison Mason Jars

D65 The Good, the Bad and the Ugly: Challenges Faced by the Forensic Clinical Nurse Specialist During the Evidence Collection Process

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This presentation will impact the forensic community and/or humanity by identifying deficiencies that often occur in the process of evidence collection. Such deficiencies could be resolved through education and effective communication between professional disciplines. Improved evidence collection practices could contribute to successful outcomes in forensic investigations.

After attending this presentation, the audience will understand the challenges of the forensic clinical nurse specialist during the evidence collection process. Evidence collection referred to herein will not focus on evidence collected following sexual assault but rather evidence gathered from sources of physical injury, accident, or altercation.

Saving a life is, unquestionably, the highest priority when treating victims who have sustained serious physical injury. However, once the victim is stabilized it is important that forensic nurse specialists extend the course of patient care, holistically, to include evidence collection and documentation as a standard of practice.

The role of the forensic clinical nurse specialist includes the recognition, collection, and preservation of forensic evidence. This responsibility, however, does not come without challenges and sometimes, conflict. The evidence collection process may be barred by unforeseeable circumstances, lack of education or training, and breakdown of communication between professional disciplines.

Training received by a forensic nurse specialist in basic evidence collection should include how to recognize, document, and package evidence as well as how to maintain the chain of custody of evidence until it is turned over to law enforcement officers involved in the investigation. Without such training and without open communication between law enforcement agencies and clinical professionals, evidence collection policies and procedures can become clouded and confusing. Keeping in mind that the purpose of evidence collection is to help to support the facts or to dispel a theory in the course of a forensic investigation, those involved in the evidence collection process must remain neutral in opinion and allow the evidence to stand on its own in a court of law.

Situations that surround the evidence collection process may be considered by the forensic nurse specialist to be good, bad, or ugly. "Good" situations that enhance the evidence collection process would include treating the victim within a short period of time from the incident, eliciting an accurate account of information from the victim, using appropriate collection techniques, initiating and maintaining chain of custody, and recording clinical findings into the patient record. Having a forensic nurse specialist on staff in hospital emergency departments and trauma centers would positively result in desirable outcomes in the evidence collection process.

Evidence located within a reasonable period of time following an assault that is properly collected and preserved, would likely be in better condition for laboratory testing than evidence that was hastily collected or haphazardly stored. Further, laboratory examination and scientific interpretation of the properly secured evidence would provide useful findings for the investigation.

Situations considered as "bad" result in less desirable outcomes. Sometimes evidence may be cross contaminated or saturated by blood, bodily fluids, or other sources, making the evidence collection process more difficult. Environmental factors such as extreme heat, cold, humidity, rain, light, or darkness may also interfere with evidence preservation.

"Ugly" situations are the unfortunate circumstances that occur when evidence is present but not identified, preserved, or properly collected because of lack of training and resources. Untrained medical staff could unknowingly destroy, dispose of, or fail to collect evidence because they simply do not know how. Communication barriers between professional disciplines could add further "ugliness" to a case. Clinicians and law enforcement investigators need to work together and communicate about the desired evidence collection process. Understandably, law enforcement personnel are cautious about providing information about the crime scene while the investigation is ongoing. However, to work together effectively, it is necessary to agree upon evidence collection methods that are acceptable for each discipline and also for the laboratory that will be testing the items submitted.

In some jurisdictions, hospital staff may expect law enforcement officers to gather the evidence from the patient. In other jurisdictions, law enforcement may expect that the hospital staff will collect evidence ranging from victim's clothing to samples of blood, glass fragments, or debris. In other venues, a technician from a forensic laboratory may be called upon to gather the evidence. The forensic nurse specialist's role and qualifications, if not clearly defined and delineated, may be challenged by certain authorities rather than perceived as a resource.

The evidence collection process in the clinical setting will vary from one investigation to the next …from the good to the bad to the ugly. This presentation will identify ways to avoid ugly situations and discuss how to address the challenges faced by the Forensic Clinical Nurse Specialist. Case studies will be highlighted as examples.

Forensic Nursing, Evidence Collection, Law Enforcement

D66 Rethinking "Injury at Work": A Proposal for Revising Classification of the Occupational Contribution to Medicolegally Investigated Injury Deaths

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After attending this presentation, attendees will understand an alternative approach to classifying the contribution of occupational factors to injury death. Application of this of this rubric will increase the specificity of medical examiner data and facilitate the epidemiologic investigation of injury death including the development and evaluation of effective prevention strategies.

This presentation will impact the forensic community and/or humanity by initiating a dialogue about the feasibility of its application as well as provide an opportunity for revision by those who would be implementing it on a widespread basis. It is a system that is intended to increase the sensitivity of medical examiner data to identify instances where occupational exposure may have contributed to an injury death beyond the current guidelines provided by NAPHSIS yet afford ME's the ability to still complete the 'Injury At Work' on the death certificate. It is a tool for adding value to the data collected by medicolegal death investigation systems.

The National Association for Public Health Statistics and Information Systems (NAPHSIS) issues Operational Guidelines for Determination of Injury At Work. These are intended to facilitate the completion of the Injury At Work section of the Certificate of Death. Certain types of death are characterized as work-related and others are not. In contrast, the proposed rubric uses a graded approach to account for relative contribution of occupational factors to injury death.

Assessment of the contribution of work to an injury event is best viewed as a two-stage process. First, establish work-association using the 'but for' threshold test and then follow it with further gradation of the relationship. 'But for' means asking questions about antecedents ¾ the who, what, when, where, how and why's of the medicolegal death investigation. If 'but for' being engaged work or work being the reason why one is exposed to the hazard (e.g., commuting), the individual would have avoided the exposure to that particular hazard, then the death or injury event is termed work-associated.

Within work-associated, further characterization of the relationship between the injury event and work can be made using these questions. Completion of the questions yields a grade of work-association for the injury event. Ultimately, Grades V and IV should be comparable to what is currently coded as OTJ on the death certificate using the NAPHSIS guidelines.

At the outset, identify if the physical location of the injury event is an employment setting for the decedent, regardless of whether or not it is the primary site of employment or that of a second job. Having made that assessment and in the context of the activity the decedent was engaged in at the time of death:

1) Was the site of onset the usual place of employment? If yes, death is OTJ Grade V if event occurs during normal/usual days/hours of operation and/or the employer has an obligation for occupational safety f no or unknown, proceed to next question.

2) Was the decedent engaged in his/her usual occupation (was she/he performing her/his usual duties)? If yes, then death is OTJ Grade IV (especially if the decedent is working for his/her employer and/or for fiscal gain). If no or unknown, proceed to next question.

3) Was the decedent engaged in ANY activity for fiscal gain or benefit? If yes, then OTJ Grade III (regardless of who is the beneficiary and whether the effort results in monetary benefit or in-kind assets). If no or unknown, proceed to next question.

4) Did his/her employer consider the decedent on 'travel status'? If yes, then OTJ Grade II (regardless of the activity at the time of onset). If no or unknown, proceed to next question.

5) But for the nature/location of the decedent's work (and/or his/her efforts to honor that responsibility), would she/he have been at risk for onset of the fatal event? If yes, then OTJ Grade I (as having to be in that location at the time of onset as a function of fulfilling job responsibilities makes the event work-related). If no, then the death is not OTJ or work-related. If unknown at this point, place case in the undetermined category for work-association.

Implementation of this schema would find application in the medical examiner investigation of fatal injury events. Specific training (usage guidance) would need to be provided to local medical examiners to ensure adequate application of the rubric. The assessment of work-relatedness should be made independent of the ascertainment of cause and manner of death. Moreover, the assignment of work-related status should be independent of any assessment of employer liability for death benefit compensation. The emphasis in developing and employing this alternative way of classifying the contribution of work to fatal injury should be on the identification of common risk factors, followed by the development, implementation and evaluation of preventive measures.

Occupational, Fatal Injury, Death Classification

D67 Danger of Cellular Phone and Autopsy in Case of Death by Lures

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The goal of this presentation is to expose the dangers of handling not struck and/or damaged explosives during external examination on the accident scene and during autopsy.

This presentation will impact the forensic community and/or humanity by demonstrating the necessity to be very prudent in case of external examination and/or autopsy when damaged or not struck ammunitions or others cartridges are present in the corpse or around the scene. Secondly, in such cases, it is important and necessary for an intervention following the bomb disposal expert. Finally, prudence should be practiced with cellular phones!

Case-Report: A case of a young soldier is presented who was found dead after an explosion. He worked in a French military base, and transported explosive ammunition and lures.

Suddenly, an explosion occurred. Part of the ammunition exploded followed by other explosions. The blast projected the body several meters high, and according to parabolic trajectory, of about thirty meters. During the external examination on site, we discovered the cephalic impact on the top of the hangar, five meters higher. The victim's cell phone was discovered near the accident scene. This was a very significant because, in these kinds of dangerous areas very sensitive to electromagnetic waves, any cellular phone is prohibited. After external examination, the corpse was transported to the Forensic Service for autopsy. During radioscopy at autopsy, many parts of the ammunitions (cartridges, shell…) were found. Although damaged, many were not struck cartridges. All these components were embedded in the corpse. The damage was very impressive. All of the organs were destroyed and in pieces. It took considerable time to remove all the ammunition! The toxicological analyses were negative.

Hypothesis of mechanisms: The different hypotheses are:

- The cellular phone was responsible for the first explosion (electromagnetic waves)
- A mechanical release by a fall from 1.5 m height (falls by awkwardness for example)
- The building which had a metal structure could play a part like an antenna (not like a Faraday cage) with a release by an electrical current
- The presence of a radio operator transmitter with strong power (160 W) in the zone of the disaster
- The possible action of two radars which emitted in direction of the building.

The accident and consequences: The explosion of the ammunitions propelled the other ammunition that did not explode, but they were damaged, unstable, and very dangerous. They had become very sensitive to a shock, even the most insignificant.

They were also sensitive to electromagnetic waves, which happened to be emitting from cellular phones in the investigators' pockets during autopsy!

Discussion: In this case-report, different kinds of firing and the operating conditions of the terrestrial lures are discussed. These are responsible for the explosions because they started thermal and physics reactions in chain.

In cases of this type of "discovery," personal safety of the forensic pathologist, policeman, radiologist, and other laboratory personnel is essential. In the case reported, this could have been too late…because the team became aware of the dangerousness after the external examination and autopsy and after a literature revue!

Conclusion:

- The purpose of the case-report is to sensitize the medical and forensic pathologists about the dangerousness of cartridges and paradoxically and especially the lures, even without shocks, only, potentially, with a cellular phone
- The intervention of bomb disposal experts is required in every suspicious case, before forensic intervention. Forensic intervention must take place as soon as the site is protected and made inoffensive.
- Ammunitions must be handled with care
- A good forensic pathologist is an a live pathologist…

Lures, Autopsy, Safety

D68 Ethics for the Public Administrator: An Overview for the Forensic Professional

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Attendees will become familiar with the basic ethical expectations of public administrators operating in a city or county which adheres to principles of New Public Management, a current trend in public administration today.

This presentation will impact the forensic community and/or humanity by offering forensic professionals an overview of ethical standards drawn from the theories of new public management (NMP). Considering the popularity of NPM theories and practices amongst city, county, and state administrators, this presentation offers a working understanding and a vocabulary for forensic practitioners that are understood by their non-scientific governmental superiors and the public at large.

Although scientific expectations can be codified and standardized for the many professions recognized by the AAFS, the day to day ethics of these professionals as public administrators are often left vague and unspoken until a crisis arises. The purpose of this presentation is to offer an overview of ethical expectations for the forensic professional. Drawn from the wealth of literature on New Public Management—a currently popular trend in government practice today— a clear, concise, and accessible set of ethical expectations for the forensic administrator to draw upon in day-to-day administrative practice is offered.

Public Administration Ethics, New Public Management, Accountability

D69 Forensic Ethics: Getting Scientists and Lawyers on the Same Page

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After attending this presentation, attendees will understand some of the danger areas for scientists and lawyers to be aware of in cases, and ways to prevent ethical problems at trial.

Often, lawyers and scientists approach cases from different perspectives. They also each have their own independent scope of knowledge. Scientists can be caught between the prosecution and the defense, between the science and the law. This presentation will impact the forensic community and/or humanity by making scientists aware of their ethical duties and will examine how the lawyers can, and must, help the scientist carry out their ethical duties.

From 2002 through 2004, Sheri Mecklenburg was lead defense counsel on a series of cases involving reversed convictions, which alleged crime lab fraud in the old Chicago Police Crime Laboratory. Those cases generated headlines throughout the country and sent a shudder of concern throughout the legal and forensic communities. The lessons learned led to an examination of the practices of Crime Labs across the country and to recommendations for improvements. But through the anatomy of the

Crime lab cases, Ms. Mecklenburg was able to view the ethics of the prosecutors, defense counsel, and crime lab scientist. Ms. Mecklenburg had the rare experience of viewing the cases with 20/20 hindsight, of picking them apart to determine what went wrong, and of spending hours upon hours in depositions asking each of the players what they did and why they did it. Ms. Mecklenburg, who has previously conducted seminars on Crime Lab Ethics, will discuss the lessons learned and how the three key players in forensic evidence can and must "get on the same page."

Ethics, Lawyers, Scientists

D70 Discrimination of Dyed Fibers Using Raman Microspectroscopy for Forensic Analysis

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The goal of this presentation is to evaluate the potential of Raman microspectroscopy to discriminate between common fiber classes, fiber subclasses, and fiber dyes in a forensic setting.

This presentation will impact the forensic community and/or humanity by providing the ability to obtain discriminating Raman spectral data on mounted fibers, which will greatly improve the forensic scientist's capability to identify fibers that cannot be discriminated by other techniques or samples that cannot be re-mounted.

Fibers are commonly encountered as trace evidence in crimes involving personal contact, such as homicide, assault, or sexual offenses. The value of these fibers as evidence depends on the forensic scientist's ability to identify and discriminate different fibers. Typically, fibers are visually identified using polarized light microscopy (PLM), however various spectroscopic methods (*e.g.*, UV-Vis, IR and Raman) have also been shown to be useful for fiber discrimination. Whereas PLM provides morphological and index of refraction information, spectroscopic measurements can provide more direct molecular information and in the case of IR and Raman, unique vibrational "signatures" can be obtained. Raman spectroscopy can potentially be used to determine the generic fiber class (*e.g.*, cotton, acrylic, polyester, nylon), and gain information on the structures of the dyes present, without the need to remove the fiber from the mounting medium. In Raman analysis, the ability to use glass slides is a tremendous advantage compared to IR, where the fiber must be removed, and remounted in a cell that is IR compatible. A disadvantage of Raman spectroscopy is that the relatively weak Raman signal can become easily overwhelmed by high backgrounds from thermal degradation products or sample fluorescence. The effect of high background signals can be minimized by either reducing the background or increasing the relative intensity of the Raman signal. Raman signals can sometimes be increased substantially by the use of resonance Raman spectroscopy (RRS) or surface-enhanced Raman scattering (SERS) techniques. Raman signal enhancements from 10^5 to 10^6 are often reported using these techniques, and still larger enhancements can be realized using the two together (SERRS). Both techniques have been used to generate enhanced Raman signals for fiber dyes alone, as well as dyes on fibers.

A study evaluating the potential of Raman microspectroscopy to discriminate between common fiber classes, sub-classes and fiber dyes in a forensic setting will be presented. The Raman spectra show features from the base fiber, the dyes on the fiber, and other fiber constituents such as TiO_2, a delustering agent. The Raman spectra also show features due to mounting materials and so care must be taken in the selection of mounting adhesives, slides and cover slips.

Raman microspectroscopy is used to quantify TiO_2 levels in delustered polyamide fibers at concentrations from 0-7.1%. Issues of concern found in measurements of TiO_2 in textile fibers include particle spacing and the possibility of particle agglomeration, which can lead to large signal variations. Methods to alleviate this signal variation will be discussed. Depolarization ratios have also been measured for TiO_2 in polyamide fibers for the purpose of providing additional discriminating data. It was found that the depolarization ratios are affected by polarizing effects of the fibers themselves. Solutions to this issue will also be discussed.

Dye fluorescence can be a concern for many types due to the typically weak Raman signals. Also, degradation products can be produced by thermal- or photo-degradation of fiber dyes and can contribute to high background signals. We have found that degradation product background signals can be minimized through careful control of the laser power incident on the sample. In general longer-wavelength laser excitation also reduces background signals by reducing both direct fluorescence and laser-induced dye degradation. It has also been found that SERS and RRS can be used for many types of fiber dyes to obtain greatly enhanced Raman signals. The use of SERS, RRS and SERRS is being explored to measure both extracted dyes and dyed fibers directly. SERS is also useful in suppressing fluorescence as the metal surfaces typically used for SERS quench fluorescence for adsorbed dye molecules. SERS and RRS data will be shown for both dyes and dyes on fibers.

The intent of this paper is to evaluate Raman microspectroscopy for the identification of fibers and dyes of forensic interest. Raman spectroscopy has great potential to contribute to the forensic analysis of textile fibers. The ability to obtain Raman spectra on mounted fibers will greatly improve the ability to identify fibers that cannot be discriminated by other techniques such as FT-IR or samples that cannot be re-mounted.

Fibers, Raman Microspectroscopy, SERS

D71 Validation of the CI Print Macroscopic Chemical Imaging System for the Analysis of Latent Fingerprints

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After attending this presentation, attendees will learn about the validation research of the CI Print Macroscopic Chemical Imaging System (ChemImage Corporation, Pittsburgh, PA). How chemical imaging is applied to latent fingerprint visualization as well as the advantages of chemical imaging over conventional methods will also be discussed.

This presentation will impact the forensic community and/or humanity by improving detection and visualization of fingerprints to the forensic science community. Chemical Imaging is an evolving technology that provides this improvement.

This oral presentation will describe the research that ChemImage Corporation has put forth to develop and validate a cost effective macroscopic chemical imaging system for latent fingerprint analysis. The validation research focused on establishing the CI Print as a reliable technique for fingerprint imaging. The validation procedure included reproducibility studies, age degradation studies, substrate variation studies, chemical treatment studies and a glycine limit of detection study. These studies included both raw images and processed images. Every image was compared back to a set of known inked fingerprints from the donors to evaluate the possibility of artifacts or deleted minutiae. All samples imaged using chemical imaging techniques, were also imaged using a conventional method of fingerprint imaging (i.e., digital camera and single-barrier filter configuration).

Chemical Imaging is a validated technology that combines molecular spectroscopy and digital imaging to provide morphological, compositional and structural information of materials. Through the use of an electro-optical imaging spectrometer, images of latent fingerprints and other trace forensic evidence materials are recorded as a function of wavelength, generating a fully resolved spectrum unique to the material for each pixel location in the image. Advantages of chemical imaging over conventional methods include lower detection limits and increased contrast between the sample and the underlying background.

The CONDOR™ Macroscopic Chemical Imaging System is the predecessor to the CI Print system. The luminescence and visible absorbance chemical imaging modes of the Condor have been successfully applied to various treated and untreated fingerprint samples. Chemical imaging using the CONDOR has also been used to demonstrate increased contrast of fingerprints developed on difficult backgrounds such as those that are dark, uneven, fluorescent and/or multi-colored surfaces. The CONDOR has been a viable strategy for detecting the most challenging latent fingerprints when standard development methods fail, and has also proven useful for other forensic analyses, including biological stains, inks and gun shot residue.

ChemImage's CI Print is a modified version of the CONDOR Macroscopic Chemical Imaging System. It was developed using smaller and more cost effective components and is designed specifically for the use of latent fingerprint analysis. The CI Print can be used on both routine and difficult samples. A comparison of sensitivity and application specific parameters will be discussed to compare and contrast the CI Print and the CONDOR.

This validation study yielded promising results. The CI Print produced higher contrast fingerprint images than the conventional method. Also, improved detection limits of glycine were achieved using the CI Print system as compared to the conventional barrier filter method. Lastly, the specialized image processing software used with the CI Print system, ChemImage X-Pert™, produced images with higher fingerprint to substrate contrast than conventional methods when evaluated on difficult substrates. The CI Print Macroscopic Chemical Imaging System has been shown to be a valid method for the imaging of routine as well as difficult latent fingerprints.

Chemical Imaging, Fingerprints, Validation

D72 Trends in Phencyclidine (PCP): History, Synthesis, and Analysis

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Attendees will become aware of the history and present situation concerning phencyclidine (PCP) production and use. Attendees will also be familiarized with analytical techniques that may be used to handle any future submissions.

Phencyclidine use is on the rise. This presentation will impact the forensic community and/or humanity by providing forensic scientists and law enforcement officers who may not have had previous experience with the dangerous nature of this drug, both in the laboratory and on the street.

PCP was originally developed as an anesthetic in the 1950s, but after a wave of extreme side effects, its use in humans was discontinued in 1965. In the late 1960s, PCP became available for use as a veterinary anesthetic under the trade name of Sernylan® and was placed in Schedule III of the Controlled Substances Act (CSA). With abuse on the rise, the variety of side effects encountered was disconcerting. In 1978, it was transferred to Schedule II of the CSA and manufacture of Sernylan® was discontinued. It has been documented that peak use occurred around 1979. Consequently, the Drug Enforcement Administration's (DEA) laboratory system saw an incredible surge in exhibits analyzed in the early to mid 1980s. In 1986, the laboratory system analyzed nearly 5,000 PCP exhibits. The overwhelming majority of these exhibits were collected in the Washington, D.C. area and forwarded to the Mid-Atlantic Laboratory for analysis. The Mid-Atlantic Laboratory continually received the majority of exhibits for the rest of the decade. They accounted for approximately 90% of the PCP exhibits submitted to DEA laboratories between 1982 and 1989.

In recent years, the abuse of PCP has increased. Recent emergency room surveys indicate PCP abuse is increasing with over 6000 admissions in 2001. The DEA laboratory system has seen a steady increase of PCP submissions. There has been a 40% annual average increase in submissions from 1998 to 2003. The Washington, D.C. area still accounts for over 80% of those submissions. According to the El Paso Intelligence Center (EPIC), seizure of clandestine PCP laboratories is also on the rise. From 1998 to 2003, 54 clandestine PCP laboratory seizures were reported with the majority being in the state of California.

This presentation will take a look at the history of PCP and examine recent trends to see if PCP is making a comeback to the levels that it attained in the 1980s. It will discuss synthesis routes that have been and are currently being used, i.e. Maddox method, via enamines, and analogue synthetics. Techniques being used by forensic chemists to analyze routine and non-routine samples will also be addressed. Finally, a case that made local headlines in Baltimore, Maryland will be evaluated. A very large-scale clandestine PCP laboratory was seized in November 2002. The laboratory had the capacity of producing over 1000 gallons of liquid PCP. This seizure reveals that large-scale production is still a distinct possibility.

Phencyclidine, Clandestine Laboratories, Synthesis

D73 The Truth Will Set You Free: Lessons From a Shaken Baby Case

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Attendees will gain an awareness of pitfalls in investigation alleged offences where the evidence is mainly medical. They will also gain an appreciation of ethical issues in such investigations.

The recounting of actual experience of the issues, dilemmas, and difficulties faced in such cases from the attorney's perspective will impact the forensic community and/or humanity by raising awareness and stimulate debate, thus improving the quality of investigation and management by the professionals involved.

This paper presents the story of a trial where the evidence was almost exclusively forensic medical evidence from areas where research is active and "accepted" views are in a state of flux. It will be illustrated with material from the actual trial (some subject to Supreme Court permission).

The story is told from the perspective of the author, who was the defence lawyer in the trial, currently conducting research about juries and forensic evidence. The trial took place simultaneously with a public awareness campaign about "SBS," and starkly highlighted ethical dilemmas and professional and personal issues for lawyers and scientists including:

1. The problems for lawyers in weeding out the prevalent junk science.
2. Whether a judge or jury can hope to evaluate opinions in fields such as paediatric neuropathology, toxicology, radiology, forensic pathology, haematology, and ophthalmology.
3. The difficulty some scientists have in remaining objective in this field.
4. The uneasy co-existence of investigative and treating roles of hospitals.
5. The enormous responsibility for scientists in providing reports in areas where research is active and they may or may not be "up to speed," especially where police may be unable to make an independent judgment as to whether to charge a person with murder due to the highly technical nature of the evidence.

6. What happens when an expert changes his or her mind between arrest and trial?

The paper encourages a consideration of the ethical issues for lawyers, scientists, and police in such cases and proposes approaches, which may help to avoid injustice and increase confidence in verdicts.

SBS, Ethics, Investigation

D74 Forensic Evaluation of Toxic Mold Claims

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After attending this presentation, attendees will understand the science and controversies regarding mold related illness. This presentation will impact the forensic community and/or humanity by educating attorneys, physicians, psychologists, claims examiners and industrial hygienists regarding toxic mold claims.

Participants will learn about the growing "toxic mold industry." They will learn how to evaluate from medical, toxicologic, and neuropsychiatric aspects of toxic mold claims. The connection between claims of mold related illness to other forms of abnormal illness behavior, and syndromes such as multiple chemical sensitivity, sick building /new building, fibromyalgia, and chronic fatigue will be addressed.

Mold spores are present in all indoor and outdoor environments and cannot be eliminated. Of more than 50,000 species of fungi, only about 150 are known to be human pathogens. While mold mycotoxins can cause mucosal irritation, there is no clear evidence of chronic, nonmucosal pathology in human beings, even in water-damaged buildings. Mold related litigation is described as "the next big thing" after asbestos.

Between 1999 and 2001, there has been a thousand-fold increase in toxic mold-related insurance claims. A query on Google showed 114,000 hits for the term "Toxic Mold Neuropsychiatric." These key words showed zero hits on Psych info and Medline.

A third of the 600 million dollar homeowner claims paid out by Farmers Insurance in the state of Texas over the past two years was mold related. California became the first state in the nation to legislate mold-related regulations, i.e., the Toxic Mold Protection Act, SB732, 2001. The magnitude of payouts have led to major insurance companies excluding coverage for mold related damage

Though sometimes serious, physical illness in toxic mold claims is often of short duration. Attorneys and doctors with high profile toxic mold practices often emphasize neuropsychiatric claims of disability and suffering from physical problems. This is especially true when there are a few robust findings on laboratory and physical examination. Allegations of brain damage are made on the basis of nonreplicable anecdotal and idiosyncratic interpretation of technologies, such as SPECT, PET, and neuropsychological testing that often do not meet Daubert Standards. Body fluids are often sent for expensive and obscure tests. Findings of illness and disability may not be substantiated by face-to-face examination, the patient's account of day-to-day functioning, on independent psychological testing, as well as by reviewing prior medical records and depositions. There is often evidence of pre-existing and concurrent factors, unrelated to the mold exposure in these individuals. Dr. Arora will cover key points in the medical examination. Dr Jain will discuss the toxicology of mold mycotoxins and factors in the physical and laboratory examination. Dr. Nair will present the steps in the psychological/psychiatric examination, and review of records Controversies in psychological/neuropsychological testing and neuroimaging findings will be discussed.

Attorneys, toxicologists, occupational environmental medicine, and mental health professionals who conduct Independent Medical and Psychiatric Examinations will benefit from this workshop.

Toxic, Illness Behavior, Mold

D75 Alternate Testing Procedures for the Modified Griess Test

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After attending this presentation, attendees will understand: (1) the procedure for conducting a modified Griess test for enhancing gun shot residue (GSR) powder patterns; understand the results of altering five testing procedures on three types of fabric; and understand the advantages and disadvantages of the altered procedures to enhance visualization of powder patterns. The purpose of this presentation is to present the results of an experiment that evaluated the modified Griess test procedure and five changes in the testing procedure on three types of fabric for GSR powder patterns at specific distances.

This presentation will impact the forensic community and/or humanity by aiding the forensic community in understanding GSR pattern testing procedures and alternatives for conducting the modified Griess test.

A model 686 .357 S&W revolver, with a 4-inch barrel was used to produce GSR patterns by firing .38 caliber Winchester ammunition with 150 grain lead round nose bullets into samples of 100% cotton, a blend of 65% cotton and 35% polyester and 100% polyester. All of the samples were white in color to enhance the comparison of the size of the pattern on the cloth to the modified Griess pattern on photographic paper. All samples were shot at a distance of 6 inches from muzzle to target.

The materials prepared for the modified Griess test included 12 sheets of 203 x 254 mm (8 x 10 in) Agfa multi-contrast double weight fiber base paper and 6 sheets of Kodak polycontrast RC (resin coated), type F photographic paper. Both papers were fixed with Kodak fixer for 10 minutes at 20°C (68°F). After fixing, it was washed in 20°C (68°F) water for 10 minutes and dried. The fiber base paper was air-dried and the RC paper was dried in an RC dryer. The desensitized photographic paper was then immersed in a chemical mixture. The mixture was prepared in two parts. Part one was prepared by adding 0.5 grams of sulfanilic acid in 100 milliliters of distilled water. Part two was prepared by adding 0.28 grams of alpha-naphtol in 100 milliliters of methanol. The two parts were mixed and the desensitized paper was immersed for 1 minute and dried at 20°C (68°F).

Eighteen pieces of 203 x 254 mm (8 x 10 in) cotton cheesecloth were soaked in 15% acetic acid for 1 minute. Each sample of fabric was then covered with a piece of treated photographic paper with the surface of the GSR pattern adjacent to the paper's emulsion. Controlled test conditions included using 100% cotton fabric and ironing the cheesecloth for 1 minute on medium steam heat with the weight of the iron on the cheesecloth using fiber base paper. An orange color developed on the photographic paper in the presence of nitrites. The photographic paper was then washed in 26°C (80°F) water for 1 minute and then rinsed with methyl alcohol.

Controlled testing procedures included using steam heat at 154°C (309° F) with the weight of the iron on the cheesecloth and ironing for one minute on fiber base paper. Five variables in the procedure were altered. They included: use of no steam heat, ironing for 2 minutes, increasing the weight of the iron by 1500 grams, use of RC paper, and increased iron weight also using RC paper.

In conclusion, the GSR pattern diameters on fabric ranged from 8.26 cm (3.25 in) to 12.07 cm (4.75 in) with the average diameter of 10.16 cm (4.00 in). The GSR pattern diameters on photographic paper ranged from 5.08 cm (2.00 in) to 8.89 cm (3. 50 in) with an average diameter of 7.19 cm (2.83 in). The modified Greiss patterns were approximately 30% smaller than the patterns on the fabric. The 100% cotton, 65% cotton and 35% polyester blend, and the 100% polyester fabrics yielded darker colors and larger patterns on RC paper than on fiber based paper. The blended and polyester fabric revealed an outline of the bullet hole in the GSR pattern on RC paper. All fabrics had a tendency to stick to the photographic emulsion when ironed for 2 minutes. Therefore, the recommended alternative method for conducting the modified Griess for 100% cotton, 65-35 blend and 100% polyester is to set the iron on steam heat at 154°C (309° F), add 1500 grams of weight to the iron and iron for 2 minutes on RC paper.

Gunshot Residue, Modified Griess Test, Powder Patterns

D76 Non-Lethal Firearm: Excessive and Inaccurate Terminology

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Certain ammunitions named "non-lethal," often used by untrained persons can produce very significant or fatal wounds. A review of several studies would be necessary to estimate the penetration of this ammunition and to estimate the risks of fatal lesions. The goal of this presentation is to create a different or more accurate name such as "lethality reduced."

This presentation will impact the forensic community and/or humanity by demonstrating the importance of the danger of non-lethal firearms evidenced by concrete cases during autopsies and recognizing studies on corpses. This demonstration could allow the reclassification of these types of weapons and to change their category in the French and European legislation.

Non-lethal weapons are by the definition approved by the NATO in September, 1999: "Non-lethal weapons are weapons which are explicitly designed and developed to incapacitate or repel personnel, with a low probability of fatality or permanent injury, or to disable equipment, with minimal undesired damage or impact on the environment." Wounds caused by 12 various caliber ammunitions with non-lethal kinetic effect were studied, as well as blank cartridges from firearms.

Three weapons were used: 12/50 caliber Pistol SAPL GC 27, .9 mm Pistol Walther MLE P99, and 12/70 caliber Pump-action shotgun MLE 801.

Five types of ammunitions were studied: caliber 12/50 FUN TIR cartridge (16 mm diameter missile rubber ball), caliber 12/50 SLUG protection (16 mm diameter missile rubber ball), calibre 12/50 BUCK SHOT protection (6 mm diameter missile rubber buckshot), caliber 12 LD (16 mm diameter missile rubber ball), and .9mm P.A. Knall (blank cartridge).

Two anatomically intact, deceased subjects were used for the study: subject 1 is male, slight muscular build, low fat mass, and with fragile osseous structure; subject 2 is female with more pronounced muscular build and fat mass.

The shots were made by a marksman at a distance from the target from 0 m to 1.5 m. The use of corpses modifies and limits the severity of the induced wounds. Indeed, on dead bodies, tissue retraction, inflammatory process, and bleeding, are absent. However, the characteristics of lesions remain better defined than those supplied by a gelatin form. The severity of aftereffects depends on the wounded anatomical zone. The most critical zones are head and vital organs even when the impact did not cause penetration.

This study demonstrates that at a shot distance of less than 0.5 m, most ammunition penetrates the body and creates fatal wounds. It would be necessary to conduct additional experiments to estimate the limits of distance through clothes and different shot angles.

Estimation of lesion risk inherent to the various types of non-lethal ammunitions is difficult because of the different parameters playing in wound mechanism (shot distance, ammunition conception, victim type, wounded anatomical zone, protection type). It is difficult to find the best compromise between efficiency (assailant neutralization), and wound profile (reversible after effects). However, the researchers were surprised by the wound severity caused by certain "non-lethal" ammunitions, which can be used by unprepared individuals. It would be desirable to create a different more accurate name such as "lethality reduced."

Non-Lethal Firearms, Gunshot Wounds, Lethality

D77 Bland Murder Cases: A Spicy Recipe for Possible Conviction

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The goal of this presentation is to illustrate the possibility of a favorable outcome in the judicial system of cases which may lack one or all of the key elements generally thought necessary for conviction through presentation of a case which was successfully adjudicated despite lack of an eyewitness, murder weapon, or confession based upon a strong circumstantial case corroborated by forensic evidence; and to highlight the significance of interviews, scene investigation, physical evidence, and exploration of the many tips that arise during the course of a homicide investigation and the complementary role each plays in the favorable resolution of a case which may initially appear hopelessly unsolvable.

This presentation will impact the forensic community and/or humanity by reinforcing the importance of teamwork in a homicide investigation, i.e., relate how information/evidence collected by one group of investigators/scientists may corroborate that by others converting a weak case against a suspect into a powerful case even in the absence of the primary elements many deem necessary for a successful outcome in the judicial system.

Like a skillful chef presenting a fine meal for the hungry, many prosecutors prepare (for a jury) hearty helpings of testimony filled with at least one, if not all, of the three main ingredients often required for successful prosecution in many murder cases:

1) A witness to testify to the events of the crime and to identify the suspect.
2) The murder weapon linking the suspect to the victim's death.
3) The suspect's detailed account of his/her involvement (confession).

Naturally both investigators and prosecutors prefer that all three ingredients be served together at the banquet of justice, but in an imperfect and unpredictable world they are often faced with the prospect of presenting a bland case to the jury without any of the three elements, which provide the usual spice. While these cases may initially lack the flavor and substance to stimulate the palette of most jurors, a few added ingredients may enhance the existing flavor so that the case is more palatable. Often the identity of a potential suspect finds its way into the investigator's notebook from an anonymous tip, but without one, if not more, of the crucial ingredients, the hope of an arrest and prosecution is doubtful. In many such cases, careful examination of forensic evidence secured during the investigation in connection with the circumstances surrounding the death may convert an otherwise unsolved murder into a compelling circumstantial case with successful resolution in the criminal justice system. This link provided by the physical evidence and a powerful circumstantial case may add the "spice" required to convert that weak unpalatable case with none of the three aforementioned primary ingredients into a feast that most jurors will savor.

This presentation examines the murder of a male subject who was shot to death in suburban New Orleans in April 2002, in retaliation for burglarizing the defendant's vehicle. Common to many murder cases, this investigation lacked an eyewitness, and yielded no suspect weapon or confession. In contrast to many cases with ballistic evidence where the possible brand and model of weapon are multiple, in this case the Firearms Examiner was able to identify a specific caliber, brand and even model number based upon the evidence left on the scene by the suspect. Investigators subsequently secured documentation of the suspect's ownership of a weapon of this specific type from a pawnshop owner, and an interview provided information, which led other investigators to a distant location where additional physical evidence was, recovered which exactly matched that from the primary scene of the crime. This physical evidence in concert with the other investigative information formed the nexus of the case linking this suspect not only to a specific weapon of this type, but also to participation in this crime.

Murder, Investigation, Ballistic Evidence

D78 Crime Scene Registration Using Photography and Laser Scanning for the Purpose of Documentation and Scenario Testing

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The goal of this presentation is to provide guidelines for crime scene registration in all stages of a forensic investigation using state of the art techniques including panorama photography, video, laser scanning, aerial photographs, GPS and geodimeters, and data from cell phones and surveillance video; and to provide guidelines for presenting 3-D computer models of crime scenes and animations showing scenario's

This presentation will impact the forensic community and/or humanity by providing simple guidelines for more accurate and complete crime scene registration and how to take full advantage of new technologies such as photogrammetry, laser scanning, computer modeling, and animations that might be available within their organizations or that might be offered by commercial companies.

Since commercial companies have been offering services, such as 3-D animations of scenarios for crimes and accidents and 3-D laser scanning of crime scenes, a program was started at the Netherlands Forensic Institute (NFI) to do an extensive exploration of all the possibilities and limitations of these new technologies in criminal case investigations.

The first case in this program was the investigation of the firework disaster that happened in Enschede in 2000. In this case a 3-D model of the scene and an animation to demonstrate a scenario for the chain of happenings that led to the fatal explosion based on the outcome of all forensic investigations was created. Then, a number of new questions came up that could be answered by use of the 3-D model and photogrammetry. Since then, experience with 3-D modeling for the purpose of photogrammetry in video material (e.g. estimation of the body length of a robber or the speed of a car), reconstruction of bullet trajectories, virtual blood spatter stringing, and visualization of crime scenes and scenario's for industrial accidents and murder cases has been acquired.

In all cases, researchers have observed that animations and visualizations can be very suggestive in unexpected and surprising ways. In a 3-D visualization of a scene it is important to give information about the geometrical accuracy and the completeness of details and traces. In animations it is important to show the difference between facts and hypotheses.

Further, it was noted that crime scene recording happens in different stages. During the first response to a crime incident, no systematic registration is done and a lot of changes of the crime scene are unavoidable. Information has to be gathered from eyewitnesses, surveillance video, phone taps of emergency calls, photographs and video taken by by-passers or journalists, etc. This information can be used to get an overview of the scene during the crime and the changes during the first response. Then, the forensic investigation starts which an overview and close-up photographs are taken. In this stage the crime scene is changed when evidence material is gathered for further investigation.

Finally, in some cases it is necessary to go back to the crime scene to do a more accurate registration of the scene for the purpose of documentation, photogrammetry, reconstruction of trajectories of bullets, blood spatters, cars, people, etc., and validation of results. In the last two stages use of 3-D laser scanners was tested.

One of the main problems observed with the use of close-up photographs, overview photographs, and laser scans taken by different people in different stages of the investigation is to assess the relative position and orientation of the depicted objects, persons and traces.

This paper, discusses some techniques and guidelines for crime scene registration in different stages of the investigation using photography, video, laser scanning and markers. Some examples of crime scene documentation using interactive 3-D visualizations are given.

Crime Scene Registration, Computer Modeling, Virtual Crime Scene

D79 Standard Guidelines for Field Investigation Drug Officer (FIDO) Program

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Attendees will learn about an existing successful model, as well as standardized guidelines for implementation, operation, and continuing support of Field Investigation Drug Officer (FIDO) program.

Successful implementation of the FIDO program will impact the forensic community and/or humanity by having the potential to streamline the adjudication process, enabling the reduction of backlogged drug investigations and the efficient use of resources.

The efficiency of the entire criminal justice system is impacted by the overwhelming caseload of drug investigations. As a result, many cases fail to be prosecuted in a reasonable time frame or are dismissed due to a lack of timely sample analysis.

Straightforward possession drug cases comprise a significant percentage of those investigations. Handling the cases at the investigative level has the potential to streamline the adjudication process, enabling the reduction of backlogged investigations and the efficient use of resources.

Based on the evaluation of an existing model, operated by the Phoenix Police Department, the effective implementation of a Field Investigation Drug Officer (FIDO) program affords certified officers the capability of providing a preliminary identification of the most commonly encountered drugs of abuse. The benefits include immediate investigative information without the need for extensive laboratory analysis as well as facilitation of case adjudication in the preliminary phase. The results of the field-test factor into obtaining a plea agreement. However, cases proceeding to trial are submitted for complete analysis at the laboratory. The successful program in Phoenix has demonstrated a positive impact on the regional criminal justice system with cost savings and increased efficiency at all levels.

The National Institute of Justice (NIJ), in partnership with its National Law Enforcement and Corrections Technology Centers (NLECTC) and Forensic Resource Network (FRN), has addressed this issue. A focus group consisting of representatives from the law enforcement, forensic science, corrections, legal, and judicial communities was established to facilitate development and deployment of the FIDO program.

Following focus group discussions, the program was designed with sufficient flexibility to enable adaptation based on agency-specific needs and resources and to accommodate future technologies. The program is comprised of a comprehensive training program and quality assurance system that provides law enforcement personnel with the resources necessary to perform preliminary identification of controlled substances.

Deriving the maximum benefit from the FIDO program will require the full cooperation and participation of all members of the criminal justice community. The potential reward of this collaboration will be a significant increase in the efficiency of the system and an enhanced capacity to process drug-related cases.

Case Backlog Reduction, Drug Testing, Resource Allocation

Jurisprudence

E1 Digital Evidence and Expert Testimony: Applying Rule 702 to the Digital World

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The goal of this presentation is to explore how Federal Rule of Evidence 702 applies to expert testimony in the emerging field of digital forensics.

This presentation will impact the forensic community and/or humanity by serving to provide useful information to both legal and forensic practitioners who operate in this high technology area. This exploration may assist in refining the roles of practitioners in other applied forensic sciences.

As defined by the Scientific Working Group on Digital Evidence; digital evidence is information of probative value, stored or transmitted in binary form. The forensic examination of computer hard drives, tapes, and disks has been done for well over a decade. Initially the work was done by criminal investigators in the field and in their offices. In this initial phase, the vast majority of digital forensics was done by people whose education and training was neither forensic science nor computer science. However, as they were, compared to the judges, juries, and most attorneys, "experts" with respect to computers, they began to testify.

In 2003, digital evidence was accepted as a discipline, subject to accreditation by the American Society of Crime Laboratory Directors – Laboratory Accreditation Board. With this acceptance has come rapid adoption of many of the traditional forensic science features, including formal education. However, many of the digital evidence forensic practitioners do not meet the standards that are imposed by traditional accreditation. Does this mean that only laboratory examiners from accredited laboratories can testify as experts in this area?

Since the early days of computer forensics, computers have become ubiquitous. People interact with a wide variety of digital devices, from traditional computers to digital video and audio devices to computers and electronic storage that is imbedded into cars, homes, and offices. These interactions result in the production of probative information for all forms of legal proceedings.

In the early days, the majority of digital evidence was being collected, examined and utilized in criminal trials, often in technology related crimes such as computer trespass, intellectual piracy and sexual exploitation cases. Now that "digital breadcrumbs" are being left everywhere, that is no longer the case. The vast majority of records created by business are now stored and transmitted in electronic form. A byproduct of this activity is a large quantity of latent digital evidence on the computers used to produce and view these records. Electronic discovery is becoming common in civil and regulatory cases. Forensic examination of electronic devices is a natural extension to this trend.

A byproduct of this trend is the increasing need to admit digital evidence into court. But who should testify, how and on what basis; expert or lay witness? This presentation will focus on a number of ways in which Federal Rule 702 could be applied to issues of digital evidence.

Rule 702, Digital Evidence, Expert Testimony

E2 Poking the Wookie: The Chewbacca Defense in Digital Evidence Cases

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The goal of this presentation is to frame a growing debate in the area of computer forensics as it relates to the reliability of digital evidence to prove culpability in civil and criminal cases.

This presentation will impact the forensic community and/or humanity by exploring ways in which officers of the court might approach claim challenges, think about its affect on current evidentiary presumptions and burdens of proof, and define reasonableness standards related to digital evidence.

The ubiquity of computers has forced society to increasingly turn to digital evidence to resolve disputes in the civil and criminal arena. The difficulty of tying an individual to a particular computer that was used in a crime, the interconnectedness of computers via the Internet, and the mutable nature of electronic information, have conspired to facilitate evidentiary challenges to the reliability of digital evidence. Specifically, the prevalence of computer vulnerabilities and malware (virus, spam, spyware, trojan horse programs)- mechanisms that allow unknown persons to access one's computer- have facilitated oftentimes outlandish defense claims.

This presentation explores the new challenges that this "unknown third party" defense presents in the context of computer forensics. Does countering it amount to having to prove a negative? To help frame the debate, presenters will draw analogies from the "DNA Wars" and map how defenses to DNA technology have shaped and been shaped by technology evolution. DNA had a battle of experts DE is now experiencing the same phenomenon

Conclusion: this presentation will explore ways in which officers of the court might approach claim challenges, think about its affect on current evidentiary presumptions and burdens of proof, and define reasonableness standards related to digital evidence.

Digital Evidence, Reliability, Computer Forensics

E3 Identity Theft: The Tools of the Trade

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The goal of this presentation is to present the forensic community an overview of recent developments in the crime of identity theft, including not only the tools and techniques used by criminals, but also those used by law enforcement officials in catching criminals.

This presentation will impact the forensic community and/or humanity by educating the listener as to the tools used by identity thieves so as to prevent one from becoming a victim of identity theft. In addition, the paper will educate the listener as to the techniques that can be used by the scientific community to aid in catching those who would commit identity theft.

This paper will present a discussion of the equipment and methods used by criminals in the commission of identity theft, as well as the methods used by law enforcement officials in preventing identity theft and catching those who do. In recent years, identity theft has become an increasing concern to citizens. Although identity theft is not a new crime, recent technological advances have given would-be criminals a variety of

new tools to use. The increased use of computers and the Internet have created new methods for criminals to access personal information without the same risk of being personally identified. In response, several state and federal law enforcement agencies have stepped up enforcement efforts, including developing methods to respond to these new techniques, including not only new technological advances, but also the creation new legislation and a national database to track identity theft. In addition, state legislatures, as well as the U.S. Congress, have implemented a variety of new laws designed to stop the continued growth of identity theft, as well as to protect victims.

The purpose of this paper is to educate the listener as to the advances made by both criminals and law enforcement. The paper will present case examples, discuss the specific equipment used, recent legislation passed, and give general tips for the prevention of identity theft. The listener will leave the presentation with an understanding of developments in the field of identity theft and the techniques that can be used to prevent future victims.

The impact of this paper on forensic sciences and / or humanity will be to educate the listener as to the tools used by identity thieves so as to prevent one from becoming a victim of identity theft. In addition, the paper will educate the listener as to the techniques that can be used by the scientific community to aid in catching those who would commit identity theft.

Identity Theft, Law Enforcement, Legislation

E4 The Scientific and Civil Litigation Approach to a DNA Exoneration: A Cooperative Approach to the Search for the Truth - A Case Study Approach

Ingrid A. Gill, JD, 4835 North Kenmore Street, Chicago, IL 60640*

After attending this presentation, attendees will learn the practical advantages of attending forensic DNA workshops at AAFS and implementing that knowledge in post conviction DNA litigation identify the privacy issues arising out of DNA exonerations, and the correlation between DNA exonerations and false confessions and the use of civil remedies for wrongful convictions.

This presentation will impact the forensic community and/or humanity by providing attorneys specializing in wrongful convictions and DNA exonerations should receive training in forensic DNA from the AAFS. That there must be more focus on the science to prove actual innocence and black letter law and less on the court of public opinion in correcting the injustice of wrongful convictions. Attorneys should use DNA exclusions in civil pleadings as newly discovered evidence thereby staying within the four corners of the document to prove actual innocence in setting their clients free.

After attending this presentation, participants will see the practical advantages for attorneys specializing in DNA exonerations to (1) attend AAFS forensic DNA workshops, (2) utilize that knowledge in selecting labs to test degraded evidence, (3) take a team approach with the post conviction attorney, District Attorney, law enforcement and the state crime lab in locating evidence,(4) and identifying the best lab to test highly degraded evidence to prove actual innocence, (5) identify the privacy issues arising out of testing private citizens as suspects and for elimination purposes, and (6) the correlation of DNA exonerations to signed false confessions. Also, the author hopes to address ancillary issues arising out of DNA exoneration.

On July 12, 2004, Lafonso Rollin's was release from prison when two DNA tests excluded him from two separate rapes. The two DNA exclusions supported his allegations of a coerced false confession, and mistaken witness identification which lead to an unreliable photo composite used by police to arrest him. This presentation presents a scientific and civil remedy approach to DNA exonerations for use by post conviction attorneys, district attorneys, and forensic DNA labs. The presenter was the attorney who freed Lafonso Rollins from prison by using a civil petition to vacate a final judgment based on newly discovered evidence. This presentation will be the first time she has publicly discussed the case.

The facts used for the case study come from the police reports, state crime lab forensic reports and trial testimony. Illinois allows an inmate to petition for post conviction DNA testing under various statutory schemes. Upon receipt of the petition, the Illinois Courts will appoint counsel if identify was in issue at trial. In Cook County, the District Attorneys and Public Defenders have received specialized training in forensic DNA by attending AAFS workshops. When dealing with highly degraded evidence, the attorneys are able to utilize their forensic DNA training they have received from AAFS workshops to independently evaluate the reliability of new technologies to prove actual innocence in DNA exonerations. The attorney's forensic DNA knowledge and comprehension opens channels of communication to the state crime lab for their advice of the best mechanisms for the testing of degraded evidence. The crime labs are sometimes able to provide a good source of information on where to find old police reports because of the lab's document retention policies. Once evidence is found and the type of forensic DNA testing is determined, there are still many other unresolved issues the attorneys must address. First, the issues of voluntary DNA testing of civilians must be addressed as to elimination samples. What Bioethics issues are raised by the need for the victim's and possible family members reference samples? What happens to the profiles of civilian non suspects? What of other civilians who are possible suspects? What happens to their profiles if they are excluded? What rights does a defendant have of his reference samples in the databases once his claim of actual innocence is proven to the Court after a DNA exclusion contradicts the sworn testimony of the eyewitnesses and the police detectives? Is this prima facie evidence of a false confession? What are the ancillary legal consequences on the forensic community to these increasing frequent situations? The presentation will present some possible outcomes to these scenarios. Finally, with a DNA exclusion that proves actual innocence, the inmate petition to vacate his judgment of conviction under different legal mechanisms. The author will discuss the pros and cons of using the traditional post conviction or habeas corpus proceeding versus the civil remedy of vacating a final judgment based on newly discovery evidence.

This presentation is of interest to anyone in the forensic science field who is involved in DNA exonerations, false confessions, mistaken identification and unsolved cases.

DNA Exonerations, False Confessions, Legal Issues

E5 Recent Ontario Court Decisions Involving Hair Evidence

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After attending this presentation, attendees will gain an awareness of current legal issues pertaining to the admissibility of microscopic hair comparison evidence.

Recent challenges and rulings regarding microscopic hair comparison evidence have arisen in Ontario, and these may have an impact in other jurisdictions. As such, this presentation will impact the forensic community and/or humanity by fit to hair examiners to be aware of the issues involved.

The goal of this presentation is to familiarize forensic hair examiners and individuals in the legal community regarding some recent hair evidence admissibility issues in Ontario courts.

This presentation will cite and summarize recent Ontario court rulings involving microscopic hair comparison, including brief discussions of hair findings, the courts' interpretation, and ruling implications and applications.

Due, in part, to *R. v. Morris* (1983) and the *Report of Inquiry into the Wrongful Conviction of Guy Paul Morin* (1998), the onus has been placed on judges to consider the admissibility of evidence whilst keeping in mind prejudicial effect versus probative value. This is separate from the issues of acceptability of the science (as in the Supreme Court ruling of *R. v. Mohan*, 1994) or the relevance of the evidence, where admissibility relegates the determination of weight or probative value to the trier of fact. Case by case, the judge must take into consideration the circumstances relative to the evidence to determine admissibility vis-à-vis prejudicial effect. As a result, the courts in the province of Ontario have increased their scrutiny regarding microscopic hair comparison. The admissibility of hair evidence has been challenged in trial and appeal courts. Some rulings have resulted, which may have a direct impact on other cases in court or in pre-trial discussion.

For obvious reasons, the courts accept hair comparisons that are supported by nuclear or mitochondrial DNA analysis. There is also an acceptance of hair examination when it is used for exclusion purposes or in screening, prior to DNA analysis. Although no rulings have been made in Ontario to exclude microscopic hair comparisons supporting that an individual is the source of the hair, challenges commonly hinge upon hair comparisons that fail to exclude an individual, yet have no associated DNA results. Latitude has been given for some such hairs, when accompanying similar hairs do have supporting DNA results, the extrapolation being that, together, the possibility of their originating from the same source is stronger.

In *R. v. Portillo* (2003), the Court of Appeal agreed with the trial judge that "hairs which were a DNA match to the appellants were found on the deceased could add to the probative value of the evidence that certain other hairs found at the scene were microscopically similar to the appellants' hairs, and at the same time diminish the potential prejudice."

In *R. v. Bennett* (2003), the Court of Appeal disagreed with the trial judge who allowed the hair examiner to testify with respect to hairs that were only partially similar to hairs from the accused, and to hairs at the scene which matched the accused by nuclear DNA analysis, albeit with the caveat that the jury should be clearly advised of the limitations of these hair comparisons (as was done by the expert). The implication was made later by the Crown that these were relevant due to the number and locations of the hairs and their racial origin (uncommon to the area). The appeal court questioned the wisdom of the defense counsel in accepting, at face value, those hairs which were microscopically similar to the accused but had no associated DNA results. It did not, however, rule against their admission, citing *R. v. Portillo*.

This ruling affected at least two cases. Within a fortnight of its release, defense counsel in *R. v. Vanezis* (2003) called for a *voir dire* regarding the admissibility of the hair evidence. Both the Crown and defense mutually agreed to enter into evidence those hairs with nuclear DNA results (no microscopic comparisons done), but not include hairs with microscopic comparisons that had yielded inconclusive results (due to lack of an adequate control sample from the accused). In *R. v. Paul* (2003), the judge cited *R. v. Bennett* and *R. v. Morris* in his refusal to admit certain hairs that had been compared to a human hair wig on the deceased. At the pre-trial hearing, the color analysis performed (microscopic and thin layer chromatography) was equated by the expert to forensic fiber comparison, not traditional morphological microscopic hair comparison.

Forensic hair examiners should have a clear understanding of the issues involved in these rulings and be prepared to discuss the implications relative to their cases. The rulings are apt to be applied incorrectly by court officials who do not have any forensic science background or understanding of the scientific premise or limitations of hair examination.

Hair, Admissibility, Courts

E6 Fingerprint Comparison Standards and Discovery Practices for the Trial Advocate

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The purpose of this abstract is to address issues arising from trial challenges to fingerprint identifications: whether *Daubert* reliability issues are viable in light of recent cases; how SWGFAST Guidelines address issues in comparison and identification; and what are the responsibilities of the trial advocate in discovery practices and trial preparation.

Although courts continue to accept fingerprint identifications as unassailable, there have been recent cases showing errors in fingerprint identifications. As forensic science moves into the 21st century, critical comparison to the development of standards and discovery practices in other forensic disciplines, particularly DNA and this presentation will impact the forensic community and/or humanity by acting as an effective means to preserve the integrity of the identification procedures used in the adversarial system of justice.

The purpose of this paper is to address issues arising from trial challenges to fingerprint identifications: whether *Daubert* reliability issues are viable in light of recent cases; how the Scientific Working Group on Friction Ridge Analysis, Study and Technology, (SWGFAST) Guidelines address issues in comparison and identification; and what are the responsibilities of the trial advocate in discovery practices and trial preparation.

Fingerprint identification has been in use in forensic science and accepted by the criminal courts since the early part of the 20th century. At the end of the 20th century fingerprint identification was attacked under various theories of reliability under the *Daubert* standards of admissibility (e.g., *U.S. v. Mitchell* and *U.S. v. Plaza*). Although courts continue to accept fingerprint identifications as unassailable, there have been recent cases showing errors in fingerprint identifications as forensic science moves into the 21st century.

In Boston, in 2004, Stephan Cowans was released from prison after a fingerprint used to convict him of shooting a police officer was acknowledged not to be his. Post trial analysis of DNA evidence was used to exonerate the man. Law enforcement described the misidentification as an honest mistake by the technician.

In Scotland, in 1999, a former detective, Shirley McKie, was cleared of perjury charges arising from her claims that a fingerprint at a homicide scene was not hers. Scottish law enforcement had previously identified the fingerprint as McKie's.

Also, in 2004, Brandon Mayfield was released after Spanish officials conceded that fingerprints on a bag near the March terrorist bombing site in Madrid were erroneously identified as Mayfield's. The error in identification was attributed to a substandard quality image of the latent fingerprints.

Issues in these and other cases put the forensic science and legal communities on notice to scrutinize the methods employed and bases for the conclusions made in comparisons and identifications. SWGFAST has published guidelines to develop consensus standards in the latent print community including standards for qualification, training, quality assurance, professional conduct, and conclusions. SWFAST has also identified areas for research including review of latent print training, the use of digital enhancement, and the sufficiency of exclusion, among others.

As forensic science evolves in the 21st century, fingerprint identification continues to be an important discipline even with the use of DNA analysis as the cutting edge technology in identification. Developments of legal standards in discovery and due diligence review in DNA cases will be compared to practices in fingerprints, with specific recommendations for the trial practitioner in discovery, discovery requests, case evaluation, trial preparation, and trial.

Areas the trial advocate must be prepared to address include how the evidence fits the theory of the case and the sufficiency of the physical evidence, quality and quantity of the latent print. In discovery, a full copy of

the case file is necessary, including documentation of the evidence procession and collection, fingerprint evaluation, comparisons, and searches, as well as the latent prints and comparison standards. Evaluation of the case includes review of the methods used and conclusions made, interview of the analyst and possible independent review. The use of these practices act as an effective means to preserve the integrity of the identification procedures used in the adversarial system of justice.

Fingerprints, Discovery, Trial Preparation

E7 Remedial Disciplinary Education in Prescribing Controlled Substances

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After attending this presentation, attendees will understand how healthcare providers with a permit from the Drug Enforcement Administration (DEA) and some state licensing agencies have been allowed, in certain cases, to study and learn appropriate controlled substances prescribing in order to remove sanctions against their licenses to practice.

This presentation will impact the forensic community and/or humanity by educating the doctor in pain management, problems of over-prescribing as well as under-prescribing, reducing medical errors, dealing with the balance between treating pain and falling prey to the abuser. The state licensing agency can mandate this educational endeavor and have the healthcare provider enroll in the course immediately and can reduce the lengthy and costly litigation and prolonged time of license probation, suspension or revocation. It is utilized by hospital and HMO administrators, malpractice insurance companies, and attorneys. The material can be updated on the DVD quickly and easily as new drugs and drug combinations are marketed, used and abused.

The 22-year-old course utilized by most state healthcare licensing agencies has been reformatted into the modern technology of DVD discs. The "students" view the expert lecturer in the privacy, safety and comfort of their home/office without the expenses and loss of income incurred in traveling to the five and a half day course in New Jersey at the University of Medicine and Dentistry of New Jersey (UMDNJ), administrator of the national Mini-Residency in Appropriate Prescribing (MRAP).

The 25 hour course encompasses performing adequate history and physical examinations, supervision of physician assistants and nurse practitioners, pharmacology, assessing pain and anxiety disorders, development of a treatment plan, proper medical record-keeping, biomedical ethics, detecting the drug abuser, treating the former or present drug abuser presently in pain, federal and state laws and board regulations, informed consents, treatment contracts to control and manage the flow of opioids and sedative/hypnotics, utilizing consultants, pain managers, addictionologists, physiotherapists, radiological studies, laboratory tests, urine and serum drug screening, addiction and scams of the drug-seekers.

The course is not only for those practitioners who have been sanctioned by their licensing agencies but also serves as a basic course for physicians assistants and nurse practitioners who seek education in order obtain state approval for prescribing controlled substances.

The DEA is looking to the medical, dental, podiatric, pharmaceutical, and nursing professions to recognize that these professionals are not receiving adequate education in their core curricula and to aid in insuring that accurate education with documentation is provided in order to apply or re-apply for their DEA permit.

A professionally monitored examination to assure competency is provided in most cities of every state and Canada. The examination is electronically scored with a report sent to all registrants, their attorneys and licensing agencies, hospital credentialing committee or malpractice insurance company.

The complete manual contains 12 DVD discs, Microsoft® PowerPoint slide printouts of each expert representing 25 hours of study plus forms by which the provider can educate his/her patient and regulations in prescribing controlled substances as outlined in Federation of State Medical Boards of the U.S.'s, "Model Policy in the Prescribing Controlled Substances for Pain Management."

The MRAP will benefit the patient by educating the doctor in pain management, problems of over-prescribing as well as under-prescribing, reducing medical errors, dealing with the balance between treating pain and falling prey to the abuser. The state licensing agency can mandate this educational endeavor and have the healthcare provider enroll in the course immediately and can reduce the lengthy and costly litigation and prolonged time of license probation, suspension or revocation. It is utilized by hospital and HMO administrators, malpractice insurance companies and attorneys. The material can be updated on the DVD quickly and easily as new drugs and drug combinations are marketed, used and abused.

Sanctions, DVDs, MRAP

E8 The New Drug Wars: The Coming Wave of Child Psychiatric Medication Related Litigation?

Mohan Nair, MD, 5212 Katella Avenue, Suite 106, Los Alamitos, CA 90720*

After attending this presentation, the legal community will be informed about some of the inherent dangers present in the use of psychotropic medications and the systemic and individual case related failures that have led to serious and at times deadly consequences. Clinical and forensic mental health practitioners will learn about the pitfalls in diagnosis and treatment that can result in malpractice.

This presentation will impact the forensic community and/or humanity by providing a clearer understanding of the science and practice of psychotropic medication use in children and adolescents.

From Jan 2004 to July 2004, the U.S. has spent approximately 22 Billion dollars on the war on drugs, including convincing the public that amphetamines (speed) causes brain damage.

At the same time, unprecedented numbers of juveniles are being prescribed amphetamines. In 1996, one million prescriptions were written for methylphenidate. In the Baltimore district 6% of children were on stimulants, with the numbers going up to 25% or more in some inner city schools. Stimulants are seen as having more serious and long lasting effects on the brain, even compared to cocaine.

The warning bells raising concerns about the use of these medications are not being sounded by fringe elements such as but by respectable neuroscientists and clinicians. For example an North Carolina study in 2000 suggested that about 3 out of 4 children that received these medications did not meet the diagnosis of ADD/ADHD.

Close on the heels of Britain outlawing the use of antidepressants in children and teens, the US FDA has mandated 'black box' warnings on the pediatric use of several antidepressants. Warning shots have been fired by the NYC AG Elliot Spitzer against the manufacturer of Paxil for not disclosing relevant data. Antidepressants are being blamed for suicides and mass school killings such as Columbine. Even the FDA has been accused of being in bed with the drug companies.

This presentation will provide the legal community information about the inherent dangers in psychiatric medication and some of the systemic and individual failures that result in adverse and sometimes, deadly consequences. Mental health practitioners will learn about potential pitfalls in diagnoses and treatment that can result in malpractice. A case where a child with fatal adrenoleukodystrophy was misdiagnosed as ADHD will be presented.

Antidepressants, Stimulants, Children

E9 Cutoff Concentration of Ketamine and Metabolite in Urine Was Set in Taiwan for Certified Laboratories

Chiareiy Liu, MD, Wen-Ing Tsay, MS, Choung-Huei Lee, BS, and Jih-Heng Li, MD, National Bureau of Controlled Drugs, #6 Linsen South Road, Taipei, 100, Taiwan*

Taiwan is the first country of the world to set the cutoff concentrations of ketamine and its metabolite in urine for certified laboratories. Ketamine, which is a non-barbiturate, rapid-acting disassociative anesthetic is used in pediatric burn cases, in dentistry and is used experimentally in psychotherapy. It is a Schedule III controlled drug, whose abuse as a "club drug" or party drug has been rising rapidly in Taiwan in recent years as documented by the amount of the drug seized by the police, the number of arrestees testing positive, the high percentage of ketamine use in recreational places, and the increased use reported from psychiatric hospitals case report statistics. This presentation will call attention to the forensic community of the growing abuse of ketamine and establishes a workable cutoff concentration in order to test for the drug and its metabolites.

In a study conducted from January to April 2003 there were 51 positive urinary ketamine analysis specimens collected in the laboratory. From January to April, 2004, there were 413 positive specimens collected, which represented an increase of more than a 700% in just one year. As a result of this increased use of ketamine, the Department of Health of Taiwan sought an accurate standard to measure for the presence of ketamine in urine and added ketamine to the list of drugs to be analyzed by accredited drug analysis laboratories.

Five research projects were conducted from 2002 to 2003 on different methodologies to measure for the presence of ketamine. The National Bureau of Controlled Drugs, Department of Health, had established the cutoff limits for the detection of ketamine and its metabolites, norketamine and dehydronorketamine by the use of GC/MS, LC/MS, GC-NPD and CE methods. At the same time testing laboratories around Taiwan accepted requests to conduct analyses of ketamine, but used their own methods and cutoffs for urine analysis. One laboratory used 200 ng/mL for ketamine or norketamine as the cutoff, while another was used 100 ng/mL for ketamine, norketamine and dehydronorketamine as their cutoff limit.

Accurate confirmation of the presence of any drug in a urine specimen requires two testing methods utilizing a different methodology for each test. Immunoassay coupled with GC/MS methods have been 'the gold standard" for urine drug testing laboratories in Taiwan. However, Taiwan has revised its "Statute for Narcotics Hazard Control" to include ketamine, and the Department of Health promulgated on December 24, 2003, revised "Regulations Governing Drug Abuse Urine Testing Operations" and the "Regulations Governing Certification and Management of Drug Abuse Urine Testing and Medical Institutions" which took effect on January 9, 2004. These new regulations establish a ketamine analysis standard.

Since there are few commercial immunoassay methods available at this time in Taiwan, for the screening test of ketamine and metabolite, it was decided that any proper chromatographic methods coupled with a suitable detector would be allowed and the cutoff was set at 100 ng/mL for either ketamine, its metabolite-norketamine or the sum of the concentrations of the two compounds. For the confirmation test, the GC/MS method should be used for the analysis of ketamine and norketamine, the cutoff concentration is 100 ng/mL for either of the two compounds or both of them combined.

The National Bureau of Controlled Drugs proposed the new standards in an amendment to the regulation, which was approved by the Institution Certification Review Committee of the department of Health on June 28th 2004. The amendment of the regulations is expected to take effect as soon as possible after it is enacted by the legislature.

Ketamine, Taiwan, Cutoff Concentration

E10 Operator-Induced Errors in Speed Measurement of Motor Vehicles

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After attending this presentation, attendees will understand the accuracy and reliability of vehicle speed measurement devices for law enforcement are adversely affected by operator-induced error. Devices subject to these errors are hand-held timers, radar, and lidar. Operator error is manifested through improper target sighting or inappropriate display interpretation. Available literature focuses on intrinsic equipment accuracy rather than operator-induced errors. Potential operator errors are here presented, specific to each device.

This presentation will impact the forensic community and/or humanity by demonstrating operator-induced errors which have been acknowledged by the relevant community, but they are minimized or ignored during operator training in order to avoid questioning the perceived accuracy or reliability of the test results.

The accuracy and reliability of vehicle speed measurement devices for law enforcement are adversely affected by operator-induced error. Devices subject to these errors are hand-held timers, radar, and lidar. Operator error is manifested through improper target sighting or inappropriate display interpretation. Available literature focuses on intrinsic equipment accuracy rather than operator-induced errors. Potential operator errors are here presented, specific to each device.

Errors induced by the operator include parallax viewing, inept button-pressing, unrecognized statistical fluctuations, target mis-identification, failure to field-calibrate, and imprecise target tracking. These errors are difficult to quantify, and they are minimized in operator training and related equipment manuals.

Digital readout of hand-held timers has an error of 10% - 20% through operator performance. A timer is an inexpensive electronic stopwatch designed for generic measuring of time intervals. It can be used to measure the time interval for a vehicle traveling between two fixed reference points, for speed calculation. The operator manually operates the timer as the vehicle crosses two reference points. Since the lines of sight do not remain parallel, the operator's view is subject to perspective distortion or parallax.

Another problem with timers is the manual starting and stopping of the timer, or button-pushing, requiring consistent hand-eye coordination. Activation of the button either early or late affects the accuracy of timing, thereby causing an erroneous speed calculation.

Both parallax compensation and accurate button-pushing are critical to effective timer employment. To avoid parallax errors the reference distance is typically shortened to 30 meters. However, an operator cannot normally respond to a 30-meter distance with accurate hand-eye motor coordination when a target vehicle is moving faster than 30 miles/hour. Operators can perform at tenths of a second, not hundredths or thousandths of a second as performed by automatic sensors.

Hand-held timers can be purchased which automatically calculate speed in miles or kilometers per hour. However, they still use a manually operated start-stop switch. Single-test accuracy and precision cannot be reproduced.

Traffic radar (radio detection and ranging) speed measurements are affected by statistical fluctuations in radio signals, and by the presence of unidentified targets. Operators are not familiar with electronic principles of vehicle speed measurement or equipment designs which are peculiar to traffic radar devices.

For operator convenience, the radar updates its display frequently, typically twice a second, which sacrifices speed measurement accuracy. This is because signal distortions and fluctuations occur, and any single split-second reading by itself may be a statistical outlier. The operator must visually observe the intended target over an unimpeded line of sight, and must take multiple readings. This is to compensate for fluctuating signals and to assure the radar is responding to only the intended target. Merely flicking the off/on switch and accepting a single displayed speed number is inadequate.

Target identification problems occur when (1) more than one moving object is present in the radar beam, (2) the radar unit is subjected to physical motion or vibration, or (3) in moving radar, the patrol vehicle does not maintain accurate ground track during the measurement. Appropriate target identification and continuous ground tracking is necessary for a proper reading.

Traffic lidar (light detection and ranging) uses a laser light source or an infrared-emitting diode to illuminate a moving target. Nominal training is required for an operator to "point and shoot" a lidar. The major problems are absence of speed calibration in the field, and unsteady target tracking by the operator. Errors of 5 – 10 miles/hour occur in these situations.

The device is factory calibrated, not field recalibrated, thereby making all field results suspect due to hardware and software problems. The cursory operator field check on a stationary, high-contrast object is inadequate, because it does not verify speed calculation.

Another error is the operator's facility in sighting and tracking. The bulky hand-held device must be held steady on a reflective part of the intended target vehicle, similar to operating a rifle without wavering or flinching. The operator needs to conduct multiple confirmatory readings in order to substantiate the displayed result.

These operator-induced errors have been acknowledged by the relevant community, but they are minimized or ignored during operator training in order to avoid questioning the perceived accuracy or reliability of the test results.

Speed-Timing, Radar, Lidar

E11 "DES Daughters": The French Experience

Renaud Clement, MD, and France; Olivier Rodat, PhD, Department of Forensic Medicine, University of Nantes, 1, Rue Gaston Veil, Nantes, 44 093, France*

The goal of this presentation is to study of liability of DES in the general action of "DES daughters."

This presentation will impact the forensic community and/or humanity by demonstrating the impact of French action of liability of manufactories

Diethylstilbestrol is a synthetic nonsteroidal estrogen that was used to prevent miscarriage and other pregnancy complications between 1938 and 1976 in France. In 1971, the U.S. Food and Drug Administration issued a warning about the use of Diethylstilbestrol during pregnancy after a relationship between exposure to this synthetic oestrogen and development of clear cell adenocarcinoma of the vagina and cervix was discovered in young women whose mothers had taken this treatment while they were pregnant. Women who were exposed in utero to diethylstilbestrol (DES) may have structural reproductive tracts anomalies, an increased infertility rate, and poor pregnancy outcomes. "DES Daughters" have filed lawsuits against the manufacturers of DES, alleging that their exposure to the drug caused various reproductive tract anomalies, including cancer. Examinations and expertises of "DES Daughters" were performed by Department of Forensic Medicine, University of Nantes unit in France. Sixteen 16 cases of "DES Daughters" plaintiffs were exposed. Vaginal adenosis concerns 7 cases, infertility five cases, poor pregnancy outcomes 4 cases, and genetics' disease one case. Liability of DES is established, and causality of DES to explain the damage is investigative. Damage compensation is estimate for each injury.

Diethylstilbestrol, DES Daughters, Injury

E12 End of Wrongful Life in France After the Law of March 2002

Renaud Clement, MD, and France; Olivier Robinson, PhD, Department of Forensic Medicine, University of Nantes, 1, Rue Gaston Veil, Nantes, 44 093, France*

The court ruled that Nicolas Perruche could sue his mother's physicians because they had failed to detect that she had caught rubella, a virus similar to the measles, during her pregnancy 17 years before. As a result of his mother's infection, Perruche was born blind, deaf and has a mental disability. Perruche's parents claimed that they would have aborted him as a fetus had they known he would have those disabilities. The controversial French landmark case became known as a "wrongful life" claim.

However, a firestorm of controversy by the religious leaders, philosophers as well as medical and legal ethicists sought to overturn the French Supreme Court. Consequently, in March of 2002, the French Parliament enacted a law prohibiting liability for wrongful life claims and apparently overruled the French High Court by stating that "No one may claim to have been prejudiced by the simple fact of their birth." This presentation will demonstrate how, the wrongful life action was created in France and how it was changed in view of the French legislation prohibiting such claims. A study was performed at the University of Nantes to study how, if at all, this changed the liability of French physicians.

The special law prohibiting wrongful life actions established that there must exist a direct link of causality between the medical malpractice and the injury in order to award monetary damages to the child. However, this law has accepted the liability of the physician in specific cases of medical fault. The purpose of this study is to define those professional faults.

French judges now employ the *sine qua non* (indispensable condition or thing) theory of causality and have abandoned the "but for" rule that causation would not have occurred without the party's conduct. Now a physician's failure to properly terminate a pregnancy, which was requested by the mother or failure to utilize the available diagnostic test during a pregnancy or the failure to detect an immune antibody in the fetus, which results in injury to the newborn are now typical acts of medical malpractice, which will hold the physician at fault.

Wrongful Life, Professional's Faults, Sine Qua Non Causality

E13 Idolatry of the 21st Century Forensic Sciences: Gateway of Opportunity for the Conviction of the Wrongfully Accused

Chantal Ferraro, PhD, Department of Anthropology, CW Post Campus, Long Island University, Brookeville, NY 11548; O'Brian C. Smith, MD, and Teresa A. Campbell, MD, 381 Cherry Hollow CV, Cordova, TN 38018; and Elayne J. Pope, MA, Department of Anthropology, University of Arkansas, Fayetteville, AR 72701*

Attendees will gain the ability to discriminate between effective science, erroneous science and the need to ensure criminal investigations are well coordinated and integrated.

This presentation will impact the forensic community and/or humanity by demonstrating higher quality investigations, recognizing inherent flaws in the system, and avoidance of wrongful prosecutions.

The *Frye* test and now the *Daubert* standards are evolving tools designed to ensure the sciences and attendant expert opinions presented in court are truthful, accurate, accepted by the scientific community and are stated by persons who are themselves sufficiently qualified to truly know what they are testifying about. Despite the evidentiary requirements, each case is initially an isolated event before a judge who stands as the sole gatekeeper to scientific testimony and unless some issue is addressed at an appellate level, inappropriate evidence may be admitted with devastating effects.

The risk of admitting erroneous science has many sources, human, cultural and systemic. The various etiologies reflect the systemic inability of a diverse scientific and medical community to adhere to accepted guidelines and protocols, to monitor themselves, correct the misinformed and the inexperienced apply sanctions to the charlatans and those with agendas or lacking objectivity. Cultural practices affect investigative techniques: do scientists correlate laboratory findings with the crime scene to account for changes in specimens occurring between the crime and the analysis? Did the testifying scientist perform the procedure or are they depending upon the work of another? Do agency rivalries or rifts exist because of differences in culture or competencies? Human factors also abound, how thoroughly do investigators communicate? Are members of a multi-agency "task force" sufficiently familiar with each other to use communication tools (statements vs. summaries) in common? This unseen environment is permissive; prosecutors are susceptible to using errors of science because they work with whatever they have been handed. After all, not being scientists and expecting *Daubert* to be followed innately may produce a mindset where the possibility of being misled accidentally, much less deliberately never occurs to the attorneys involved. Anxious, since forensic science crime shows became so popular, for the most scientific support of their argument, the opportunity exists for attractive yet erroneous science to enter the courtroom. Under the current rules of evidence it becomes the burden of the defense to either challenge everything under *Daubert*, compromise or fail to challenge because the discovery "looks OK" or seek to identify potential discrepancies in the science. This latter is often difficult since the worksheets capable of revealing this are not readily discoverable.

Sources of error with some examples for presentation:

- Disjointed investigation: communication problems among investigators arising from using the "task force" concept. Incomplete turnover of information, personal and agency mindset, rotation of personnel, "do loops" [old wrong information circulates about and returns as "new" information and is still wrong].
- Opinions formed from a distance: use of suboptimal technology failure to ask questions and gain essential details. Lack of proximity to situation results in limited communication, investigators and attorneys know only others decide to share.
- Opinion as fact: "trust me I'm a doctor."
- Loss of objectivity: sentimentalism destroys emotional balance, as seen with child cases, sexual assault.
- Science removed from reality: building foundation of proof from one fact, an inverted pyramid of logic (Descartes, 1596-1650).
- Violation: failure to obtain peer review.
- Infraction: failure to follow established agency guidelines for establishing new procedures.
- Bias: identification with government, wants to be a "team player."
- Misinformed: reliance upon an incomplete fact basis.
- Dogma: reliance upon tradition, "father to son" science as in exploding heads.
- Myth: hypothesis appealing to emotionality as in rule-of-three theory in child deaths.
- Absence of scientific method: intuitive reasoning, not deductive, rejection of coincidence.
- Idolatry: new "sciences" profilers, cadaver/anthrax dogs, facial recognition.
- Subjective validation: belief beyond accepted norms currently accepted in court, polygraph.
- Cultural prejudice: ritual (satanic) abuse of children in daycare facilities.
- Inappropriate expertise: over-reaching from one discipline to another.
- Ignorant: flat out don't know what they are talking about.
- False Authority: documented expertise in one area is not conferred with administrative authority over other areas.
- Misplaced confidence: assumptions that scientific guidelines have been followed.
- Charlatan: junk science and pseudo-science.

The above lists some of the "cracks" that are currently open for anyone prone to making assumptions is likely to enter. If one is to be as proud of science in the 21st century as in 20th, then advances need to be lauded with the ability to guarantee its quality matches its utility.

Jurisprudence, *Daubert*, Forensic Science

E14 Don't Tell The Defense: A Case Study in Forensic Misconduct and Wrongful Conviction

Gregory W. O'Reilly, JD, MA, Cook County Public Defender, Suite 1700, 69 West Washington, Chicago, IL 60602*

Attendees will learn about the need to follow ethical and legal requirements to turn over exculpatory information to the defense, the hazards of creating injustice from failing to reveal exculpatory test results, the costs of laboratory refusal to remedy institutional failures, and the promise of post trial DNA testing to correct erroneous convictions.

This presentation will open the eyes of attendees in the community about how scientific misconduct can happen, how responses can become a denial of responsibility and circling of the wagons, the costs of such misconduct in wrongful conviction, loss of focus on alternate suspects, the loss of public trust, and million dollar judgments against government entities. The presentation will also show the community the benefits of open discovery and how the fear of turning over results and information to the defense is short-sighted.

In 2004 the City of Chicago and Cook County Illinois paid John Willis $2.5 million to settle his legal claim of forensic fraud. Willis had been erroneously convicted as the "Beauty Shop Rapist," on eyewitness testimony for a string of unusual serial rapes and armed robberies in Chicago's Chatham neighborhood during 1989 and 1990. No physical evidence or confession linking Willis to the crimes was introduced at either of the trials. Before trial, however, Willis had requested serology testing on a toilet paper wrapper into which a victim had spat the attacker's semen. On March 19, 1991, counsel for Willis filed a discovery motion under the rules of the Illinois Supreme Court, and asked for test results and exculpatory information. The motion also asked for "any report and results of any and all scientific tests, experiments and examinations made by experts or others and the names of such persons who conducted the tests, (including, but not limited to, such tests as ballistics, fingerprints, blood, semen and other stains) pertinent to this case."

The Chicago Police Department laboratory, however, contended in a report that testing was "inconclusive," and the lab's analyst repeated this contention at trial. No test results were provided to the defense. After Willis was arrested, the string of crimes continued in the neighborhood, until another man, Dennis McGruder was arrested and charged with committing five more of the unusual serial rapes and armed robberies in the same neighborhood. Prosecutors' succeeded in keeping information about McGruder from the jury. Willis was convicted of two of the cases, and sentenced to 100 years. McGruder pleaded guilty to five cases, and was sentenced to 40 years.

In July 1997 Willis, then represented by the presenter, requested DNA testing on the semen-stained toilet paper wrapper and other evidence. It was the first request under what was then the nation's second post trial DNA statute. Upon hearing of Mr. Willis' request, the prosecutor told the press that such testing would be meaningless, because "John Willis absolutely, positively is the rapist." Nonetheless, a court granted Willis' request for DNA testing. In late 1997, police, the lab, and prosecutors contended that all evidence had vanished without explanation. In 1998, defense investigation revealed that, from the nineteen-eighties until his arrest, Dennis McGruder lived in the center of the crime spree attributed to Mr. Willis. Also that year, the defense discovered key evidence was

concealed from Willis for eight years—blood typing results performed by the Chicago Lab in 1991 but not given to the defense that showed he was type B, while the rapist was type A.

The Chicago lab's analysts test results excluding Willis as the semen contributor in the rape were test results that the law required to be produced to the defense. They were not turned over. The test results were also exculpatory—evidence of innocence—that must be turned over to the defense by Supreme Court rules. Indeed the U.S. Supreme Court ruled in *Brady v. Maryland* that government has a continuing duty to disclose such evidence of innocence to the accused. No test results were turned over to counsel for Mr. Willis before trial, and the lab analyst testified that the results were "inconclusive" without saying a word about the fact that they excluded Mr. Willis.

In the Willis case, and possibly other recently revealed cases, the Chicago Police Department laboratory engaged in a pattern of concealing exculpatory test results. This began in the Willis case when the results were not turned over to the defense before trial in 1991. It continued when the laboratory report indicated that the results were "inconclusive," and was compounded by the deceptive and inaccurate trial testimony about the supposedly "inconclusive" results. Ironically, according to the serology protocol then used by Chicago lab "the goal of the expert witness should be the ascertainment of scientific truth." More startling, personnel at the Illinois State Police laboratory in Chicago, which absorbed Chicago's lab in 1996, were aware of the exculpatory results in 1997, when Willis requested testing, and never told the defense.

In August 1998, the defense interviewed the analyst, now working for the Illinois State Police, who acknowledged the authenticity of the test results. Forty-five minutes into the interview, the prosecutor said he had found the slides from the semen-stained wrapper in the "trial file." No explanation was ever provided for why they had claimed all evidence was missing, or what became of other evidence, including the semen-stained wrapper, which had been used by the prosecution as an exhibit at trial. The defense had the slides documented at Microtrace in Elgin, Illinois. The amount of sperm from the semen remaining on the slide was the size of a pinhead. The defense then drafted a testing protocol, and had the slides tested under the direction of Pamela Newall and Ed Blake, at the Center for Forensic Sciences in Toronto. In February 1999 testing cleared Willis. The defense obtained a court order to have a DNA sample from McGruder tested, and it matched the attacker. In March of that year, all charges against Willis were dismissed. One week later newspapers reported the analyst had been promoted to head the Illinois State Police DNA section in Chicago—an ASCLAD/LAB accredited forensic laboratory. Willis had spent over nine years in prison as a notorious serial rapist, his eldest son, John Jr., was murdered while he was in prison, and his life was left in taters. In 1999 Governor Ryan granted Willis a pardon based on actual innocence. In 2004, the City and County settled Wills' suit for $2.5 million. No action or discipline was taken against any government agency or individual.

Ethics, Discovery, Fraud

E15 Judicial and Jury Bias in the United Kingdom: An Analysis of Recent Cases

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After attending this presentation, attendees will gain knowledge of recent cases relating to judicial and jury bias in the United Kingdom and an appreciation of their application in other common law jurisdictions.

This presentation will impact the forensic community and/or humanity by providing insight into some of the extra-curial factors that can influence judicial proceeding and the way that that British Courts try to minimize them

Judicial and Jury bias in the United Kingdom is a topic that has been litigated in a number of interesting cases in recent years. Presented here are some of those cases and drawn conclusions that will be of interest to and helpful to Jurists and Advocates in other common law jurisdictions.

- What happens when a Politician becomes a Judge?

This is something that is relatively rare in the UK, but is probably more common in the United States where a significant number of Judges have to actively engage in the political process in order to reach, and stay on, the Judicial Bench. In *Davidson v. Scottish Ministers* [2004] UKHL 34, the House of Lords held that Where a government minister who had drafted or promoted legislation subsequently became a judge and was required to give a judicial ruling upon the effect of that legislation, there was a real risk of apparent bias because, despite the judicial oath, there was a very real possibility that that the judge would subconsciously strive to avoid reaching a conclusion that would undermine the assurances he had previously given to Parliament.

- What happens when a Judge is a member of an organization with a political agenda?

In 1998, General Pinochet, the former Chilean Head of State was arrested whilst visiting London for medical treatment on an International Warrant alleging crimes against Humanity. Hardly surprisingly, litigation followed. Amnesty International was a party to some of the litigation. The House of Lords Appellate Committee hearing one of the cases included Lord Hoffman, a Director of Amnesty International. In ordering a fresh hearing, a differently constituted Court somewhat briskly concluded "Once it was shown that the judge had a relevant interest in the subject matter, he was disqualified without any investigation into whether there was a likelihood or suspicion of bias unless he had made full disclosure."

- What happens when a Juror falls in love with an Advocate?

This has been litigated on a number of occasions; in *R v. HM Coroner for Kingston – upon Hull* [2001] EWHC Admin 352 a number of issues arose. This was a Judicial Review following a contentious inquest into the death of an Afro-Caribbean ex-paratrooper in police custody. One of those issues was that a juror had apparently had a torrid affair with one of the advocates. The Administrative Court found that in fact the affair had started after the Jury had returned their unlawful killing verdict. The Court nonetheless reviewed the law relating to jury bias and the test that had to be applied. The same test was applied in *R v. Alexander & Steen*, two court of appeal cases heard in July 2004, the Court heard how the female foreman of the Jury had sent champagne and a dinner invitation to the prosecution counsel after the unanimous guilty verdict had been returned.

- Does membership of a Masonic or Quasi-Masonic organization constitute judicial bias?

It can, as held by the European Court in *Remli v. France*, ECHR 1995/510/593. Norman Robertson, an ardent Scottish Nationalist, who changed his name by deed poll to Robbie The Pict engaged in a long series of cases in the Scottish Courts related to his disinclination to pay the toll charged to drive over the bridge to Skye. In one case, *Robbie the Pict v. HM Advocate* [2003] ScotHC 12, he took issue with the fact that many members of the Scottish Judiciary are members of the Speculative Society, a quasi-Masonic organization, and that this could create an impression of bias in fair minded people. His arguments did not cut much ice with the Court who in their judgment commented "we can see no reason why any reasonable onlooker could suspect that the loyalties and friendships that typify any society of this kind should in this case override the obligations of the judicial oath."

Judicial and Jury bias is a practical and ethical issue in all jurisdictions. The British approach with vigorous supervision by the Higher Courts, who are, on occasion invited to judge the conduct of their own members, is instructive.

Ethics, Bias, Triers of Fact

E16 Forensics and the Media: The Affects of Forensics on Television on the American Juror

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After attending this presentation, attendees will gain a better understanding of the sociocultural influences on many disciplines.

This presentation will impact the forensic community and/or humanity by seeks to identify the challenges of expert testimony and court procedure due to preconceived folk knowledge of forensic science.

In contemporary times, a myriad of forensic sciences exploded onto the scene that parallels the ferocity of technological advancement, thus expanding capacity to increase the objectivity and accuracy of criminal investigations. Parallel to this phenomenon is a vast public intrigue that has been increasing just as feverously - as marked increased lip service in the media, the development and proliferation of television dramas with forensic science services as its primary premise, and the expansion of secondary and post-secondary educational courses and degrees in the forensic sciences. Unfortunately, there is an uncertain amount of misinformation that may have a very strong influence on the criminal justice system in various ways, particularly in the portrayals of the forensic sciences on television. In the criminal justice system, jurors perhaps are the most susceptible to use this misinformation in their decision making. This project seeks to identify the problematic portrayals of the forensic sciences, to describe the influence it has on the American juror, and to determine if this phenomenon has any detrimental effect on the jury trial system.

Media, Law, Jury

E17 Forensic Science and the Bermudian Criminal Justice System

Mark J. Pettingill, JP, Wakefield Quin, Chancery Hall, 52 Reid Street, Hamilton, HM 12, Bermuda*

After attending this presentation, attendees will understand an analysis of the use of forensic science in two Bermudian murder trials and the application of the Bermuda Criminal Code Act 1909 and other relevant legislation in those cases highlighting the distinctions in law in an old Colonial system

This presentation will impact the forensic community and/or humanity by calling attention to the inadequate methods of gathering and presenting forensic evidence currently practiced here in Bermuda. A consequence of this general approach to the gathering and presentation of forensic evidence is that it may well lead to injustice as evidence of questionable quality and degree is left to the jury for final analysis. In an infamous Bermudian murder case that drew international attention, the prosecuting authorities clearly failed to initially conduct a proper forensic investigation. Subsequently, when eminent professional Dr. Michael Baden and Dr. Henry Lee gave clear evidence at trial, the case was dismissed by the trial judge on the basis that there was no case to answer; a decision later heavily criticized by the British Privy Council.

The proposition of this presentation will highlight how modern forensic science and the gathering of forensic evidence have been poorly applied to an older, British colonial system of law; the British approach to all evidence being guided still by the maxim, "Evidence is good even if it is stolen."

The context will involve a brief overview of the relevant law and discussion of three legal cases, two of which involved the expertise of both Dr. Henry Lee and Dr. Michael Baden. The presentation will involve crime scene photos and discussion of expert evidence.

One will conclude that an improper approach to the application of modern forensic science may lead to injustice within the Bermudian Criminal Justice System.

Crime Scene, Admissibility of Evidence, Bermuda Law

E18 The Use and Admissibility of Sense-Enhanced Technologies in Criminal Cases

Richard D. Karasiewski, JD, and Gregory J. Mitchell, JD, U.S. Dept. of Justice/ Drug Enforcement Administration, Office of Chief Counsel, E-12145, 600 Army Navy Drive, Arlington, VA 22202*

After attending this presentation, attendees will understand the prescient analysis of the legal issues involved in the use of sense-enhanced technologies.

This presentation will impact the forensic community and/or humanity by identifying keys issues regarding the admissibility of scientific evidence; reviewing the history of sense-enhanced technology; and providing understanding of the legal conditions for the use of sense-enhancing technologies.

The Fourth Amendment of the United States Constitution governs all searches and seizures conducted by government agents. It provides that *The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no warrant shall issue, but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched and the person or thing to be seized.*

In 1886, the United States Supreme Court first considered the Fourth Amendment threshold question of whether the conduct of government agents constitutes a "search" or a "seizure" that interferes with an individual's rights. During the 80 years that followed, the Court has continued to re-evaluate the reach of Fourth Amendment protections in the context of advances in more sensitive scientific investigative methods. In 1967, in *United States v. Katz*, the Court provided the backdrop to subjective notions of privacy versus the government's use of electronic or sophisticated sense-enhancing technology (an electronic listening and recording device attached to the outside of a phone booth) to perform informational searches on an individual. In 1983, in *United States v. Place*, the Court determined that drug sniffs by trained canines did not constitute a search. The Court stated *in dicta* that government agents may supplement their senses, without constituting a Fourth Amendment search, by using a narcotics detection dog to indirectly examine the concealed contents of an individual's container. The Court stated that this limited disclosure "ensures that the owner of the property is not subjected to the embarrassment and inconvenience entailed in less discriminate and more intrusive investigative methods." The Court has not articulated whether or how this principle may apply to subsequent sense-enhanced technologies. However, in 2001, in *United States v. Kyllo*, the Court fashioned a new standard for determining the admissibility of such scientific evidence. Justice Scalia held that "where government uses a device that is not in general public use, to explore details of a private home that would previously have been unknowable without physical intrusion, the surveillance in a Fourth Amendment 'search,' and is presumptively unreasonable without a warrant."

As technology advanced, law enforcement agents gained the ability to conduct searches using sense-enhanced technologies to obtain information that once required actual physical invasion. Law enforcement use of "pen registers" to record numbers dialed from a telephone, "beepers" to track a suspect's movements, high altitude aircraft to photograph facilities on the ground, or a thermal infrared imaging system to measure escaping heat and "see" through walls, have usually been deemed by the Supreme Court as measures not generally requiring a warrant, due to their level of intrusion. As a result of *United States v. Kyllo*, however, courts may deem the warrantless use of novel advanced technologies (such as an Ion Mobility Spectrometer (IMS) an unconstitutional search. However, there has been little case law regarding the use and intrusion of IMS (a particle sampling device for detection of drugs and explosives) as a drug field testing method by law enforcement agents.

In 2003, in *McGee v. State of Alaska*, the court addressed the issue whether the police must have reasonable suspicion to temporarily remove McGee's package from the normal flow of commerce and test it with an IMS. The State conceded that, until the police tested McGee's package

with the IMS, the police did not have reasonable suspicion that McGee's package contained or constituted evidence of criminal activity. In citing *Gibson v. State*, the court ruled that the police needed reasonable suspicion of criminal activity before they could temporarily detain a package and subject it to sniffing by a drug detection dog. In applying this earlier decision to McGee, the court held the same rule applies when the police temporarily detain a package to test for controlled substance with the IMS. The United State Supreme Court has not addressed this issue.

This presentation will examine law enforcement history and use of sense-enhanced technologies in light of the Fourth Amendment's reasonable expectation of privacy and the varying levels of intrusion involved.

Fourth Amendment, Sensory Enhancing Technology, Ion Mobility Spectrometry

E19 A Multi-Agency Protocol for the Mandated Destruction of DNA Samples (Exemplars) and Results

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The goal of this presentation is to provide information about how Canada has dealt with the issue of the retention and subsequent use of suspect and elimination DNA samples and records; and to describe the development of a multi-agency protocol for the destruction of DNA samples (exemplars) and results in criminal cases and provide information on some of the legal, policy and operational issues requiring consideration during the development of the protocol.

This presentation will impact the forensic community and/or humanity by demonstrating various legal and policy issues have arisen in the forensic science and legal communities in regard to the retention and subsequent use of suspect, elimination and victim DNA samples and records. This presentation provides information on 1) how Canada has dealt with this issue by mandating destruction of DNA samples and records under certain conditions, and 2) the design of a multi-agency protocol in the Province of Ontario to accomplish the destruction. The presentation also provides information on various legal, policy and operational considerations in the protocol design.

This presentation will describe the protocol being used in the Province of Ontario to accomplish destruction of 1) DNA samples obtained under "DNA warrant" or by consent from suspects, accused persons, and other persons of interest in criminal investigations, and 2) the records of forensic DNA analysis of those samples. In addition, the legal/policy and operational considerations involved in the development of the protocol will be discussed.

In Canada, the *Criminal Code* mandates destruction "without delay" under certain specified conditions of the results of forensic DNA analysis and of known DNA samples (exemplars) obtained, either voluntarily or under a "DNA warrant," from suspects, accused persons and other persons of interest in criminal investigations. The main ground for destruction is exclusion of the person as the source of DNA from the "crime scene" ("crime scene" includes the place where the offence was committed, medical samples taken from a victim, anything worn or carried by the victim at the time when the offence was committed, and the body of any person or thing and any place associated with the commission of the offence). For "DNA warrant" samples, destruction must also occur if the person has been acquitted or one year has expired after: discharge after a preliminary inquiry; dismissal, for any reason other than acquittal, or withdrawal of any information charging the person with the designated offence or any other offence in respect of the same transaction; or a stay of any proceeding against the person for the offence or any other offence in respect of the same transaction.

The *Criminal Code* also contains a provision whereby, in the case of samples obtained under a "DNA warrant," a provincial court judge may order that the bodily substances taken from a person and the results of forensic DNA analysis not be destroyed during any period that the provincial court judge considers appropriate, if the judge is satisfied that the bodily substances or results might reasonably be required in an investigation or prosecution of the person for another designated offence or of another person for the designated offence or any other offence in respect of the same transaction.

In designing the protocol a number of legal, policy and operational factors required consideration:

- Records kept by police, Crown counsel and forensic scientists and the nature of the information contained in those records
- Access to information within the criminal justice system
- Possibility of judicial orders delaying destruction of "DNA warrant" samples and results
- Designated officers (police officers with National DNA Data Bank duties) and upkeep of lists
- Timelines for response
- Custody, control and legal ownership of samples
- American Society of Crime Laboratory Directors/Laboratory Accreditation Board requirements for case records
- Disclosure (discovery) requirements
- The legal rights of accused persons, suspects, victims and other persons of interest under the *Charter of Rights and Freedoms*
- Case law on lost or destroyed evidence
- The legal meaning of certain terms used in the legislation (e.g., "without delay")
- Protocols in other provinces/territories of Canada.

The basic principles of the protocol are:

- Notification of the other parties by the organization in possession of the information that triggers the need for destruction
- Discussions between police and prosecutors
- In the case of "DNA warrant" samples and following discussions between the police and prosecutors, a decision on whether the Crown will apply for a judicial order to delay destruction
- Notification of the other parties when an order is made to delay destruction
- Notification of the action (destruction or retention) to be taken by the forensic laboratory and the reason for that action
- Confirmation by the laboratory of destruction.

In addition, to facilitate the destruction, changes were made to some of the information captured in records within the Centre of Forensic Sciences and to DNA reports issued by the Centre of Forensic Sciences.

DNA, Multi-Agency Protocol, Destruction

Odontology

F1 Jane Doe: The Odontologist's Role in Identification of an Unknown Decedent

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The goal of this presentation is to present to the forensic community a description of the role of an odontologist in identification of an unknown person when no other information is available. This presentation will impact the forensic community by providing a protocol or template to facilitate data integration and ultimately identification with scant antemortem information.

This presentation will impact the forensic community and/or humanity by providing a protocol for identification of an unknown victim where antemortem data is not available.

Occasionally, the odontologist is called upon to aide in the identification of an unknown decedent. Frequently, there may be no information available in order to do a standard analysis and comparison of dental radiographs. Thus, the dental analysis becomes but one piece of a larger pool of information that may be used to expedite the identification.

Other sources of information may be the forensic pathologist's report, police report, witness report, or anthropological report. These bits of information may be meaningless when evaluated alone, but when all data is collated and compared to missing persons' reports or other data based information sources, it could provide the needed answers.

By case example the author will attempt to describe a protocol for identification using all possible sources of analyses, such as pathology, missing persons' reports, NCIC, local, state, and federal data bases, anthropometric measurements as well as postmortem dental information. Often, these cases lay dormant for many years until a key piece of information is obtained. It is imperative for all investigators to be diligent in their analyses and interpretation of their findings. Dental radiographs may be of paramount importance and must be accurate and detailed in their analysis. All findings must be recorded in the appropriate databases.

The odontologist may be working independently of others. In the case example provided, this investigator had the luxury of participation in a team of experienced medicolegal professionals. Many forensic disciplines were represented and able to collaborate. My function was to collect as much dental information as possible.

The dental analysis may give clues as to the country of origin, if recognizable restorations of a particular culture or prevailing dental materials or methods can be observed. Further, age and race may be inferred by consulting with established charts. Other pertinent information may be the time of death, location, cause and/or manner of death. In this example the forensic anthropologist had made a substantial contribution by providing a possible "sketch" of the unknown based on certain class characteristics. Hair analysis was also performed.

One must consider that the victim was found along a major highway and could really be from anywhere.

Once all data is collected and reported, one could turn to a national database and search by key words, such as "rose tattoo" or "gold incisor." While these may be great distinguishing characteristics, it is usually not that easy. First of all, the victim needs to be missed by someone so that a report or file can be generated. It is difficult to identify someone if critical data about them does not exist. Second, unusual identifiers are not always present or reported. Third, attempts may be made to conceal the person's identity, such as removal of clothing, documents, or destruction of soft tissues by fire or other means. Lastly, one must consider the possibility of an individual who is in this country unlawfully, and thus no information whatsoever exists.

Using the authors' example, a protocol will be established to demonstrate the process by which all investigators could use to follow the submission of evidentiary information, follow its progress, and reach a logical conclusion based on scientific methods for identification. Actual case history will be discussed, as well as the methods used by all disciplines involved in cases such as this. Photographs will be included as part of a flow-chart design.

Identification, NCIC, Anthropology

F2 Video Superimposition: A Method for Preliminary Identification

Denise M. Giordano, MS, University of New Haven, 300 Orange Avenue, West Haven, CT 06516; and Brandi J. Schmitt, MS, University of California, Davis, Med: Cell Biology and Human Anatomy, Donated Body Program, Davis, CA 95616*

Attendees will learn that video superimposition is a viable technique to preliminarily identify human remains through photographs exhibiting anterior dentition.

This presentation will impact the forensic community and/or humanity by demonstrating how simplistic techniques, while sometime overlooked, can be viable options for the forensic scientist.

The goal of this presentation is to develop additional data sets and provide further statistics which subsequently strengthen scientific basis in the identification of human remains through video superimposition of photographs exhibiting some anterior dentition, and the dentition of recovered human remains.

The comparison of photographic media is widely accepted and has shown itself to be fundamental to the field of forensic odontology. However, published literature has established the need for alternate dental comparison techniques. Furthermore, most current research is focused on the area of bite mark identification. A previous research project by one of the authors, which was presented at the AAFS 2002 Annual Meeting, has provided initial results that validate direct visualization and video superimposition comparisons as techniques with merit for narrowing potential matches.

This initial research project used 100 photos of unknown male/female subjects compared to both a known male and female subject. The new data set is based on 100 male/female unknown photographed subjects compared to the female skull also used in the initial study. This data set focuses on the use of video superimposition of anterior dentition, specifically noting colossal patterns and morphology, but also including size, wear/trauma/disease and/or other identifiable dental characteristics.

This methodology is readily adapted to training and education, and can be easily digitized. It has the potential to provide a streamlined method of human identification through forensic odontology, as in the instances of mass disasters (major air catastrophes, acts of terrorism), as well as singular human identification. This type of identification technique has the potential to drastically reduce man-hours in preliminary elimination of subjects. Furthermore it can contribute to larger numbers of positive identifiable records with reduced false inclusions and/or results that are indeterminate. While additional research is needed to further refine these methods, an added set of data in the video superimposition technique can provide a preliminary match rate envisioned to concur with that of the initial study. Formal participant results will be available and submitted no later than September 1, 2004.

Forensic Odontology, Video Superimposition, Occlusal Pattern

F3 Use of FTA® Cards to Store Salivary DNA for Identification of Missing Children

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After attending this presentation, attendees will understand the appropriate use of FTA® cards to store salivary DNA for children. The goal of this presentation is to present to the forensic and dental communities the ease and reliability of using FTA® cards to store DNA for the identification of children.

This presentation will impact the forensic community and/or humanity by educating forensic and dental communities on the effectiveness of using FTA to store salivary DNA for children.

Patented FTA® Cards provide a safe, secure and reliable method for the collection, transportation and storage of DNA evidence. FTA® Cards is a chemical treatment, which allows for the rapid isolation of pure DNA. When samples are applied to FTA-treated paper, cell lysis occurs and high molecular weight DNA is immobilized within the matrix.

Amplification and analysis can be performed directly from the treated paper without the need for extensive extraction and quantification procedures. Genomic DNA stored on FTA® Cards at RT for over 11 years exhibits no loss in PCR efficiency. The cards are designed to kill pathogens and prevent future colonization by bacteria or fungi so the card protects DNA from microbial and environmental degradation. FTA® cards can be used to store blood samples or salivary samples. Salivary DNA is obtained through the shedding of epithelial cells (salivary glands and ducts) and white blood cells from the oral mucosa. Using current PCR technology, a profile can be determined from these cells. Dentists and parents can employ the use of buccal swabs to obtain salivary DNA. This swab is then applied to the FTA® Card and the card is allowed to dry for approximately forty-five minutes. No special storage conditions are required - enabling parents to store the cards with other child-identifiers, such as fingerprints, videotapes, and photographs.

Given the overwhelming statistics of missing children, parents are encouraged to store valuable identification information for their children. By obtaining salivary DNA on FTA® Cards, a known reference sample is stored for possible future use. Community programs are in place to obtain other information. One such product being employed that is gaining popularity in the dental community is Toothprints®. Toothprints® is an arch-shaped thermoplastic wafer that is softened in hot water. A child is instructed to bite the wafer for 50 seconds. The wafer is then placed into a plastic bag and stored at room temperature. This product is being marketed as a bite mark registration and possible DNA source. The product, however, contains no substrate for retention or preservation of the salivary DNA. Although PCR analysis is effective on as few as 50 cells, it is uncertain how long any cells will be available with this technique as no testing has been performed.

If one has the opportunity to proactively store DNA material that can be useful in the identification of missing children, a reliable, proven method such as FTA® Cards should be used.

Salivary, DNA, FTA® Cards

F4 A Camera Apparatus That Can Aid in the Reduction or Elimination of Type I Angular Distortion in Bite Mark Photography

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After attending this presentation, attendees will understand an innovative technique to reduce or eliminate Angular I Distortion by using an attachable camera apparatus in bite mark injuries.

This presentation will impact the forensic community and/or humanity by enabling any forensic investigator, even those with minimal or no training in bite mark photography to take quality pattern injury images of victims to be analyzed and submitted as quality evidence in a court of law.

The author will introduce an innovative apparatus that can be attached to a digital or 35mm camera to aid and assist first responder photographers, law enforcement agencies, medical professionals and odontologists in the reduction or elimination of Type I Angular Distortion while taking bite mark evidence photographs.

The first line of processing evidence of any crime scene is through photography and other visual mediums. Often time an Odontologist is not available to take the necessary photographs in bite mark cases. The first responder may have minimal amount of photography training and possible none in bite mark photography. Depending on the nature of the incident and sensitivity of the occurrence, a time-limited activity may allow one opportunity to correctly complete the task. In bite mark cases, wide-angle orientation images are usually taken first without the scale, followed by close up photographs with scale. The purpose of the close up images is to obtain an accurate spatial relationship. This final process is crucial to insure that a significant comparison analysis can be accomplished.

One of the concerns in bite mark photography is Angular Distortion. There are four types. The apparatus being discussed minimizes Type I distortion only. Type I Distortion is the result of the scale and the pattern injury being on the same plane, but the camera angle not being perpendicular to the pattern injury.

Scale placement is of utmost importance in photography. The recommended scale is the ABFO #2 designed by the American Board of Forensic Odontology for use in bite mark photography and is considered the standard measuring device for this application. This is an L shape scale with measuring units on the inside of the L. Included are circular reference shapes, contrasting measuring bars and an 18% gray scale. The width of the L's is one inch. This technique incorporates **TWO** ABFO # 2 Scales. The scales should be placed upon the same plane of the pattern injury. If the plane runs on an angle, that angle must be matched to the scale. First, by placing two scales at right angles to one another, a square or rectangle is formed around the pattern injury. The second step is to align the guides that are attached to the camera apparatus, parallel to the square or rectangle (formed by the two rulers) around the bite mark. These guides are adjustable vertically and horizontally to incorporate the variable widths of the bite marks and distance into the LCD monitor or viewfinder. Bite marks should be photographed using oblique lighting, both at the crime scene and morgue. It is recommended that the LCD monitor be used for composing images when shooting close-ups in order to avoid parallax error when using a digital camera. An articulating LCD can be a great help when taking high, low or awkward angled images. If the currently recommended 5.0 mega-pixel resolution capability or higher digital cameras are used, then it is not necessary to use Macro Mode or to be within a few inches for a close shot. There are software products that allow for enlarging and obtaining Life Size (1:1) images. Even with the software program, detecting and correcting angular distortion is paramount before any accurate resizing and meaningful comparison can occur. One advantage of using a digital camera is the immediacy of the image. It is suggested that the camera be mounted on a tripod for support, and for keeping the camera in position after composing the close-up image for both types of cameras.

Documentation in photography is an important and powerful tool in the investigation of violent crimes as in bite mark injury. By using the attached apparatus, a forensic investigator may reduce Angular I Distortion and provide high quality images as evidence.

Forensic Odontology, Forensic Photography, Angular I Distortion

F5 Morphological Analysis of Root Development of the Third Molar by the Study of Digital Ortopantomography

Francesco Introna, PhD, Valeria Santoro, DDS, Antonio DeDonno, MD, and Maura Belviso, PhD, Section of Legal Medicine DIMIMP, University of Bari, P.zza Giulio Cesare, 11, Bari, 11-70124, Italy*

The goal of this presentation is to test the possibilities offered by ortopantomography executed by means of digital technology.

At present there is a large immigrant population in Italy and young foreign criminals sometimes have false passports bearing a later birth date with the goal of evading punishment. This presentation will impact the forensic community and/or humanity by providing a method of age determination, which is becoming a significant forensic issue.

Accurate timing of the eruption of first and permanent teeth is an important parameter in forensic odontology to establish the age of dead or live individuals.

Determination of adulthood may determine, for example, whether an individual convicted of a crime is sentenced as an adult and incarcerated in a state penal institution or as a juvenile and sent to a juvenile camp. At present there is a large immigrant population in Italy and young foreign criminals sometimes have false passports bearing a later birth date with the aim of evading punishment. In such circumstances age determination is becoming a significant forensic issue.

Late in adolescence, after formation of the premolars and canines, only the third molars continue to develop. According to several studies, although the third molars are the most variable teeth in the dentition, they remain the most reliable biological indicator available for estimation of age during the middle teens and early twenties.

In this study the authors test the possibilities offered by ortopantomography executed by means of digital technology, with the aim of exploiting the advantages of the computerized digital technique compared with the conventional technique, to determine adult age on the basis of root development of the third molar.

Digital x-ray technology is currently applied for dental identification of dead individuals, in particular in mass-disaster cases. Digital radiography is simple to use, quick and effective, allowing superimposition and enlargement; the images can be electronically stored and transported.

In comparison with traditional opt, the digital technique features greater diagnostic accuracy of some anatomic structures: upper and lower front teeth, root apexes, floor of the nasal fossa and maxillary sinus, nasal septum, and mandibular condylus. Moreover, digital ortopantomography suffers less from artefacts.

The digital ortopantomographies of 51 subjects (33 females and 18 males) aged between 16 and 22 years were analysed in standard conditions, assessing the degree of maturation of the upper and lower third molars.

A standardized computer procedure was used to acquire the x-ray images, recording three per plate: the overall ortopantomography and two enlargements of optical type of the left and right sides, to reveal the third molars while maintaining unaltered the image resolution.

For the analysis the authors adopted Demirjian's staging system that classifies development of the third molar in eight stages (A, B, C, D, E, F, G, H) on the basis of morphological criteria. This has been statistically proved to feature notable precision and high predictive ability.

To assess any sex-related variations in mineralization speed, the series was subdivided by gender. The study demonstrated that such differences are more evident under the age of 18 years.

Overall, the observation of 181 third molars showed faster development of the upper than the lower third molars, a prevalence of stages D to G in the age range between 16 and 18 years, and a clear predominance of stage H in individuals over 18 years of age. Finally, an intermediate stage between G and H was demonstrated in subjects aged between 17 and 21 years.

Forensic Odontology, Digital Radiology, Third Molar

F6 Query Analyzer for WinID - From Beta to Release

Kenneth W. Aschheim,DDS, 44 East 67th Street, New York, NY 10021*

The goal of this presentation is to familiarize the attendee with the final released version of a new odontologic computer program to be used in conjunction with Dr. James McGivney's WinID8 dental identification program. The attendees will be introduced to the new user interface, context sensitive help and new feature that allows the program to be used not only in a mega disaster but also in the national security and in nationwide management of odontological forensic data.

This presentation will impact the forensic community and/or humanity by demonstrating how the release of this computer program will help expedite the identification of victims of a mass disaster or bioterrorist attack by odontologic means. New features allow the program to be used for the nationwide management of odontological forensic data.

Last year the basic theory behind Query Analyzer for WinID8 (QA for WinID8) was presented at the AAFS meeting. The program was designed to run with Dr. James McGivney's WinID8 dental identification program - the gold standard used by forensic odontologist's for many years.

QA for WinID8 has be designed to deal with large amounts of odontological forensic data whether it comes from victims of a mass disaster, a national database of missing persons, or any other need to match dental information with known data. It utilizes filters, which in computer jargon are referred to as queries, and is designed to reduce the number of possible matches by eliminating "unexplainable discrepancies." Because of the universality of the Standard Query Language (SQL), the method QA for WinID8 uses to filters information, it allows for an easy method to bridge with other database programs. This filtering is done automatically by QA for WinID8 and therefore does not require any knowledge of the SQL.

This year the program has undergone refinement to further increase it usefulness. The user interface has been simplified, context sensitive help, and a user manual has been added. In addition the algorithms have been further modified to better identify matched sooner. New expanded security features have also been added to limit access to the program to authorized users. Finally new "multi-site bridging capability" has been added to greatly expand the programs functionality.

Computer Program, Mass Disaster, Query Analysis for WinID

F7 Grin Line Identification Using Digital Imaging and Adobe® Photoshop®

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The goal of this presentation is to present the exposure to a digital imaging method which can utilize antemortem photos of a victim to assist in postmortem identification.

This presentation will impact the forensic community and/or humanity by showing how the comparisons made by the forensic odontologist using the Grin Line ID System (GLID) may allow determination of a possible or probable identification or exclusion.

Background: Successful forensic dental identification is dependent upon accurate antemortem and postmortem records. The process is hindered when no antemortem dental records exist. Digital technology and software improvements have revolutionized analysis and processing techniques for imaging and management of photographic data to the point where they are valuable tools in this operation. Currently, some forensic dentists have successfully utilized photographs to aid in identification.

Objective: 1) to outline a method by which an antemortem photograph of a victim can be evaluated against a postmortem photo in an

effort to facilitate the identification process; 2) to describe the steps involved with the digital camera, a flatbed scanner, and the Adobe Photoshop software in developing the image management used for comparisons; and 3) to understand the applications and the limitations of the GrinLine Identification (GLID) system.

Methodology: Ten subjects, between the ages of 27 – 55 years old, provided historical photos taken of them exhibiting a broad smile with anterior teeth showing to some extent (a grin). These photos were termed "antemortem" for the purpose of this study.

A Sony DSC-V1 digital camera was used to take a current photo of each subject's grin at approximately the same angulations as the historical photo. These photos represented the "postmortem" images.

This combined data was then entered into a computer via a scanner or direct input from a memory stick. Using Adobe® Photoshop® software, the images were resized and oriented for comparative analysis.

Conclusions: Utilizing the techniques outlined in the **GrinLine** ID system, it was possible to confirm its benefit as another tool in the armamentarium for analysis. It appears to be better suited for those instances when the odontologist is working with a smaller number of cases to compare since the procedures involve image management comparisons. Mandibular teeth show more variability and are more suited to analysis. The primary difficulties encountered were with respect to geometric and spatial orientation of the antemortem and postmortem views and the availability of a recent antemortem photo of adequate quality showing anterior teeth. Pictures that show a wide smile with visible lower teeth in a full-face photo are much easier to orient and have a higher validity in comparisons.

The comparisons made by the forensic odontologist using the GLID system may allow determination of a possible or probable identification or exclusion.

Odontology, Photographic Comparison, Forensic Identification

F8 Universal Standards for Charting in the Dental Office Using WinID

Susan G.S. Anderson, BS, DMD, 711 West Fourth Street, Williamsport, PA 17701; James McGivney, DMD, 66 Grasso Plaza, St. Louis, MO 63123*

The goal of this presentation is to recommend universal dental charting standards based upon the WinID computer program symbols and odontograms, and to encourage complete dental charting and radiographs for patients of the dental office.

Adopting Universal Standards for dental charting and accepting the responsibility for completely charting and radiographing patients' oral environment will impact the forensic community and/or humanity by streamlining identifications in the cases of future disasters. Terrorist attacks, as well as natural disasters, challenge resources to adequately identify victims in a timely fashion. By standardizing record keeping, this presentation will impact the forensic community and/or humanity by providing dentists a tool to provide a great service to humanity.

Universal standards for dental charting will ease the burden of identifications in mass disasters, missing persons, or unidentified bodies nationwide by providing the forensic odontologist with antemortem charts that can be readily interpreted and easily entered into the WinID computer program. Forensic odontologists must lead the way by setting the example for general dentists.

Any forensic odontologist who has made a dental identification, or worked a disaster is familiar with the difficulties of reading and interpreting antemortem dental records from the general dentist or specialist. Often dentists have their own shorthand and charting techniques, which vary from area to area, dentist to dentist, and even country to country. This presents a major problem for odontologists when trying to compare antemortem and postmortem records.

Dental schools teach that the standard for recording information on patients in a dental office should be a complete charting of the head and neck, extra-oral, intra-oral, and dental regions. Included in this is charting of all present restorations and caries, and a full mouth set of radiographs. Unfortunately, many dentists do not completely chart patients for a baseline. Many only record the dental work needed to be done and chart the work completed.

Incomplete charting provides little or no information for the odontologist to use in comparison. This travesty is a disservice to families of deceased or missing loved ones. Only complete head and neck, extra-oral, intra-oral, dental and radiographic recording in the chart can provide an adequate baseline from which a comparison can be made.

It is critical for forensic dentists to set the example to initiate universal charting standards and complete charting procedures. Using charting designations based upon the WinID computer program standardizes records making interpreting and translating these records into the WinID program antemortem chart significantly easier and faster.

The WinID program, designed by Dr. James McGivney, has been used in many disasters including: commuter plane crash in Guam in 1996; Korean Air disaster in Guam in 1997; Alaska Air disaster in Ventura, CA; Bourbonnais, IL Amtrak train wreck; AirEgypt in Rhode Island; and the World Trade Center in 2001. It was reported that WinID was also used in Madrid on March 11, 2004 (known as 3/11) and in Bali at the bombing.

WinID is available in several languages, including English, Spanish, French, and German. An improved French and Italian version is expected soon. The charting's simplicity makes it attractive for use by general dentists, and its ease makes it straightforward to incorporate into the dental record.

The WinID Antemortem Chart provides odontograms and a descriptors list of primary and secondary codes for charting the oral cavity. The new NCIC dental codes (NCIC2000) are a subset of the WinID codes. Included on the page is personal and radiographic information. Using this chart can assist the dentist in assuring that the chart is complete and conforming to universal standards.

When a dentist conscientiously charts a code for every tooth area using WinID's codes, minutes if not hours can be shaved from the time it takes the forensic odontologist to translate this information into the computer program. For instance, if a dentist charts teeth #17, 18, and 22 as EXT, CR and "nothing," respectively, the odontologist has to interpret and translate those designations into the WinID codes before entering it into the Antemortem Chart. However, if the dentist codes them X, MODFL/GCR, and V respectively, the codes can be immediately transferred to the Chart.

Disasters, as well as increased numbers of missing or unidentified persons, are occurring at an alarming rate. The ease and speed with which an odontologist can make identification is related to the ability to read and interpret records provided by the antemortem dentist. Establishing a universal dental charting standard based upon the computer program WinID provides the forensic odontologist with records that can be quickly and easily added to the WinID database for comparison with postmortem data. Forensic dentists must set the example by implementing these standards into their own dental offices and encouraging non-forensic dentists to do likewise.

Universal Dental Charting, WinID, Identification

F9 Tooth and Consequences

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Attendees will be provided with a different method of odontological comparison and understand the importance of evidence technicians.

This presentation will impact the forensic community and/or humanity by showing a unique way to utilize dental evidence to help in a robbery homicide.

The defendant (SAB, Jr., a white male, age 27) went into an adult video store in College Station, Texas at about 5:30 a.m., September

28,1994, demanding the clerk's (WJW) money and truck keys. After he was given the requested items, he then shot the clerk in the head with a folding type 12-gauge shotgun. The defendant was not familiar with this type of stock folding weapon and it kicked back and struck him in the chin, lip and mouth breaking a front tooth when the fatal shot was fired. He cleared the cash register of its cash, estimated to be between $40-50. The defendant then fled the store in the victim's pickup truck. The truck was later spotted in an adjacent town by a Texas State Trooper who arrested the defendant. At the time of the arrest the defendant then fled the store in the victim's pickup truck. The truck was later spotted in an adjacent town by a Texas State Trooper who arrested the defendant. At the time of the arrest the defendant had a cut under his lip from the recoil of the shotgun and blood on his shirt. Following his arrest he confessed to the robbery and murder. A dental study cast was taken shortly after the arrest of the suspect. Mr. Berry Wilherson, an evidence technician from the College Station Police Department recovered a portion of a human tooth from the scene of the robbery homicide. This fragment matched a missing portion of a tooth in the dental study cast of the suspect. The defendant was convicted in the robbery and murder on August 1, 1995, and was executed by lethal injection on May 30, 2002. His statements given at the time of his arrest and execution will be given in the presentation.

Robbery/Murder, Tooth Fragment, Execution

F10 The Dental Forensic Value and Usefulness of ToothPrints®

Jon C. Dailey, DDS, 4504 Guildford Court, Evans, GA 30809; James McGivney, DMD, 66 Grasso Plaza, Saint Louis, MO 63123*

After attending this presentation, attendees will appreciate the usefulness of ToothPrints® in the dental identification of children.

This presentation will impact the forensic community and/or humanity by demonstrating this study indicates that a properly fabricated ToothPrints® can be useful in completing a dental identification of a child.

ToothPrints® is a product that has been made available to dentists by the Kerr Unit of Sybron Dental Specialties, Inc. ToothPrints® is a patented, arch-shaped thermoplastic wafer. The wafer is softened in hot water. A child bites into the softened wafer to record their individual tooth characteristics, tooth position within the arch and the upper to lower jaw relationship. The ToothPrints® is stored in a zippered plastic bag provided and kept in a safe place by the child's family. ToothPrints® have been marketed as a source of dental information and as a convenient way to store a child's DNA. Identifications by both dental means and by DNA are routinely used in missing person cases.

The manufacturer recommends that three ToothPrints® impressions be taken at various times in a child development. The initial impression is taken at age three when all the primary teeth have erupted. The second is taken in the mixed dentition stage at about age seven when the permanent incisors and first molars have erupted into function. The last impression is taken after all the primary teeth have been shed and the second molars have erupted, at about age 12.

This study was undertaken to determine the ability of a ToothPrints® impression to provide useful forensic dental evidence. A ToothPrints® examination and comparison protocol has been proposed. The protocol was tested. The protocols ability to correctly discriminate an individual from among a group of similar dentitions was studied.

Fifteen ToothPrints® were available for study. Each ToothPrints® has a maxillary impression on one side and a mandibular impression on the other. The collection of ToothPrints® used in this study were from individuals from three to 12 years of age.

Each side of every ToothPrints® was both digitally photographed and scanned. The resultant images were brought to Adobe Photoshop as JPG files. Each JPG was manipulated to produce a positive image of the dental structures of interest.

The cusp tips of various teeth were marked. For the ToothPrints® from three year olds, the cusp tips of each primary second molar were marked. For the ToothPrints® from seven year olds, the cusp tips of each permanent first molar were marked. For the ToothPrints® from 12-year-olds the cusp tips of each of the permanent second molar were marked.

The cusp tip markings were connected with straight lines to produce a circle–like figure for each tooth. For every tooth studied, the lengths of the connecting lines were calculated. The angles described by adjacent lines were also calculated.

Each ToothPrints® yielded four groups of numbers, one for each of the studied teeth. Each group contained line lengths, and angle measurements. The lower permanent molars usually had five cusp tips while the rest of the studied teeth had four cusp tips.

The groups of numbers from each ToothPrints® were compared to the groups of numbers from the other ToothPrints®. The correct tooth print could be identified in every case.

As a child matures the teeth are worn. This will affect the placement of the cusp tip marking. Future studies to determine for how long a period of time that a ToothPrints®' information is valid and useful in dental identifications will be undertaken. The variability introduced by having ToothPrints® produced by dentists, by dental hygienists and by dental assistants need to be studied. As will the reliability of producing ToothPrints® for very young patients.

This study has shown that ToothPrints® is a reliable method to record dental information that is of forensic value. This study presents preliminary findings and verifies the need for a larger and more controlled study. A larger study will produce a larger database that may prove useful in assisting the identification of missing children. The ability of ToothPrints® to record and store forensically significant DNA has been left for future study.

Forensic Dentistry, Dental Identification, ToothPrints®

F11 A Trilogy - Lessons Learned

Barry E. Lipton, DDS, 11200 Seminole Boulevard, Suite 108, Largo, FL 33778*

After attending this presentation the participant will understand how to avoid some of the common pitfalls faced by odontologists in the three main areas of forensic dentistry: bite mark analysis, victim identification, and missing persons; and learn about three cases will be presented with insight on how to utilized all available information and evidence in reaching a positive conclusion in your investigation and routine procedures to follow even in what appears to be the simplest of cases.

Case #1: "DO THE DENTURES FIT?" What started out as a routine request by the local medical examiner concerning the Identification of a badly decomposed male and whether dentures found at the scene belonged to the victim, could have turned into a miss-identification based on assumptions and the limited antemortem information available. At the time of the examination, the investigators for the medical examiner said that no antemortem dental records could be found for this victim. What started out routinely, turned into several sleepless nights when the medical examiner, upon receiving my report asked if the victim's body could have been switched with someone with a similar dentition. The author will share some of the routine procedures that followed in similar cases with limited antemortem information and the conclusions now in use in reports related to victims based on "DO THE DENTURES FIT?"

Case #2: "WHO FILLED OUT THE MISSING PERSON NCIC FORM?" A female skeleton is recovered and both the anthropologist and forensic dentist agree on the age of this victim as being 14-years-old ($\pm$ 30 months). Unique dental features are noted, including severe overlapping and mal-occlusion of the maxillary anterior teeth and a retained primary left second molar with no radiographic evidence of the permanent premolar

replacement. Why did it take ten months to identify this missing teen when all of the proper NCIC forms were filed in a timely manner?

Case #3: "WHERE'S THE RULER?" A dedicated detective working a 22-year-old cold case involving the rape and murder of a single mother, is able to use DNA technology, un-available in 1980, to link a suspect not previously thought to be involved in this case. In addition to the recovered DNA, a bite mark noted at autopsy but never analyzed, now became part of this new investigation. Only one autopsy photograph, showing the bite mark, was available after 22 years. Although excellent detail of the bite mark was present in this photograph, there was no ruler present to help resize this pattern injury. A ring noted on one of the victim's fingers had been lost over the years. This case was a good example on how to utilize the crime scene photographs and other evidence recovered from the crime scene to resize to a 1:1 ratio the bite mark injury. Although the defense in this case felt they had a strong argument to fight the DNA evidence, this changed when presented with the bite mark comparison. The suspect eventually pleads guilty to first-degree murder, a murder he had gotten away with for 22 years.

Document, NCIC, Ruler

F12 Restored Interproximal Surfaces in Dental Identification

James McGivney, DMD, 66 Grasso Plaza, Saint Louis, MO 63123; and Gwendolyn M. Haugen, MA, JPAC-CIL, 310 Worchester Avenue, Hickam AFB, HI 96853*

After attending this presentation, attendees will understand scientific methods of human identification; know why teeth can be used to identify human decedents; and complete unique dental identifications based solely on the comparison of restored interproximal surfaces.

This presentation will impact the forensic community and/or humanity by serving to verify the certainty of dental identifications based on the comparison of restored dental interproximal surfaces.

The mainstay of forensic dental identification is the comparison of antemortem and postmortem radiographs. But in some cases, an individual's antemortem dental record may lack some or all radiographs, which presents a challenge to identification efforts. In a mass disaster situation, an urgency to make forensic identifications quickly is also present. As the number of points of concordance necessary to make a positive dental identification is not a static number, the strength of identification is typically based on the subjective opinion of an odontologist. Developing techniques to expand capabilities in these situations are important. Attempts to individualize based on the quantifiable patterns created by missing, filled, and/or restored teeth are one area that has been explored. Statistical research conducted separately by Sognnaes (1975) and Keiser-Nielson (1980) looked at the diversity of dental patterns while assessing each unique dental characteristic independently. The observed dental pattern would be broken down by individual characteristics (e.g., three missing teeth and five restored teeth) that were calculated independently and then multiplied together providing the final figure of possible combinations. The problem with this approach is that dental treatment does not occur randomly throughout the mouth therefore; possible dental patterns are not equally probable in occurrence. Although theoretically possible, the likelihood of observing some of the dental patterns in a population is very small (e.g., every tooth having a restoration). This makes the theoretically derived figures misleading which is problematic in a forensic context. Adams (2003) improved on this with a method of *empirical* comparison that derived frequency information from the occurrence of missing, filled, and unrestored teeth (excluding third molars) as detailed in written treatment records and/or charts from two large reference datasets. This research was able to validate the use of individualistic dental patterns derived from nonradiographic records as an aid to forensic identification.

This research presents the results of a study that attempted to individualize based only on bitewing visible interproximal restored surfaces from a reference dataset. The 11 interproximal surfaces commonly detailed on a bitewing radiograph were assessed simply for the presence or absence of a visible restored surface and assigned a score. This relatively objective analysis could be quickly performed. Individuals with no interproximal restored surfaces were not included in the dataset. Based on the results of this study, individualization based solely on bitewing visible interproximal restorations was validated.

This study is the first leg in a series of investigations that should lead to the automation of collection of dental data from antemortem radiographs. It should be possible to input dental bitewing radiographs into a specially designed scanner and have as output information about the individual's interproximal dental status that will be sufficient to make a positive dental identification. This technology should speed up the identification process in mass disaster and large casualty terrorist attacks. This technology may also prove useful in developing and maintaining a nationwide database of dental interproximal data for use in identifying missing persons and unidentified human remains.

Dental, Human Identification, Interproximal

F13 Positive Forensic Dental Identification Based on Visual Enhancement of a Conventional Pulp Chamber Radiograph

John M. Carson, DDS, West Virginia Office of the Chief Medical Examiner, 3132 Collins Ferry Road, Morgantown, WV 26505*

The goal of this presentation is to demonstrate the possible forensic identification value of conventional radiograph enhancement using 3-dimensional techniques.

This presentation will impact the forensic community and/or humanity by demonstrating a 3-dimensional software application to conventional radiographs can be of significant value in examining isolated dental structures during the forensic dental identification process. Any tool, which improves the potential to identify decedents, has value to the forensic community, as well as to the family and loved ones involved.

An 18-year-old male was returning home with his date after a high school prom at 5:30 a.m. He was intoxicated by (history). His vehicle impacted a tree at a high speed resulting in multiple rotations and impacts. His date was ejected from the vehicle and was unconscious, in a field. When she regained consciousness, the vehicle was on fire. The occupant was incinerated. A recovery effort was attempted after the fire was extinguished. Due to the extreme temperature of the fire, the degree of incineration was extensive. The medical examiner was able to recover small fragments, three of which were teeth fragments.

Dental records were obtained form the treating dentist, based on a tentative identification. Duplicates of written clinical records and bitewing radiographs were surrendered. Initial examination of the three fragmented teeth, along with multiple angulations of postmortem radiographs was undertaken. Comparison to antemortem radiographs was non-productive. The treating dentist produced the original bitewing radiographs following an additional request, at which time the need for better resolution of the radiographs was explained.

An additional attempt to resolve the identification was made using the original bitewing radiographs. The pulp chamber of tooth #14 appeared to have similar characteristics when the antemortem radiographs were compared to the postmortem radiographs under 3X magnification. Enhancement of the images for the purpose of detailed comparison was indicated.

The antemortem and postmortem images of the crown and coronal 1/3 of the roots were scanned using a HP scanjet 5470c and digitized using Forensic IQ software. This software allows for each grayscale shade to be assigned a pixel height and depicted on the z-axis, thus, rendering a

3-dimensional image. Rather than viewing 32 shades of gray as seen with the human eye, the software allows visualization of all 256 grayscale shades. Filtering the images and adjusting the contrast of the images visualized multiple points of concordance. The angulation of the coronal 1/3 of the buccal root canals was also consistent.

Application of this software to the antemortem and postmortem images involved in this particular case allowed a positive identification to be made and closure of this tragic event brought to the family. 3-dimensional visual enhancement of conventional radiographs appears to have value for the purposes of selected forensic dental identification cases.

Forensic Dental Identification, Conventional Radiographs, Visual Software Enhancement

F14 Practical Guidelines for Releasing Dental Records When Requested by the Medical Examiner's Office

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The goal of this presentation is to create a better understanding of which records are useful for the purpose of dental identification, HIPPA as it applies to medical examiners and coroners and the importance of surrendering original dental radiographs. Suggested standardization of release forms will also be presented

This presentation will impact the forensic community and/or humanity by defining the elements of a request for dental records, emphasize the necessity and value of having original radiographs during the identification process, and explain the HIPPA exemption as it applies to medical examiners and coroners. By standardizing the request for records, the identification process will be completed in a more timely fashion and closure brought to the family of the decedent.

Obtaining adequate and complete dental information is essential to the dental identification process. In an attempt to facilitate identification of the decedent, individuals not familiar with forensic odontology and the comparison techniques, which are involved in the identification process, often initiate the request for records. Such individuals may include well-intentioned law enforcement officers or inexperienced office staff. A clear understanding of the required records on the part of the individual making the request, the individual obtaining the records and the dentist surrendering the records should be a well-defined, coordinated effort. Lack of such an effort can significantly delay the identification process and subsequent release of remains to the victim's family or loved ones.

The treating dentist should understand that a request for records is not a threatening act.

Comprehensive collection of dental clinical information hastens the identification process, thus bringing closure for the family. Records to be requested should be in a checklist format and include the following: all bitewing radiographs; all periapical radiographs; all panoramic radiographs, and any other radiographs such as cephalometric or T-M joint studies. The need for original radiographs must be stressed, since loss of resolution during the duplication process may preclude a successful identification. All radiographs should be labeled with the patient's name, date taken and dentist's name. Dental models should be obtained if available. Written records should include intake information, noting demographics and insurance information. The medical history obtained should include the name and address of the patient's primary care physician, as well as, any hospitalizations or medical referrals. Clinical records should include odontogram charting, clinical progress notes, and any dental referrals or previous treatment to include the contact information for each practitioner.

HIPPA regulations went into effect in April 2003. This statute created a great deal of confusion among dental and medical practitioners regarding release of records. Treating dentists should be presented with the applicable section of the HIPPA statute that permits the release of records to medical examiners and coroners for the purpose of identification and/or determining the cause of death (164.512 (g)). The treating dentist should retain both the request for records and the HIPPA exemption.

Complete contact information of the treating dentist should be obtained with the records. This should include full name, office address, office phone number, home phone number, mobile and pager numbers, as well as, E-mail addresses. This allows for contact during the identification process, should the need arise and also provides information necessary for the return of records once the identification process is completed.

Many dentists are reluctant to surrender original records when requested to do so. Having a clear understanding of the reasoning behind this request, along with the assurance that the records will be returned, greatly facilitates the overall process. This in turn benefits the family of the decedent and helps to bring closure to the loss of a loved one.

Forensic Dental Identification, Required Records, HIPPA

F15 Forensic Odontology in Kosovo: The Role and Responsibilities of the Forensic Odontologist With the United Nations' Office on Missing Persons and Forensics - Personal and Statistical Account

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Attendees will gain knowledge of the functions of the forensic dentist in Kosovo.

This presentation will impact the forensic community and/or humanity by showing importance of forensic odontology in postwar, mass-murder victim identification.

During this brief lecture the roles and responsibilities of the forensic odontologist with the Office on Missing Persons and Forensics of the UN Mission in Kosovo will be presented. From the exhumation of human remains, through autopsy, odontogram, and interviewing next-of-kin, to a brief statistical analysis of overall results of the mission, all aspects of dental activities will be touched upon. The presentation will include detailed photographs of some of the more interesting facets of work in Kosovo including many cases analyzed by the author. The secondary purpose of the lecture will be to promote further awareness and understanding regarding the humanitarian goals of the profession.

Kosovo, Odontogram, Identification

F16 Dispersed Anatomical Parts Meet Various Forensic Disciplines

Claude Wyss, State Police, Rue du Bugnon 21, Lausanne, Vaud 1005, Switzerland; Michel Perrier, DDS, MS, University of Lausanne, av. de Rumine 7, Lausanne, Vaud 1005, Switzerland; and Marc Bollmann, MD, Daniel Cherix, MD, and Patrice Mangin, PhD, University of Lausanne, Rue du Bugnon 21, Lausanne, Vaud 1005, Switzerland*

After attending this presentation, attendees will understand the importance of integrating various forensic disciplines in a criminal investigation.

This presentation will impact the forensic community and/or humanity by demonstrating the relevance of a teamwork approach of various forensic disciplines in an unusual criminal investigation.

The purpose of this presentation is to demonstrate, using a specific case that occurred in Switzerland as an illustration. The importance of a multidisciplinary forensic approach to identify human body fragments dispersed over a wide territory (200 km), and to subsequently reveal the circumstances of death and the identity of the perpetrator or perpetrators.

On the morning of March 18, 2002, a forester notices a fire burning approximately 20 meters from a road, at an altitude of 1342 meters, near a village in the canton of Bern, Switzerland. A closer look reveals that a human corpse is being consumed. A rapid examination of the anatomical piece shows that the corpse has been decapitated. It is not possible to conclude whether the limbs had been burnt or removed: the traces of charring reach mid-thigh level and only some rests of the femurs remain.

On the evening of March 20, 2002, a man and his son are strolling along a river in the canton of Geneva, at an altitude of 410 meters. Suddenly, the man sees plastic bags and pieces of clothing resting on a sand bank, held by a fallen tree trunk. Upon closer inspection, the man discovers a human leg and a human foot, partially covered by sand. These remnants turn out to be two legs, one right and one left, obviously cut off from a corpse at knee level. A kneecap is still attached to one of the legs. The clothing includes a sweater, a pair of pants, and a sort of towel. The body parts and the clothing were double-bagged and six cuts, probably made with a knife, were apparent in the plastic. The bags show tearings typical of predators. The place where these remnants were discovered is at a distance of 90 km from the first site.

In April 2004, a couple is mushroom hunting on the shore of the lake of Neuchâtel, in the canton of Vaud, at an altitude of 435 meters. They discover a perfectly clean human skull, devoid of any soft tissue. An on-site search by the police reveals a unique mandible, lying close to the skull.

A multidisciplinary forensic approach integrating entomology, odontology, anthropology, and genetics resulted in a focused investigation leading to the conclusion that the dispersed human remains belonged to the same person. A precise postmortem interval (+/- 24 hours) was also determined.

The investigation conducted by the criminal police led to the identification of the cadaver. The investigation to identify the perpetrator or the perpetrators and the circumstances of this homicide are currently under way.

Odontology, Entomology, Genetics

F17 Hazmat and the Forensic Dentist

Richard Serchuk, DDS, 5 Valentines Lane, Old Brookville, NY 11545; and B.K. Friedman, DDS, Office of the Medical Examiner Suffolk County, PO Box 6100, Hauppauge, NY 11788-0099*

The goal of this presentation is to make the forensic dentist aware of the potential dangers of chemical, biological and radiological exposure.

This presentation will impact the forensic community and/or humanity by increasing the desire for more continuing education and training relating to HAZMAT and WMD.

The knowledge required to be a competent forensic odontologist is always evolving. The possible use of weapons of mass destruction (WMD) associated with terrorism now requires the inclusion of HAZMAT training to the forensic odontologist. Dentists are secondary responders and must be aware of the dangers that can be present. This presentation will discuss HAZMAT training for the forensic dentist.

First responders arriving at an event must be aware of potential dangers that may not be immediately apparent. What has caused the event needs to be considered prior to entering a scene. If personnel approach the scene without evaluating the incident, they too can become the injured or deceased. The incident will now become bigger and more complicated.

Secondary responders should never go to a site without orders from your incident command section chief. The view of the incident as forensic dentists must now widen. Bodies can become contaminated for many different reasons. An act of terrorism is only one possible means. Chemical accidents can occur at factories or on the highways with trucks colliding or train derailments. Prior to handling he living or the deceased, one must take care that people are decontaminated and safe to handle. If they are not decontaminated experts must know how to handle the remains.

There are many levels of HAZMAT. There is a HAZMAT awareness course. This basic course is sufficient for most dental personnel. Everything you ever wanted to now about HAZMAT, a hazardous scene, and hazardous materials are covered very briefly in this course.

Secondly is a HAZMAT operation. This is the next level for people who wish to have a better understanding of hazardous materials. How to store, transport, and handle hazardous materials are discussed. The different placards and symbols that appear on trucks and railcars are explained in more depth in this course.

Once these two basic courses are completed, there are several advanced courses depending on need.

Continuing up the HAZMAT line, there are different levels of equipment to be worn at different parts of an incident. There are Level A, Level B, and Level C suits. Level C is the lowest protection and level A being the highest.

Level C might be a Tyvek suit with a simple mask and filter. Dental personal wore this at the Twin Tower landfill.

Level A suit is a self-contained suit. A person is literally sealed into the suit. A Self Contained Breathing Apparatus is part of the equipment. Someone who has reached the level of HAZMAT technician wears this type of suit. To reach this level, training is very intensive and rigorous.

There is also Hazmat Specialist. This is a much more advance type of training. As the title implies, it is for specialty training.

Level A and Level B suits are almost impossible to perform identification and would be unrealistic in a large-scale event. There is also the question of need. How much training is really necessary? Should everyone take HAZMAT awareness, what about HAZMAT operations? With the knowledge of these dangers, what is one expected to do? Can remains be manipulated in a Tyvek suit? What about level A suit? How much or will decontamination be provided before the remains are expected to be seen.

No advanced training in HAZMAT would be complete without knowledge of the Incident Command System. This is an organizational flow chart that was designed to handle diverse agencies and personnel that arrive at an incident.

In this presentation the author will also give realistic options opinions and expectations for the forensic odontologist when involved in an incident.

Hazmat, Forensic Odontology, Weapons of Mass Destruction

F18 How Technology Helped Forensic Dentists to Organize and Handle Two Concurrent Mass Disasters: Flight 587 and the World Trade Center

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After attending this presentation, attendees will understand how technology helped identify the victims of a mass disaster.

This presentation will impact the forensic community and/or humanity by demonstrating how technology helped identify the victims of a mass disaster.

On November 12, 2001, American Airlines Flight 587 took off from John F. Kennedy International Airport and crashed into Belle Harbor, New York (in the borough of Queens) shocking the city of New York that was already reeling from the attacks of September 11th. All 260 people on the flight along with five people on the ground perished. The airspace over New York was closed, with the assumption that this was another terrorist attack.

The Office of Chief Medical Examiner City of New York (OCME), its disaster victim identification team (DVIT) faced the unprecedented task of running two mass disaster identification efforts at the same time.

Since the Manhattan office of the OCME was already set up for the processing and identification of the World Trade Center (WTC) victims, it was decided to bring the victims of Flight 587 to Manhattan approximately 20 miles away, instead of setting up a new recovery site at the Medical Examiner's Queens office.

The DVIT teams consisting of pathologists, medical legal investigators, NTSB investigators, FBI investigators, the NYPD and other agencies as well as the forensic dental teams were in place and began processing the victims. NYPD detectives processed property, including wallets, jewelry etc. and other personal effects on the victims, which helped give clues in the identification process. The NYPD also fingerprinted all the victims according to the protocols set for the WTC identification process. After the pathologists performed the autopsies and obtained DNA samples, the postmortem dental teams examined the full body radiographs to confirm presence of dental remains. The jaws were dissected as necessary and chartings and radiographs were done. The dental chartings were entered into WIN-ID, a dental comparison and identification program. The postmortem radiographs were scanned and entered into a database with Adobe® Photoshop® which is accessible by the WinID program.

In the Manhattan office, new protocols were set up to differentiate the victims of Flight 587 from the victims of the World Trade Center. New computer databases, new identification numbers and different visual cues, i.e., the color of paper, folders etc. were implemented.

The antemortem dental team began the task of gathering dental records. Flight 587 was bound for Santo Domingo in the Dominican Republic, an island in the Caribbean. Many of the victims were from the Dominican Republic and the task of getting dental records was made more difficult because of the language barrier and the possibility of no existing dental records. All antemortem records were entered into WinID and antemortem radiographs were scanned using Adobe® Photoshop®. This enabled the comparison teams to pull up the ante and postmortem radiographs quickly for evaluation.

After two weeks, all the postmortems were completed. All postmortem chartings were entered into the computers with incident numbers differentiating Flight 587 from the World Trade Center. After about four weeks, all dental records that were available were received and processed into the computer databases. Postmortem and antemortem comparisons using WinID were done and completed. The victims of Flight 587 that could be identified by forensic dentistry were completed after four weeks. Other means of identification including DNA were utilized to identify those whom no antemortem dental records were available.

Forensic Odontology, WinID, DNA

F19 Avoiding Confusion in a Small-Scale Disaster

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Attendees will be given recommendations for handling victim identification logistics in a small-scale disaster.

This presentation will impact the forensic community and/or humanity by providing conclusions and recommendations, which may assist others in the forensic community when faced with a similar situation.

In April 2003 a construction accident precipitated a natural gas explosion and fire that destroyed four street-level stores and second-floor apartments in a small strip plaza in Toronto. Initially, the police determined by interviewing family members that there were six individuals unaccounted for following the incident. The family dentists of the presumed decedents were contacted and coroner's warrants were issued in order to obtain six sets of original dental records.

The bodies of six victims were recovered from the accident site and transferred to coroner's office for identification within 24 hours of the incident. Two forensic odontologists commenced the identification procedures on Victim #1, using the standard methods of dental charting and a visual comparison of antemortem and postmortem radiographs. Each of the six sets of dental records was examined in sequence. This process was then repeated before it was concluded that Victim #1 did not match any of the records available. The Coroner and the police were advised that it was likely there may a seventh victim as yet undiscovered. A second search of the disaster site over the next 24 hours did indeed result in the discovery of a seventh body. The dental records for Victim #1 were ultimately obtained and an identification confirmed.

This episode underlined the importance of never assuming that an open population is closed or that a closed population is actually closed. In addition, there may occasionally be a delay in notification from next-of-kin that a family member is missing. Despite the pressure from many sources to process victims quickly in an event of this scale, a delay may be unavoidable in the interests of exercising due caution and prudence in the identification process. It is recommended that the police carefully re-examine local missing persons lists and canvass the neighborhood thoroughly whenever a small scale disaster occurs that involves multiple victims.

Finally, the relatively small size of this incident resulted in pressure on the forensic dentists to identify the decedents within an abbreviated period of time. It is the author's opinion that this pressure is unique to small-scale mass fatality incidents. Such pressure must be resisted, in order that appropriate procedures for the identification of multiple fatality incidents can be completed accurately.

Missing Persons, Dental Identification, Small-Scale Mass Disaster

F20 Tooth Color as a Possible Indicator for Age

Guy Willems, DDS, PhD, and Nathalie Devos, DDS, Katholieke Universiteit Leuven, School of Dentistry, Oral Pathology and Maxillofacial Surgery, Department of Forensic Odontology, Kapucijnenvoer 7, Leuven, B-3000, Belgium; and Robert E. Wood, PhD, Princess Margaret Hospital, Department of Dentistry, 610 University Avenue, Toronto, Ontario M5G 2M9, Canada*

The goal of this presentation is to investigate the color of tooth roots and crowns in a standardised manner using a spectrophotometer and analyse its relation with chronological age.

Although further research is needed on a more extensive population, this presentation will impact the forensic community and/or humanity by contributing to a better approximation of chronological age of an individual by employing a complimentary technique that should not be very difficult to use, but may have its power in the fact that it supports other more traditional techniques by its outcome.

Outcome: Regression analysis rendered a relation displaying an adjusted R-square between 0.45 and 0.48.

Introduction: Color is a subjective sensation and is as such difficult to use in a quantitative study. On the other hand, a number of clinical studies on extracted teeth have shown a good correlation between tooth color and age.

Aim: The purpose of this study was to examine the usefulness of a specific spectrophotometer in determining tooth color on extracted and non-extracted teeth and to look for any age relationship.

Materials and methods: There were two parts in this study. In part 1, the tooth collection of Ten Cate *et al*., 1977 was used and single rooted teeth were selected out of each of the 5-year age groups (ages ranged from 15 to 84, both for males and females). Color measurements were performed on the mesial and vestibular sites of the roots as well as on the mid-vestibular aspects of the enamel crown. In part 2 the color of certain upper anterior teeth was measured in living patients. Heavily restored, endodontically treated or heavily discolored teeth were not taken into

account. In total, 217 upper anterior teeth from 78 patients ranging between 15 and 83 years of age were measured with a spectrophotometer, a technologically advanced shade taking system. It digitally analyses the shades and immediately transmits the data to the main unit via an infrared interface. It records hue, value and chroma according to the CIE-LAB system without being affected by lighting conditions. Each color measurement was repeated five times.

Results: Statistical analysis of the results revealed regression formulas for both extracted and non-extracted cases, displaying an adjusted R-square of 0.48 and 0.45 respectively.

Discussion: The high correlations found in an earlier reported study by Lackovic and Wood, 2000 on the same material of Ten Cate *et al*., 1977 could not be confirmed, although similar age-related trends were found. The disadvantage of the spectrophotometer employed is that only the central part of the clinical crown was taken into account for the determination of tooth color. On the other hand it is clear that this technique opens possibilities for future research on age estimation in living individuals.

Forensic Odontology, Chronological Age, Dental Age Estimation

F21 General vs. Population-Specific Dental Age Estimation Method: A Greek Study

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Attendees will learn, retain or implement into their practice dental age estimation methods, which should take into account differences in diet and dental care when victims come from across countries and cultures such as in case of international disaster.

This presentation will impact the forensic community and/or humanity by showing that population-specific differences in diet and dental care are important factors and should be addressed in dental age estimation methods.

If someone's age is in question – whether based upon human remains or in a living person – forensic odontologists can choose from a number of dental age estimation methods. However, most dental age estimation methods have utilized teeth from mixed populations, so as to be applicable to any population. However, a generic method may theoretically result in less accurate age estimates, because population-specific factors are not taken into account.

The principal investigator traveled to Athens, Greece to evaluate whether population-specific factors might exist in the Greek population and how they might be incorporated into more accurate dental age estimation method. The trip was sponsored by grants from the Friendship Association of the Finnish-Athens Institute, the Columbus Foundation of University of Tartu, Estonia, and the American School of Classical Studies at Athens. The investigator examined the skeletons in the Wiener Laboratory's Human Skeletal Collection, housed at the University of Athens. This important collection consists of 63 modern day Greek skeletons of known age at death, cause of death, and gender. The investigator photographed all the skulls, jaws, and teeth of these skeletons. A photographic database of the findings has been prepared and various age-related changes have been measured. In addition the investigator dissected one representative tooth from each age group for histological analyses.

The results showed that virtually all of the teeth examined had cervical abrasions, which increased in degree with age. These were more marked in extent than reported in previous studies. The degree of abrasion was a significant factor correlated with the estimated age of these Greek skeletons. Greek cuisine is rich in acids such as lemon juice and vinegar, which may contribute to these cervical abrasions. Other reported methods of dental age estimation do not utilize cervical abrasion, perhaps because the degree of abrasion is more variable and not significantly correlated with age in previously studied populations. However, in selected populations such as the Greeks, it may be crucial to take into account differences in diet and dental care.

The findings of this study are especially important when identification questions arise in international disasters, when victims come from across countries and cultures. The author recommends further study of culture and country-specific differences in dental wear patterns as an adjunct to improving the accuracy of dental age estimation.

Dental Age Estimation, Cervical Abrasion, Population-Specific Factor

F22 Determining the Accuracy and Reproducibility of Adobe® Photoshop® Overlay Techniques Using WinBite Software

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After attending this presentation, attendees will understand the usefulness of overlays in bite mark analysis; will be able to understand the different techniques used to producing overlays; and will appreciate the accuracy of digitally prepared overlays.

This presentation will impact the forensic community and/or humanity by demonstrating the accuracy associated with digitally prepared overlays in bite mark analysis can now be quantified.

The use of bite mark evidence in court has been a controversial issue in the forensic community. The concerns regarding bite mark analysis include examiner objectivity as well as the reliability and reproducibility of the current methods used by forensic odontologists.

The methods of bite mark analysis have come under even closer scrutiny as a direct result of the 1993 U.S. Supreme Court *Daubert* Ruling. The *Daubert* Ruling set a new standard for the admissibility of scientific evidence in the federal courts and has been accepted by many state jurisdictions as well. This new standard requires that the utilized scientific methods be tested, reproducible and have a known or potential rate of error.

Recently, members of the forensic odontology community have made efforts to test and report the reliability of various bite mark overlay methods used for courtroom presentation.

Other odontologists have been exploring new methods of bite mark analysis using stereometric and mathematical approaches to reduce examiner subjectivity. One of the most widely accepted methods of bite mark overlays is the computer generated overlay. Bowers, Sweet, and Senn have suggested protocols to produce overlays using Adobe® Photoshop®.

The goals of this study are to assess the reproducibility and reliability of different methods of overlay production.

A dental cast of interest was scanned at 72 dpi and saved as a bit mapped (BMP) image. Two examiners then produced overlays of the working surfaces of the incisors, canines and first premolars. Each examiner reproduced 20 overlays of the same scanned image of the dental cast. Half the overlays were fabricated by using the Threshold Tool and the other half with the Magic Wand tool.

On the dental cast the occlusal surfaces of the teeth were measured with a digital caliper and the "centroids" were marked with black pen. The marked dental cast was then scanned and saved as a 72dpi BMP image.

WinBite software was used to produce a mathematical description of the dental cast and a mathematical description of each the 40 overlays.

WinBite is a computer program written in Visual Basic®. Data is stored in a Microsoft Access® database. WinBite can analyze the pixels that compose each tooth segment of an overlay. The pixels are mathematically summed to yield a centroid at the center of the tooth segment. The centroid is recorded with X axis and Y-axis coordinates. Once each tooth segment of the overlay has been analyzed and recorded, the lengths of lines that connect adjacent centroids are calculated and recorded. Then the

angles formed between adjacent lines are calculated and recorded. The coordinates of the centroids, lengths of the connecting lines and measures of the described angles form the mathematical description of the overlay. A similar method was used to produce the mathematical description of the cast.

WinBite software was then used to look at the differences between the cast and each overlay. The sum of the differences of corresponding line lengths and the sum of the differences of corresponding angle measurements were combined to yield a numeric discriminator. The discriminator is a measure of how much a given overlay deviates from the cast. The discriminator was used to rank each of the overlays as they compared with the cast.

The primary goal of the study was to measure and rank the ability of different methods to produce a suitable and scientifically accurate overlay. The subjectivity introduced by each examiner was also measured.

The intent was to establish both the reproducibility and reliability of different methods of fabricating overlays and to establish error rates for these methods.

Bite Mark, Forensic Odontology, Overlay

F23 "Non-Sexual" Biting During Sexual Assault – A Comparison of Two Cases

Bruce R. Wiley, DMD, 337 Greybull Avenue, Greybull, WY 82426*

The purpose of this paper is to show the comparison of what is traditionally considered non-sexual biting in two separate sexual assault cases.

This presentation will impact the forensic community and/or humanity by demonstrating an interesting and possibly helpful project to accumulate more cases of this type to evaluate the perpetrators and the details of the crimes committed.

"Sexual" biting is usually categorized as those bite marks, which are found on the breasts, buttocks, and/or genitals. In the following two sexual assault cases the bite marks were of a more "nonsexual" nature in their location.

In October 1996 a party was held on the campus of Northwestern University in Powell, Wyoming. Many of the students admitted to the consumption of alcoholic beverages prior to the commencement of the dance. According to witnesses, Levi Collen and his date were no exception. They were both seen leaving the dance shortly after it began.

Levi Collen returned to his dormitory room, reportedly spattered with blood, at approximately 1:00 a.m. Following several fabricated alibis, Collen admitted that he had taken his date to Polecat bench on the outskirts of Powell. The area is reported to be a popular hangout for underage partying and other lascivious behavior.

Mr. Collen initially reported that following consensual sex in the passenger seat of his Pontiac Grand Prix, his date got out of the vehicle to urinate. He decided to do the same on the driver's side of the car. While he was relieving himself he claimed that this 115-pound female rushed toward him and hit him on the head with a Coor's Lite bottle. She then allegedly started "pinching" him on the neck to the point that he reportedly feared for his life. He said that he then returned to his vehicle, retrieved a knife from the glove compartment, and stabbed her in self-defense.

According to the autopsy report, during Collen's period of "defending himself" the victim was apparently stripped of her clothing, sexually assaulted, bitten at least six times on the face, left arm, and inner right thigh, and stabbed about the face and neck approximately 20 times.

In July 2004 the victim of the second case was allegedly drinking at a bar in Cody, Wyoming. Prior to the closing of the bar for the night, she struck up a conversation with one of three men who were partying together. Apparently, she liked one of the men and gave him her address and phone number. She proceeded to her home in hopes that the one young man would follow. He did go to her house, but also brought his two friends. The man with whom she was enamored had what was reported by all parties as consensual sex. The details of what followed were apparently somewhat blurred by the effects of the alcohol.

The lady states that one of the other three started to have intercourse with her and she told him that she wanted him to stop. During that period he allegedly bit her above her left breast on her chest. He then moved his head to a position between her legs and bit her severely just below the umbilicus. He then bit her several times on the inside of her left thigh hard enough to cause extensive bruising. She claims that she continued to yell at him to stop, but her pleas went unanswered.

Both victims were sexually assaulted but all of the bite marks were observed to be on "non-sexual" areas of the body. No bite marks were found on either of the women on the breasts, buttocks, or genital areas. Mr. Collen was known to have a history of biting women in previous cases. The perpetrator in the latest incident apparently has no history of sexual assault or battery. However, one of his friends said that the biter was "always shy around women" and was surprised that he bit her that hard.

Bite Marks, Sexual Assault, Homicide

F24 Bite Mark Analysis: Additional Investigations of Accuracy and Reliability

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The goals of this project are 1) to determine if odontologists of varying experience can select the correct biter from a group of suspects, 2) to evaluate and compare bite mark analysis on human skin in a limited but more extensive population, and 3) to assess the range of opinion in bite mark interpretation by examiners in the current study.

This study is the next logical step of a pilot study presented at the 2004 AAFS meeting by Gould and Cardoza. This study will impact the forensic community by providing information to support or question the concept that bite mark analysis can offer objective, reliable and credible science-based opinion. The study further examines the importance of using quality evidence, skillful interpretation, and trained forensic odontologists.

Background: Bite mark evidence has been accepted by the North American forensic community and legally admissible in courts in the United States of America. It has played an important part in the successful prosecution in numerous criminal cases. Nevertheless, there are critics who have questioned the scientific validity of bite mark analysis. This constructive skepticism about the process and how forensic experts derive bite mark opinions is healthy and welcome. It is also perceived as a tool in helping to excel deliberately and to strengthen the process of bite mark analysis.

Introduction: Bite marks are indicative of violence whether made by the perpetrator during an assault or the victim in self-defense. To recognize a human bite mark is an important criterion in an initial investigative phase in deceased or living human victims. Therefore, it is critical to understand and follow the protocol for data collection and preservation of bite mark evidence. If these steps are followed, quality evidence may be available to maximize accurate evidentiary analysis.

Are evidentiary opinions based on the same evidence similar among forensic odontologists? This experiment is designed to provide insight to the stated question. The accurate interpretation of bite mark evidence is essential. The implications for the lives and liberty of the accused are an enormous responsibility not to be taken lightly by competent and experienced investigators. This study explores the relationship between quality evidence and accurate interpretation of bite marks in reaching forensic evidentiary opinion. If quality bite mark evidence is properly analyzed, can trained odontologists assist triers of fact to make appropriate decisions and judgments?

Method: Dental models of ten different individual's teeth were selected and used for the exercise. One set of the models made the bite marks on the skin of a living human volunteer. To serve as test bites, each set of models made one upper and one lower bite impression on modeling clay. The test bites and bite mark on human skin were photographed with Sony cameras: 1 megapixel FD-Mavica, 1.55 megapixel DCR-PC120, 8 megapixel FVF-828 and a ABFO No. 2 ruler appropriately placed. The Universal Numbering System was used in the study. Adobe Photoshop 7.0 was used to fabricate hollow volume overlays using the technique described in the Digital Analysis of Bite Mark Evidence by Raymond Johansen, DMD and Michael Bowers, DDS, JD. Dentists with wide range of forensic experience in bite mark analysis volunteered to be examiners. The examiners were asked to compare the overlays to the test bite and bite photographs and to determine the level of confidence for each as having caused the bite marks on skin. Examiners were asked to utilize the ABFO Bite Mark Terminology Guidelines.

Conclusion: The details and results of the study will be presented at the conference. The study emphasizes the contribution and combination of quality evidence, proper application of science-based methodology, plus accurate analysis and interpretation by forensic odontologists who seek the truth. Consequently, the forensic and judicial communities are encouraged to continue to rely upon the scientific application of bite mark analysis and the opinions of forensic experts who conscientiously apply those principals.

Bite Mark Analysis, Overlays, Scientific Method

F25 A Comparison of Animal Jaws and Bite Mark Patterns

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Learning Objective and Outcome: The purpose of this presentation is to compare the jaw shape and bite mark patterns of certain animals. This paper is intended to serve as a field guide of animal bite mark patterns that may be used to help investigators analyze animal bite marks and suggest the possible source of specific marks.

Background Information: According to the ASFO Manual of Forensic Odontology, human bites are, "oval or circular contusions, bruises, or abrasions." Humans have four incisors and two canines in each arch. Human canines are only slightly longer in relation to the incisors and premolars, and are short compared to animal canines. Animal bite marks are not oval or circular, like their human counterparts. Dogs have longer arches than humans, so the bite pattern is different. Dogs have six incisors, and two much longer canines in each jaw, which often leave deep punctures. The arch form of a cat is much smaller, and almost flat in shape. Often the incisors (also six in number), are not involved in the bites, as they are short compared to the very long canines. Most of the wild animals in the order Carnivora that were examined for this study are in the cat and the dog families, so their bite patterns were very similar to their domesticated relatives.

In the United States, there are approximately 2 million dog bites per year and 400,000 cat bites. A comparison of the jaw features and bite mark patterns for both groups may be useful in assisting investigators who are attempting to determine the animal or animals responsible for a bite or bites involving human victims. While reports of wild animal bites on humans are less numerous, as the human population increases and we continue to encroach on their habitats we can expect those numbers to increase. Recent mountain lion attacks in California and Colorado emphasize this trend.

Dogs have three distinct skull shapes: mesaticephalic, dolichocephalic and brachycephalic. The most common skull shape is the mesaticephalic; the Labrador Retriever is a good example. Dogs with longer skulls, such as Collies, are dolichocephalic. Dogs with shortened maxillas, for instance, English Bulldogs, are brachycephalic. Cats have two skull types. Most cats are mesaticephalic. Persians represent the brachycephalic, with their "pushed in" faces. It was hoped at first that the arch shape of the three skull types would vary enough to differentiate the bite patterns. However, the variance is seen more in the posterior portion of the arch, and is not discernable in the bite mark pattern.

Hypothesis: Careful analysis of the size, arch shape, intercanine width, and bite pattern of the dentitions of domestic and wild animals will assist forensic dentists in their differential diagnosis of animal bite patterns.

Methods and Materials: Domestic and wild animal skulls from the mammalian collection at the Field Museum of Natural History, Chicago, Illinois, were examined, photographed, and measurements were taken of the intercanine widths. Bite impressions of the anterior teeth were made with foamed polystyrene. The impressions were photographed with an ABFO #2 ruler in place, and the resulting images were imported into Adobe Photoshop CS and rendered life size. The date, the location the specimens were collected, and the sex of each animal was recorded, if the information was available.

Results: The impact of this study on the forensic sciences and or humanity is to provide a reference tool that may be used by medical examiners, forensic odontologists, or other investigators to guide in the scientific quest for identification of the correct perpetrator/ perpetrators of animal bite marks.

Dog Bites, Cat Bites, Bite Marks

F26 Bite Mark Evidence: Junk Science or "Rocket Science"

Richard R. Souviron, DDS, 336 Alhambra Circle, Coral Gables, FL 33134*

After attending this presentation, the attendees will learn and better understand the relationship between a quality bite mark, a dental profile and a bite mark with little or no individual characteristics. Misdiagnosis of pattern injuries leading to false conclusions will be presented. The presentation will provide examples of pattern injuries that mimic bite marks but have been diagnosed as bite marks. Examples of misdiagnosed bite marks and the consequences to the criminal justice system will be discussed with ideas for corrections. The relationship of the "junk science" of bite mark identification from a world population group versus fingerprints and DNA will be explored. The relationship of a "good" bite with class characteristics as a "rocket science" and its' use as an investigative tool in identification and eventual prosecution in criminal cases.

This presentation will impact the forensic community and/or humanity by influencing bite mark comparisons with a view toward conservatism.

Human on human bite marks have been accepted in the courts in the United States for the past 30 years. Since that time, courts throughout the United States have grappled with the scientific validity of bite mark interpretations.

The original bite mark case admitted under the *Frye* Rule, Marx, occurred in California in 1975. Scientific principles were argued in People vs. Milone, an Illinois case in 1976. Two prosecution forensic odontologists testified that Milone inflicted the bite mark. Three defense odontologists testified that Milone was excluded and the injury pattern may not be a bite mark.

In the early 1980's the American Board of Forensic Odontology established standards and guidelines for documentation and interpretation of bite mark evidence. In 1984 Dr. Ray Rawson published an article detailing bite patterns left in wax and summarized the pattern uniqueness of six anterior teeth. By application of the product rule, he opined the virtual impossibility of finding two individuals with the same arrangement of anterior teeth. In 1987 Robert DeLaCruz published an article in the

American Criminal Law Review entitled "Forensic Dentistry and the Law: Is Bite Mark Evidence Here to Stay." Mr. DeLaCruz pointed out the lack of scientific validity in the bite mark identification process and the lack of scientific basis of bite mark opinions. From 1985 through 1990 articles were published describing scientific procedures applied to bite mark evidence, ultraviolet light for the enhancement of pattern injuries (Dr. Tom Krause), the use of scanning electron microscopes, CAT scans and alternate light sources.

As more bite mark cases were adjudicated, prosecution experts became more assertive in their statements regarding comparison of the suspect with the bite wound. Terms such as "it is a positive match," "bite marks are better than fingerprints," "the chances are 4.3 billion to one that no one else left this bite mark," and "indeed and without doubt," were used to obtain convictions in cases, many of which have subsequently been reversed. For example, Wilhoit was convicted in Oklahoma on bite pattern evidence and by trace saliva that contained Canada Albacans that was "unique to Mr. Wilhoit." Wilhoit was subsequently acquitted. In addition to the Wilhoit case, convictions have been overturned in the Keko, Almoilsh, Christini, Moldowan, Brewer, Harrison, and Krone cases.

Arizona State University law professor Michael Saxs has referred to bite mark evidence as "Classic Junk Science." Barry Scheck of the Innocence Project has referred to bite mark evidence as junk science. Professor James Starrs, in his scientific sleuthing publication, has been critical of bite mark evidence. Are they correct?

Some skin bite mark patterns can be evaluated by a component forensic odontologist and result in valid investigative statements pertaining to a dental profile. Upper teeth are larger than lower teeth, a space, or a rotated protruding tooth can create recognizable patterns. If the appropriate pattern is present, a forensic odontologist should be able to inform the investigative authorities that the suspect has a space between his upper front teeth or he is missing a tooth or a tooth is out of line or the individual has "buck teeth." This is not complicated "rocket science." Also, bites can produce permanent injury; the force of teeth may avulse ears, fingers and other tissues. Again, this is simple to opine, if the patterns and circumstances indicate. The size, shape and arrangement of teeth patterns can help determine if an individual is an adult or a child. When a dental profile bite mark is clearly recorded in skin, it is not difficult to eliminate individuals from a defined population of known suspects. However, to identify a dental pattern as unique to a specific individual from within a world population is a quantum leap in comparison to eliminating a suspect from a known defined group. This type of opinion evidence is open to question.

Given the same data, competent experts ought to be in agreement, but may not. Nordby, in a 1992 issue of the *Journal of Forensic Science*, "When Experts Disagree: Can We Believe What We See if We See What We Believe?" explains the basis of disagreement between competent experts. To enhance concurrence of correct interpretations, experts should apply sound scientific principles and follow ABFO guidelines and standards. Opinions should be supported by an independent second forensic odontologist. The goal is to ensure that justice is done.

Dental Profile, Bite Marks, Odontology

F27 Forensic Bite Mark Analysis of Six Pit Bulls Involved in a Mauling Death

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Attendees will gain insight into the utilization of bite mark analysis using Adobe® Photoshop® for animal (dog) bite marks.

This presentation will impact the forensic community and/or humanity by demonstrating forensic odontology bite mark analysis of human bite marks utilizing Adobe® Photoshop® has become the gold standard. However, this technique has been minimally used for animal bite marks. This case involves six dogs that produced multiple bite mark wounds in the mauling death of an elderly woman. This is a rather rare opportunity to apply accepted bite mark analysis to an animal model.

This paper will present the coordinated efforts of Medical Examiner, Dr. Julia Martin and forensic odontologist, Dr. Kenneth Cohrn at District Five Medical Examiner's office, Leesburg, Florida in determining of the possible identification of six dogs involved in the vicious attack and mauling death of an 81-year-old female victim.

The victim had just returned from visiting a neighbor on Friday, December 12, 2003 when she was attacked outside her house in rural Citra, a northern Marion county community in central Florida. The dogs belonged to a next-door neighbor who found the woman lying in her front yard with the car door open. He indicated "three or four of them were around her at the time. (I) didn't take time to identify them. (I) just wanted to get them off her." The owner didn't know how long the attack had been going on but speculated it may have been 10-15 minutes prior. "They were chewing on her, all right," he said.

The Marion County Animal Control Office had been notified several times regarding the dog's aggressive behavior. The victim's daughter pleaded with Animal Control authorities just days prior to the incident to take corrective measures to prevent the likelihood of injury or death to her mother or neighbors by these dogs.

The owner left his house about 8:30 a.m. Friday with seven mixed-breed Pit Bulls inside his house with the door wired shut. He did not know how six of the dogs escaped from the house.

Officers of the Marion County Sheriff's Office investigated three issues:

1. Whether the owner had prior knowledge of the danger posed by the dogs and had they attacked previously.
2. If the owner acted in a reckless manner by not maintaining control of the animals.
3. Whether the owner knew if the dogs had a tendency to react aggressively.

The dog owner was ultimately charged with negligent homicide.

Dr. Martin, Associate Medical Examiner, determined the cause of death to be exsanguination due to multiple vascular lesions, blunt and sharp injuries to the head, neck and trunk. The severity of many of the wounds rendered them unusable for analysis. However, there were sites on the extremities and torso that provided suitable bite mark evidence.

Vinyl polysiloxane dental impressions of the dentition of each suspect dog were taken at the Animal Control Center in Ocala, FL. Urethane models were fabricated from the impressions and scanned on a flat bed scanner. Full sized computer generated acetate overlays of each dentition were made using Adobe® Photoshop®. Digital photographs of the diagnostic bite marks on the victim were imported into Photoshop® and sized 1:1 for comparison. Models of the dentition, digital photographs and computer-generated overlays were all used by Dr. Cohrn in the bite mark analysis.

Challenges associated with the bite mark analysis included the numerous bites, gross tissue destruction, number of dogs involved and the difficulty in distinguishing individual characteristics.

The Center for Disease Control estimates that approximately 368,245 persons were treated for dog bite related injuries in 2001. Forty-two percent of the bites incurred in children less than 14-years-old. Furthermore, from 1979 – 1998 more than 300 Americans have been killed by dog attacks. Another study from 1965 – 2001 covering 431 documented dog bite fatalities shows 12% of the victims were elderly (65 – 94-years-old) and 32% were a result of a multiple dog attack. Pit Bull and Pit Bull type dogs were involved 21%, mixed breeds 16% and Rottweilers 13%. Florida ranked 4th in dog related fatalities with 22 and California first with 47. There have been legislative efforts to control certain breeds based on aggressive behavioral tendencies.

Forensic Odontology, Bite Mark Analysis, Animal Bite Marks

F28 Fatal Mauling of a Child by Three Dogs

Gregory Mar, DDS, 850 Bryant, Room 442, San Francisco, CA 94103; and Duane E. Spencer, DDS, 1855 San Miguel Drive, Walnut Creek, CA 94596*

After attending this presentation, attendees will have an increased understanding of analysis of bites inflicted by dogs in fatal attacks.

This presentation will impact the forensic community and/or humanity by reviewing the bite injuries on the victim and also review similar types of dog bite injuries.

The expression "Dogs are Man's Best Friend" has implied that there is a constant congenial relationship between humans and canines but it is known from history this is not always the case. In fact, dog bites to human are common but are rarely fatal. In recent years there seems to be more media reports of fatal mauling of humans by various breeds of dogs. Usually the victims are children and the attacking dogs are commonly Pit Bulls or Rotweillers. Often times the victim is attacked by multiple dogs in a not so understood pack attack phenomenon and from time to time the forensic odontologist is consulted for an analysis of the bite injuries to determine the biter(s). This presentation will review the 2002 fatal mauling of a six-year-old boy by three dogs of mixed breed. The breeds of these dogs are not known normally to have a violent disposition nor were these dogs trained to be aggressive. There will be a brief review of two other Northern California attacks, the death of a young boy by two Rotweillers and the fatal attack of an adult female by two adult Presa Canario dogs in San Francisco.

In February of 2002, a six-year-old boy was playing on a jungle gym in an unfenced backyard when several dogs attacked him. Initially a neighbor who happened to look out the window observed several dogs chewing at an unknown object. He decided to investigate further and discovered the object to the six-year-old boy. The boy was initially treated at St. Joseph Community Hospital in Red Bluff, California but because of the extensive nature of his trauma, he was transferred to U.C. Davis Medical Center in Sacramento, California where he later died. Initially, the local animal control agency was able to apprehend a half of dozen dogs in the neighborhood that they believe may be responsible for the attack. Their investigation eventually focused on three dogs that were owned by a police officer on retirement disability.

The Tehama County District Attorneys Office contacted the author to examine the photos of the bite mark patterned injuries on the victim. Also reviewed were the photos of the dogs and their respective dental stone models of their teeth. With the exception of one dog that was missing one canine tooth, the intermaxillary canine measurement was unremarkable and close to one another. Since the facial and scalp tissue was completely avulsed and because of the lack of any discernable bite patterns, inclusion or exclusion of any of the dogs as the biter(s) was not possible.

Because of other evidence not specifically known to the author, this matter was taken before a grand jury. The owner of the three dogs was guilty of a misdemeanor of owning vicious dogs.

This presentation will review the bite injuries on the victim and also review similar types of dog bite injuries.

Dog Bite, Fatal Mauling, Child

F29 Problems With Human Bite Mark Analysis

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After attending this presentation, attendees should appreciate the potential seriousness of problems associated with bite mark analysis and gain an understanding of the inherent benefits of 3-dimensional analysis of bite injuries.

This presentation will impact the forensic community and/or humanity by providing the forensic odontology community with an increased understanding of the 3-dimensional nature of bite injuries, and stimulate further ideas for research and practice.

Bite mark analysis is currently an extremely contentious topic. For a subject with such potentially serious outcomes for both suspect and victim, little research analyzing methods and evaluating outcomes is reaching peer reviewed journals. Although admissibility of bite mark evidence has been explicitly established and routinely accepted in the U.S. and other legal systems for a long time, some odontologists argue that bite mark methodology has never really undergone critical examination and legitimately passed the Frye test for admissibility. Other legal observers are rightly concerned that forensic odontologists are giving insufficient critical attention to the quality of bite mark evidence presented to the courts.

In Australia, there are many uncertainties surrounding bite mark evidence. The natural tendency to see what one wants to see, thereby tempting examiners to over-interpret bite marks, has led to serious difficulties when bringing such evidence before the courts. Two notorious Australian cases, R v Raymond John Carroll and Lewis v The Queen, have seen bite mark evidence rejected as 'unsafe' and convictions overturned on appeal. Perhaps for such reasons this area of forensic science is currently undergoing review and re-evaluation. Generally, courts now look for quantitative rather than simply descriptive analysis before accepting scientific evidence and it can be anticipated that future developments in bite mark analysis will have to comply if convictions are going to be made with confidence.

Perhaps the logical path to take is to analyze bite marks in 3-dimensions. There are three factors of 3-dimensionality involved when one person bites another - the curved surface of the skin, the shape of the biting object and the depth of the injury should the tooth/teeth puncture the skin to create a depression, although this is probably rare. The injury, as it is being inflicted, is 3-dimensional - the skin deforms to accommodate the shape of the teeth. However, once the teeth are withdrawn, the skin is restored to its original shape and the resultant mark is represented 2-dimensionally on the curved surface of the skin. If the force of the bite is great enough to leave an indentation in the skin, then the injury itself is also 3-dimensional.

In this study, 40 study models of human dentitions and 40 Hydroflex silicone rubber models of wax bites, made by the same subjects, were digitized by laser scanning. The Cartesian co-ordinates of a series of landmarks on each image were used to describe the dentitions and the bite models using 3D-Rugle3© software (Medic Engineering, Japan). Morphometric differences between dentitions and bite models were compared using a variance-covariance matrix. Using cross-validation techniques on all possible matches and non-matches, an algorithm was developed which estimated the probability of a dentition matching its corresponding bite model. This gave rise to a Receiver Operating Characteristic (ROC) curve with a range of values for specificity and sensitivity. For this sample of 40, the best algorithm gave a 15.4% chance of wrongly convicting an innocent person i.e. 15.4% of the non-matching dentitions and bites could not be distinguished from the true match.

Bite Mark, 3-D, Quantitative

F30 Methods to Identify Various Mammalian Bite Marks

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This presentation will impact the forensic community and/or humanity by presenting data illustrating intercanine widths, and unusual size and shape of the various animal arches. This should be helpful to investigators and medical examiners as they inspect wounds on the deceased.

The recognition of bite marks on the skin of a victim can be a challenge to the crime scene investigator. It may appear as a diffuse bruise, an abrasion, contusion, laceration or avulsive, where tissue is actually bitten off of the victim. There may be drag marks, double bite marks, whole arch, half arches, or separate and distinct individual teeth marks. Bite marks change appearance within hours or days. Investigators should be suspicious of any bruise or marks on the body, which may have the remote appearance resembling teeth marks.

The first question that needs to be asked is: Is this a bite mark? An "ideal" bite mark is a circular or ovoid patterned injury with two opposing U-shaped arches. There may be individual variation that simulates biting surfaces. Assuming that the marks appear as probable bite marks, the next question is: Was this mark caused by a human or some other animal? Is the shape and size of the arch form consistent with a human arch form? Or is it unusual in form or size? Are there deep puncture wounds that could indicate an animal's larger canines? What do animal bites really look like?

The rest of this paper will try to shed some light on what various mammalian teeth look like, the relative size and shape of their arch forms, the extraordinary length of the canine teeth and some general guidelines to assist in determining if the marks were caused by animals or another human.

The methods and materials used included examining over a dozen mammalian skulls and a similar number of adult human skulls. The arch width from canine to canine was measured on each species, using dividers and an accurate millimeter ruler. Color photographs were taken of the skull in various positions and of the individual upper and lower arches. One additional step was taken: an impression was taken of the arches with highly accurate dental polyvinyl siloxane, to give an approximate visual appearance of how a typical static bite wound might appear. The animals chosen included: house cats, wildcat, mountain lion (puma), tiger, various dogs, fox, coyote, wolf, brown bear, others, and of course, man.

Bite Marks, Animal Bites, Intercanine Widths

F31 A Vicious Sexual Attack Leads to Mutilation

Norman Sperber, DDS, 3737-A Moraga Avenue, San Diego, CA 92117*

The goal of this presentation is to present a case involving multiple human bites, fracture orbital bone, and the severing of the nose in a female sexual assault victim.

This presentation will impact the forensic community and/or humanity by detailing physical & sexual assaults that occur in the military community.

On May 8, 2002, in Phuket, Thailand, an attack by a U.S. Marine on a female U.S. Navy petty officer was so vicious and deranged that it resulted in the severing of a portion of her nose, human bite marks on her breasts, neck, and head and the breaking of the right inferior orbital bone. Both of the suspects, a 26 year-old Marine sergeant, and the victim, a 23 year-old Navy petty officer, served on the San Diego-based amphibious ship Bonhomme Richard. The ship was returning the 13th Marine Expeditionary Unit to Camp Pendleton from deployment in the Arabian Sea, related to the war in Afghanistan.

The attack occurred on the island of Phuket, a port of call, while thousand of San Diego-based military personnel were ashore. After a trip to a local bar, the victim testifies that she had a beer with Sgt. Thomas Wolf and a friend and accompanied them to the beach. She swam with them then returned to the beach. She stated that Sgt. Wolf coaxed her back into the water, punched her, bit her, and forced her under the water several times. Several witnesses, including a Marine lieutenant who had to subdue the suspect in order to save the female victim from drowning, saw this incident.

The suspect was arrested and turned over to the Military Police and eventually returned to San Diego., The victim was treated locally, then by Navy physicians and returned to Balboa Naval hospital in San Diego, four days later. This presenter was contacted by the United States Naval Criminal Investigative Service and examined the victim on May 12, 2002, at the hospital. Forensic Odontologist Greg Golden, who was conferring on a related case, assisted in the examination. Conventional and ultraviolet photography was accomplished over a four-hour period. This examination revealed the following: 15 human bite marks, orbital fracture, and loss of a portion of her nose. In addition to photography, videography was accomplished with 15 stickers placed at each bite site and then a description of each bite was logged into an evidence document for later reference.

Subsequently, the presenter at a dental clinic at Camp Pendleton accomplished dental impressions and photography of the suspect. At a Camp Pendleton court-martial, the suspect explained how he beat, raped, bit, and then tried to drown the victim. He then pleaded guilty to all charges, which included attempted murder, rape, maiming, and three counts of assault. When asked by the military judge why he attacked a person he had met that day, the defendant answered, "I don't know, sir." He also told the court, "I forcibly tried to have sex with her, and she pulled away, sir."

This presenter explained to the Marine prosecutor, Maj. Scott Woodard, that the suspect's teeth were consistent with at least one of the bites but that teeth #24 and #25 were in a slight facial version with respect to the other incisors and that they were slightly rotated. He was also informed that these slight variations were not evident in the image and that also the bite had occurred in a centric rather than protrusive relationship. This presenter also explained that even in a situation seen by dozens of witnesses, a bite mark image might not compare exactly with the biter's dentition, due to the inherent distortion in a bite mark.

On November 8, 2002, Sgt. Wolf was sentenced to 25 years in a military prison for shattering the life of his victim.

A plastic surgeon described four surgeries, thus far performed on the victim. In order to attempt the restoration of her nose, surgeons have grafted tissue from her temple and ear. Defense attorneys said Sgt. Wolf would be eligible for parole in eight years. He will be reduced in rank to private, forfeit pay and benefits, and be dishonorably discharged.

Sexual Assaults, Multiple Bites, Severance of Nose Through Biting

F32 Investigation of Relationship Between Tooth, Face, and Arch Form in a Sample of Turkish Population

Feryal Karaman, PhD, Istanbul University Institute of Forensic Sciences, Cerrahpasa, Istanbul, 34303, Turkey; and Olcay Sakar, PhD, Istanbul University Faculty of Dentistry, Capa, Istanbul, 34370, Turkey*

The goal of this presentation is to determine the possible association or correlation between the accepted esthetic parameters of tooth, face, arch form and tooth, facial profiles by means of computer analyses and studying dental casts, and facial anthropometry of living people, as well as the influence of sex upon such associations. The second goal is, to research the usability of these relations on facial reconstruction studies.

This presentation will impact the forensic community and/or humanity by researching the usability of these relations on facial reconstruction studies.

The relationship between facial shape and dental arch has not been studied and considered seriously by the forensic odontologists and forensic anthropologists. The relationship between the face and width of dental arch is individualistic.

The necessary information for the restoration of the facial contours is obtained from the data collected from the normal and full teeth subjects in facial reconstruction studies. In this study, which takes these aspects into consideration, the similarity of teeth and face dimensions with teeth and ridge shape in the Turkish population was investigated. Additionally, the relation between sex and tooth form was investigated.

One Hundred Fifty subjects (77 female, 73 male) were studied. Photographs of tooth form, facial and profile features, and intra oral models were taken from these subjects. Measurements of tooth, facial and arch forms were made, and the type of tooth form, that is, whether angulated or rounded, was assessed from the photographs and study models. The facial and profile as well as tooth forms were traced from portrait and profile photographs. The arch forms were traced from models. The tracings were projected to the same dimensions on mm. ruled paper and the coordinates recorded for computer analyses. The computed data were compared statistically to evaluate associations or correlations between the various esthetic parameters and to determine whether tooth form and sex were associated. It was found that there was no association could be established between frontal tooth form and arch form or between frontal tooth form and facial form. Even though there is a close relation between sex and teeth sizes, there has been no relation found between sex and teeth shapes. But on the other hand, strong correlations, 88% and 76% respectively, were found only between the facial and dental profiles and between the anterior facial form and arch form.

By having such a correlation, these data should be taken into the consideration especially for facial reconstruction studies. Otherwise, to presume the face shape only by adding artificial tissues may provide a platform for mistakes.

Forensic Odontology, Dental Arch Form, Facial Reconstruction

F33 Ethics and Dental Cares in Prison

Anne A. Bécart-Robert, DDS, PhD, Gilles B Tournel, MD, Valéry C Hédouin, MD, PhD, and Didier Gosset, MD, PhD, Institut de médecine légale, 1, place de Verdun, Lille, 59 000, France*

The goal of this presentation is to evaluate the dental health of inmates. Ten years after a change of legislation, this work outlines the benefits and the drawbacks of the current legislation, and the resulting consequences in dental practice. The study also shows that the specific environment of the prison can create some unique difficulties especially ethical problems.

This presentation will impact the forensic community and/or humanity by describing the functioning of French prisons, ethical problems, and possible answers encountered in this unique dental practice.

In 1994, in France, a new legislation was enacted related to the health of detainees. The purpose of this legislation was to give the prisoners the same access to care as the general population. The system was moved from private practice to public practice by the hospitals. Before 1994, the medical staff in French jails was a private staff paid by the ministry of Justice. Employees were sometimes subordinate to the prison administration and this often conflicted with patient/doctor confidentiality. Moreover, the physicians and the dentists were not present often enough in the jails to give sufficient care.

Since 1994, the medical staff working inside the prisons is employed by the hospital. The hospital organization has significantly improved the number of dental visits to inmates. The quality of care has been improved also because the hospital provids the necessary financial means. Sterilization procedures and decontamination have been updated to avoid transmissible diseases and resulting potential trials. The equipment is now quite adequate but the human resources remain insufficient. The situation has improved since 1994 but some problems remain.

The French jails are generally overpopulated. In the jails of Lille, located in the north of France, the percentage of overpopulation is more than 200% (1,100 detainees for 470 places). This problem causes a delay in the care provided because of a lack of dentists even with the assistance students from the dental university. The dental care, as with other medical services, is free to the French detainees and the requests for dental care are many. Another problem is that some prisons house men, women, and under age detainees. These different populations must be kept separate which adds to the burden of the medical personnel. Inmates isolated for medical reasons or punishment can encounter difficulties coming to the dental offices. So, inside the jail, access to dental care is not the same for all. The high number of drug addicted inmates is another important consideration. Because these inmates generally have very bad oral health, they need additional visits.

After considering the different ethical problems encountered in a prison dental practice in prison, some answers to resolve them are proposed.

Prison, Odontology, Ethics

F34 A Comparative Study on Dental Morphology Image of Chinese

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In modern forensic science, four techniques for body identification are widely used. In mass disasters, identification of dental morphology image can solve identification problems and perform very satisfactorily. This presentation will impact the forensic community and/or humanity by presenting a comprehensive description of that method.

In modern forensic science, four techniques for identification are widely used, i.e., fingerprint identification, eye cornea identification, DNA technique, and dental morphology identification. The eye cornea is a soft issue, fingerprints are generally located on organic substances, and neither can be kept for long. Although DNA techniques can offer very precise data, national archives have not compiled this information. One possible explination may be the expense and time needed to perform this task. On the other hand, in mass disaster situations, identification of dental morphology image can solve the above more than adequately. This presentation will provide a comprehensive description of that method.

Experimental Result

1. Central incisor growing balance, upper incisor (width): 11 and 21, average are both 0.84cm; lower incisor: 31, average is 0.54cm and 41 is 0.53cm.
   Feature point:
   a. growing no balance, one person 21 bigger more than 11
   b. upper incisor width less than 0.75cm about 4% and bigger 0.95cm about 2%
   c. lower incisor width less than 0.45cm about 2% and bigger than 0.6cm about 4.5%.
2. Distance from the sharp point of canine to the central line: below 1.4cm, 13 about 1% and 23 about 1%; above 2.0cm, 13 about 1% and 23 without (upper teeth). Below 1.0 cm, 33 about 1.3% and 43 about 4.2%; above 1.5cm, 33 about 2.67% and 43 about 2.82% (lower teeth).
   Important discovery: the inter-canine mean distance (upper jaw), White males 3.6cm, females 3.44c; Black males 3.83cm, females 3.66cm; Chinese 3.38cm (mean of males and females). (Lower jaw), White males 2.78cm, females 2.68cm; Black males 2.98cm, females 2.87cm; Chinese 2.52 cm (mean of males and females)

The Chinese inter-canine mean distance is less than that of the White and Black.

3. Height difference between central incisor and lateral incisor (11, 21, 31, 41 are higher as positive)
   Compared two groups data, >0 in the meantime, about 61%; =0 in the meantime, about 4.6%; <0 in the meantime, 6.42%; others, about 28.44%
4. Height difference between lateral incisor and canine (canine is higher as positive)
   Compared four groups data, <0 in the meantime, about 16.67%; =0 in the meantime, about 1.52%; <0 in the meantime, without; others, about 81.82%
5. Notching: There are 48 people, about 40.34% (totality 119 people) and one notching 25 people (concentrated on upper central incisor), about 21%; two notching 16 people, about 13.45%; three notching 3 people, about 2.42%; four notching 3 people, about 2.42%; two notching on single tooth 1 person, about 0.8%.
6. Sheltered teeth: There are 48 people, about 40.34% (totality 119 people)
7. Diastema: There are 10 people, about 8.4%, and turned-diastema, 3 people, about 2.52%
   Notice: Middle diastema is said to be more common in Australian Aborigines, South African Ostraloid, and Boskopoid people but is rare in Chinese.
8. Others: Fragmentary tooth one person, about 0.84%
   Denture one person, about 0.84%
   Convex teeth one person, about 0.84%
   Inter-concave on the teeth one person, about 0.84%

Above feature points are quite important for dental identification.

Forensic Science, Dental Morphology, Experimental Results

Pathology/Biology

G1 Deaths From Accidental Steam Inhalation During African Traditional Therapy

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The goal of this presentation is to present to the forensic community the injurious effects of steam inhalation on the respiratory system, resulting in the deaths of two children. Death from steam inhalation is a quite rare occurrence. In many countries, steam inhalation is practiced to cure cold, cough, or respiratory ailments, etc.

This presentation will impact the forensic community and/or humanity by highlighting the hazards associated with steam inhalation, if done with the whole body covered with a blanket and if necessary precautions are not taken. Under these conditions, traditional therapy can be risky.

Case history: Two children (aged 17 and 6 years) and their mother were inhaling steam from boiling water in a pot, while covering their bodies (including the face) with a thick woolen blanket. After steam inhalation of about 5 minutes, the 17-year-old knocked down the pot and boiling water spilled on the hot plate, producing a considerable amount of steam. Boiling water also spilled on that child and mother, resulting in focal scalds. Within one to two minutes, both children experienced difficulty in breathing, collapsed, and died in the home.

At autopsy, there was oedema of the larynx with blanched white tracheal mucosa in the younger child and marked congestion in the older child. Grossly, the lungs, brain, and heart showed hypoxia signs. Microscopically, there was oedema and coagulative necrosis of the tracheal mucosa; the lungs showed congestion, oedema, and haemorrhages; and the brain showed congestion, oedema and focal intra-cerebral haemorrhages.

Cause of death was attributed to hypoxia from inhalation of steam.

It is common practice among the black Africans to use steam inhalation (traditional African therapy) known as ARAMELA in local Sotho African language) for respiratory problems or congestion or get rid of unspecified ailments, or for general well-being even when there is no evidence of any ailment (superstitious belief).

Moist air has more heat to give up than has an equal volume of dry air. Severe injuries tend to occur with steam inhalation in the form of oedema of the glottis, severe thermal tracheitis and destruction of bronchial mucosa, and haemorrhagic oedema of the centrally located alveoli which can lead to hypoxia and anoxia.

Steam Inhalation, Respiratory Tract, Hypoxia

G2 Firearm Injuries in Angers: 1990 - 2000

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After attending this presentation, attendees will be able to analyze a series of 168 cases of firearm injuries in a French city.

This presentation will impact the forensic community and/or humanity by analyzing the rate of firearm injuries and deaths in a French city and discussing the different governments' politics.

Firearms are a major cause of injuries and death in many countries, especially in the USA. In France, injuries caused by firearms account for only a small percentage of trauma admissions and deaths but are frequently the subject of media and public attention.

Materials: This study is a retrospective study. The authors examined the epidemiology of firearms injuries presenting to University Hospital of Angers from January 1990 to December 2000 (Institute for Legal Medicine and Unit of Intensive Care). Information was collected from forensic medical files, police reports, and judicial files.

Results: One hundred sixty-eight of firearm injuries were analyzed. The mean age was 42 years. Of the cases reviewed eighty percent were male and 74% died. Of the 90 weapons that could be positively identified, 20% were handguns. Most often, the shooters used a rifle–especially a shotgun. In many of the cases where a rifle was confirmed as the firearm used in the shooting, it was a 0.22 calibre low-velocity weapon. One hundred seventeen (70%) were classified as suicides: victims were often males, about 43 years old and the death rate was high (75%). The head and neck was the most favored site, accounting for 72% of the wounds; the presternal-precordial region of the chest accounted for 17% of the wounds. Twenty-five percent (25%) of cases were homicides: 57% male and 43% female. The presternal-precordial region of the chest was the most favored site (40%). Five cases (3%) were accidents: these injuries were sustained during handgun training, cleaning, or carriage of the weapon. Only four cases (2%) were undetermined.

Discussion: In France, the deaths from firearms represent 3,100 deaths / year (population: about 55 million). This rate is lower than other countries with flexibles laws. Stricter gun control laws were enacted by the government, prohibiting the ownership of military-style, high-velocity, semi-automatic rifles. Indeed, no shooting in this series involved high-velocity weapons, and nationally these weapons account for only 1% of all firearm deaths. However, firearms are a frequent means of suicidal death, and the number of homicides committed with a firearm is not insignificant. Continued restricted access to firearms is necessary to maintain France's relatively low rate of fatal injuries.

Forensic Pathology, Wounds Ballistics, Firearms

G3 Evaluation of a Novel Tagging and Tissue Preservation System for Human Remains

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The goal of this presentation is to describe a new, easy-to-use, barcode-based tissue collection, preservation and body tracking system, which might prove instrumental in the containment of mass fatalities such as aircraft accidents, war-related accidents, environmental disasters (e.g., earthquakes, hurricanes, floods), terrorist bombings, or mass murders.

This presentation will impact the forensic community and/or humanity by simplifying the use of this tissue collection and body tagging system, as well as the convenience afforded by working in an ambient temperature environment without the requirement of a refrigerator/freezer or any other additional device, while maintaining DNA integrity for a long period of time, representing potential benefits for the forensic community.

Tissue preservation is a critical issue in forensic investigations where human remains are collected for DNA analysis. The maintenance of a forensically sound chain of custody is also a critical part of field as well as laboratory practice. Low ambient temperatures and rapid recovery of human remains are ideal conditions to ensure successful DNA analysis. However, such conditions are rarely met in disaster areas, which are often encountered in geographically remote regions of the world. The new ear-tag system TypiFix™ works simply by pushing a clamp-like applicator. By

operating the loaded applicator a tissue sample is punched out by a collection stud and automatically introduced into a self-sealing sample container. In the tightly sealed sample container, the tissue and its DNA are preserved through desiccation by molecular sieve beads consisting of sodium-aluminium-silicate. The ear-tag and sample container are preprinted with the same identification number as well as a barcode. They are attached to each other until the sample is introduced in the sample container. Through this simultaneous barcoding of the remains and the tissue sample at the point of recovery, sample switch is excluded.

A feasibility study was conducted to determine the usefulness and the limitations of this device in a forensic setting and to evaluate the effect of long term storage of tissues in the sealed TypiFix™ container on DNA analysis using short tandem repeat (STR) methodology. Ten bodies were selected for this study (time since death 3 - 25 days). Tissue sampling with simultaneous tagging was performed at the interdigital fold between the thumb and the index finger of either hand using the TypiFix™ applicator. Samples were stored at room temperature and processed at 2 weeks and 6 months after collection. Using a special extractor clamp provided by the manufacturer of TypiFix™, the bottom of each sealed sample container was removed and dry tissue samples were transferred to 1.5 ml eppendorf cups. The tissue samples were subjected to DNA extraction using the QIAamp DNA Mini Kit (tissue protocol, Qiagen Inc., Valencia, CA). Quantification of human genomic DNA was determined using real-time PCR (ABI PRISM® 7000 Sequence Detection System) and the Quantifiler™ Human DNA quantification kit (Applied Biosystems). Autosomal STR analysis was carried out with 1 ng of genomic DNA using the AmpFLSTR® SGM Plus® PCR amplification kit. All analyses were performed in accordance with the manufacturer's instructions.

On average 8 ± 5.7 □g DNA (mean ± SD) were purified from each sample. The success rate of STR genotyping after 2 weeks and 6 month was 100%. DNA profiles after six months of storage were identical to those obtained after two weeks.

Currently, the most commonly used method of preserving tissues for subsequent DNA analysis is freezing. Very few alternative approaches have been developed to preserve soft-tissue samples at room temperature. Using the described system keeps the collection costs low, provides fast and reliable DNA samples from a large number of individuals in a short time, and ensures a forensically solid chain of custody from the point of recovery in the field to the DNA analysis in the forensic laboratory.

The collection of tissue-samples for DNA analyses can easily be achieved under field conditions. In case of mass fatalities it enables investigating authorities to collect numerous specimen for DNA analysis and simultaneously label the remains. Barcodes can be manufactured according to customers' needs. The system is fail-safe and fraud-proof. The specimen container is contamination-proof since only the single-use parts come in contact with biological materials. The tissue sampling for DNA analysis is possible without the need to refrigerate or freeze samples. According to the manufacturer, tissues stored over 4 years in the TypiFix™ system are still suitable for amplification of long fragments by PCR.

Therefore the TypiFix™ system provides a new, reliable and useful tool for the recovery and simultaneously labeling of human remains and tissue samples in mass fatalities.

DNA Analysis, Tissue Preservation, Disaster Identification

G4 Lesch-Nyhan Syndrome and Child Abuse

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After attending this presentation, attendees will understand the importance of distinguishing child abuse from Lesch-Nyhan syndrome (LNS); understand the first description of postmotrem verification; and understand the diagnostic significance of the absence of the HPRT-enzyme in the deceased.

This presentation will impact the forensic community and/or humanity by describing how LNS should be suspected chiefly when self-injurious behavior is associated with the typical motor dysfunction and excessive production of uric acid. This may clearly distinguish it from child abuse.

Postmortem analysis of HPRT-enzyme activity is a new and important tool for forensic work-up, enabling–especially in cases of doubt–a first and guiding diagnostic step before parents are confronted with suspicion of child abuse. A confirmation of the HPRT-enzyme deficiency may not completely exclude additional child abuse. However, careful forensic analysis, including enzyme-diagnostics, combined with the presence of injuries typical of self-mutilation, will help to clarify the facts.

LNS is characterized by neurologic dysfunction, cognitive and behavioral disturbances, and uric acid overproduction. It results in complete deficiency of the enzyme hypoxanthineguanine phosphoribosyltransferase (HPRT), which catalyzes the conversion of hypoxanthine to inosine monophosphate (IMP) and guanine to guanine monophosphate (GMP) in the presence of phosphoribosylpyrophosphate (PPP). Thus, the deficiency of HPRT activity leads to accumulation of PPP resulting in excessive uric acid production and hyperuricaemia.

The hallmark feature of the disease is persistent self-injurious behavior with biting the lips, buccal mucosa and/or fingers, often resulting in partial or total destruction of perioral tissues and amputation of tongue and fingers.

The deceased, a four-year-old boy, was born after uneventful gestation and delivery. At the age of six months, he developed marked spasticity, double hemiparesis and choreoathetosis. Because the neurologic deficits were progressive and the serum level of uric acid elevated, LNS was suspected. This suspicion was confirmed after evaluation of HPRT-enzyme activity, which was almost completely missing. Initial self-mutilation occurred around the age of 18 months, following an accidental, pain-producing injury. Feeding was difficult and spasticity developed in upper and lower extremities; the boy could neither sit, nor stand nor walk without help, and he couldn't speak, only babble. He experienced several respiratory infections. One morning he had an elevated temperature of 101° F, without other signs of infection. After breakfast, he fell asleep, and a short time later, his mother found him lying in bed unconscious after vomiting. Paramedics performed resuscitation procedures without success. Although the boy's mother reported the diagnosis of LNS, suspicion of child abuse arose because of his injured fingers and his malnutrition. A forensic autopsy was performed.

Autopsy revealed an undernourhised boy with developmental delay. His thumbs were scarred from repeated episodes of biting; his tongue, lips, and buccal mucosa showed abrasions. Both lungs showed pneumonia and discrete food aspiration; internal and microscopic examinations were otherwise unremarkable.

The formation of ^{14}C-IMP was measured in a radioisotope assay in which ^{14}C-labeled hypoxanthine was converted to the labeled nucleotide. Purine base and nucleotide were separated by thin layer chromatography, the radioactivity in the nucleotide and base fraction was determined by liquid scintillation counting, allowing the calculation of the amount of purine base converted to nucleotide. The erythrocytes were extracted. The assay was carried out by mixing assay buffer, PPP, and ^{14}C-hypoxanthine with the sample. The reaction was stopped by cold perchloric acid. After centrifugation, the supernates were neutralized with equivalent amounts of $KHCO_3$ and $KCLO_4$ precipitated by centrifugation at 4°C. The supernates were spotted on aluminum backed silica-gel-thinlayer sheets containing a fluorescence indicator using unlabeled hypoxanthine, inosine and IMP as carriers. The spots containing hypoxanthine, inosine, and IMP were identified under UV-light, cut out and the radioactivity quantified by liquid scintillation counting. The controls of the series of postmortem enzyme assays demonstrated the HPRT-enzyme to be in the normal range at least up to five days after death. It was thus concluded that the HPRT-enzyme is relatively stable postmotrem as compared to the boy's HPRT-enzyme activity of less than 1.5% one day after death, demonstrating the complete deficiency of the enzyme.

LNS should be suspected chiefly when self-injurious behavior is associated with the typical motor dysfunction and excessive production of uric acid. This may clearly distinguish it from child abuse. Postmortem analysis of HPRT-enzyme activity is a new and important tool for forensic work-up, enabling–especially in cases of doubt–a first and guiding diagnostic step before parents are confronted with suspicion of child abuse. A confirmation of the HPRT-enzyme deficiency may not completely exclude additional child abuse. However, careful forensic analysis, including enzyme-diagnostics, combined with the presence of injuries typical of self-mutilation, will help to clarify the facts.

Autopsy, Child Abuse, Postmortem HPRT-Enzyme Analysis

G5 Determining a Postmortem Submersion Interval (PMSI) Based on Algal/Diatom Diversity on Decomposing Mammalian Carcasses in Brackish Ponds in Delaware

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The goal of this presentation is to share a new technique to utilize a much-neglected biological evidence (aquatic plants) to determine a postmortem submersion interval. The authors intend to demonstrate how algae and diatoms can be used in medicolegal investigations involving brackish or saline aquatic systems. The attendee will learn how to sample, photograph and identify algae and diatoms useful in forensic science.

Because very little is known on how bodies decompose in freshwater, brackish, and marine environments, and much less is known on how to determine a postmortem submersion interval (PMSI) (i.e., determine the time a body has been submerged in an aquatic environment until the point of discovery), this presentation will impact the forensic community and/or humanity by adding to a much neglected but growing database on decomposition in aquatic environments. The authors hope to provide the first analysis of mammalian decomposition in brackish ponds using botanical evidence to determine a PMSI. This approach has been used in freshwater systems but not in saline environments such as brackish ponds. It is hoped using this technique and type of plant evidence will shed new light in determining how long a body may have been submerged in these types of aquatic systems.

Algae and diatoms have been employed to estimate the location of drowning victims as well as link criminal suspects to specific aquatic crime scenes. However, little or no evidence exists on documenting algal colonization and succession on mammalian carcasses in brackish or marine environments. The purpose of this presentation is to document how saline environments influence not only the rate that pig carcasses decompose, but also characterize the algal/diatom community at each stage of decomposition in order to use species diversity and composition indices to estimate a PMSI. The objectives of this study include: 1) characterize the physical changes and rate of pig decomposition in saline aquatic systems; 2) compare algal diversity on pigs to a natural substrate such as ceramic tiles and; 3) determine if species richness or diversity differs among stages of decomposition. This study was conducted in two slightly brackish water (brackish is defined as salinity levels between 5-18% parts per thousand-ppt) ponds near Smyrna, Delaware. The stages of decomposition were identified and characterized by physical changes. The duration of each stage was estimated in degree days. Water temperature was recorded for the duration of each trial. Salinity measurements were determined using a refractometer. To examine algal diversity on pig carcasses vs. a natural substrate, samples were collected every 3 days (trial one) and every 2 days (trial two) for approximately 20 days. Algal samples were preserved in Lugoli solution and glacial acetic acid and stored in dark conditions until analysis. Algae and diatom species were identified using a light microscope and photographed with a Nikon Digital Camera. Species diversity and evenness among stages of decomposition were determined using Shannon and Simpson's diversity indices. The mean diversity indices for pig carcasses and ceramic tiles were compared using a t-test. Previous studies have revised or suggested that five (not six) stages of decomposition have been identified for mammalian carcasses in freshwater aquatic systems. Five stages are described in this study: Submerged Fresh, Early Floating, Advanced Floating Decay, Floating Remains, and Sunken Remains. Ponds in this study maintained a salinity value of 2-4 ppt. Accumulated degree days for trial one of this study was 893 degree days. Pigs began to float within three days, the duration of the Early Floating stage ranged from 3-9 days; Floating Decay stage ranged from 6-12 days; Advanced Floating Decay stage ranged from 9-21 days, and pigs sank within 15 – 24 days. The submerged fresh stage was characterized as the time the body initially entered the water until it floated to the water surface. Few physical changes were observed during this stage. The Early Floating stage was identified as when the pigs floated and began to bloat, forming indentations from the cage on their skin and with some algal growth. Little to significant disarticulation of limbs was observed on floating pig carcasses. The Advanced Floating Decay stage was characterized as much of the carcass having been removed, with the skull exposed and the loss of limb bones. The Sunken Remains stage was identified when the remains sank to the pond bottom with only bits of bones remaining. Algal diversity was significantly greater on pig carcasses than ceramic tiles. Diversity increased significantly as decomposition progressed until pig carcasses had reached the advanced floating decay stage. Mammalian carcasses will support algal/diatom communities and that these communities experience plant succession similar to terrestrial habitats. However, in terrestrial systems, plant succession/diversity increases over time; in aquatic systems, plant succession/diversity will increase and eventually decrease as the substrate (mammalian carcass) decomposes. This study shows how algal/diatom diversity and taxonomy can be used to determine the duration a submerged victim has been under water.

Brackish Ponds, Diatoms, Postmortem Submerged Interval

G6 Immunocompromised Female, Age 67, With an Angioinvasive Pulmonary Fungal Abcess

Darshan R. Phatak, MD, Beth Israel Deaconess Medical Center, Pathology Department, 330 Brookline Avenue, Boston, MA 02215*

After attending this presentation, attendees will understand the vulnerability of the immunocompromised person to opportunistic organisms that may present unexpected autopsy findings and the necessity of a complete medical history.

This presentation will impact the forensic community and/or humanity by providing an added appreciation for a thorough medical history as an aid to correlate and make sense of unexpected autopsy findings in the immunocompromised.

This poster will present the autopsy of a 67-year-old Caucasian female with a longstanding history of hairy cell leukemia (HCL) refractory to chemotherapy in whom the pertinent autopsy findings included not only residual HCL, but also a large necrotic abcess within the right lung upper and lower lobes containing thrombus and angioinvasive fungal forms consistent with *Aspergillus* species.

The immunocompromised comprise a subset of the general population who are extremely susceptible to opportunistic organisms whether due to their primary disease process, medicines or therapies used to treat their underlying illness, or other medical conditions acting in concert with the above to render them extremely vulnerable to viruses, bacteria, fungi, and parasites.

This particular patient presented to the hospital after having low to moderate grade fever, nonproductive cough, and a sore throat for five days. After a workup revealed anemia, thrombocytopenia, leukopenia, and radiographic evidence of right lower lobe lung infiltrates, she was administered leukoreduced and irradiated packed red blood cells, a course of levofloxacin and erythropoetic drugs, and discharged.

She presented again eight days after her initial presentation complaining of persistent fevers, chills, an increase of coughing (now with pain), and pain on swallowing. She was admitted and made DNI/DNR. New imaging studies showed a mass lesion bridging the right upper lobe and superior segment of the right lower lobe suspicious clinically for acute infection vs. Leukemic infiltration. Despite administration of Zuosyn and Ambisone during her inpatient course, there was no improvement in her condition. After a bronchoscopy with BAL, which was positive for *C. albicans*, the patient required oxygen via nasal canula to maintain oxygen saturation above 94%.

On the morning of her death, the patient had episodes of hemoptysis with dark blood, then bright red blood. She emergently underwent repeat bronchoscopy, where it was noted that there was a right tracheal obstruction thought to be clot and tissue. Attempts to remove the obstruction were unsuccessful and the patient entered asystole.

Even though this particular case occurred in the setting of a tertiary care teaching hospital, people having conditions analogous to that of the decedent are often maintained on therapeutic drug regimens in outpatient settings and can present as cases of sudden unexpected death to medical examiner offices. It is not only important, therefore, for primary care givers to be sensitive to changes in the baseline health of their patients as these may be the heralds of opportunistic infection, but also crucial for those performing the postmortem to obtain a complete medical history including medicines used (and if applicable, chemotherapy and radiotherapy) and to keep opportunistic infections in their differential as to the mechanism of death.

Hairy Cell Leukemia, Aspergillus, Autopsy

G7 Teen Fatality by Train: A Multidisciplinary Approach to Determination of Manner of Death

Mary H. Dudley, MD, Sedgwick County Regional Forensic Science Center, 1109 North Minneapolis, Wichita, KS 67214*

The goal of this case study is to illustrate a multidisciplinary approach to the death investigation, and highlight unique elements of staging in an attempt to disguise a suicide.

This presentation will impact the forensic community and/or humanity by demonstrating the value of a forensic team approach to the investigation of the circumstances of death for determination of the manner in complicated or staged death scenes.

Attempts by the victim to disguise suicides as homicides are not commonly encountered, and the following case study illustrates the requirement for a multidisciplinary approach to the investigation. Professionals from the disciplines of documents examination, fingerprint comparison, odontology, toxicology, forensic pathology, and law enforcement all provided information essential in the determination of manner of death.

The decedent was a 19-year-old male who resided in a small community in the Midwest. He recently graduated from high school, as class valedictorian, where he had excelled in sports as well as academics. During the early morning hours on a day in July, 2004, the engineer of a train traveling 60 miles per hour, approximately four miles from the decedent's residence, reported that he had struck "something" on the tracks. Upon searching the area, the decedent's unclothed body was discovered. The train traffic in the region where the body was discovered was reportedly fairly busy with trains passing through approximately every 30 minutes. The identity of the subject remained unknown until later that morning when family members reported the subject missing. Law enforcement investigators examined the decedent's bedroom, and discovered a handwritten note, in block letters, which indicated that the decedent had been abducted. The note, signed "The Eliminators," further made mention that the "train took care of him" and that investigators "might find a few pieces of him left at the train crossing" at a specific site. Pillows had been placed beneath the bedding to imitate a body, and the note had been placed on the pillows. There was no evidence of a struggle, and a sibling had been sleeping nearby. An exterior door in the residence near the bedroom had been discovered ajar. Further evidence recovered from the residence was a journal written by the decedent. Additional information provided by family revealed that the decedent was last seen the previous evening following a confrontation with his parents concerning his purchase of alcohol for a minor.

At autopsy, there were extensive blunt force injuries with multiple facial, basilar and calvarial skull fractures; avulsion of the brain and eyes; multiple fractures to the ribs, spine, and extremities; and multiple lacerations to internal organs. Also noted at autopsy were strands of baling wire wrapped loosely around the right wrist, waist and both ankles. Law enforcement investigators indicated that baling wire had been noted at the residence, and later discovered beneath the tracks where the impact occurred. Positive identification of the subject was obtained through dental comparison by an odontologist. A documents examiner analyzed the handwriting on the note, and it was compared with the subject's handwriting obtained from documents produced as schoolwork. The documents examiner determined that the handwriting on the note, though efforts had been made to disguise it, was consistent with the decedents' previously produced documents. A latent print was also obtained from the note, and was identified as the subject's. The content of the journal was also reviewed, and revealed the decedent's increasing despondence and self-doubt.

Despite the decedent's attempts to lead investigators to believe he had been a victim of homicide, the manner of death was determined to be suicide. Staging a homicide may be an effort to gain notoriety, install guilt or protect family members. Following this investigation, the decedent's motive for disguising the suicidal act remains unclear.

Staging, Multidisciplinary, Train Fatality

G8 A Fatal Case Due to Abdominal Compartment Syndrome (ACS)

Margherita Neri, MD, Marianna Di Padua, MD, and Emanuela Turillazzi, MD, PhD, Department of Forensic Pathology, University of Foggia, Viale Pinto 1, Foggia, 71100, Italy*

The goal of this presentation is to present to the forensic community a case of death due to a rare systemic syndrome: abdominal compartment syndrome (ACS).

This presentation will impact the forensic community and/or humanity by presenting a case worthy of reporting for the rareness of the syndrome and its great surgical and forensic interest.

This case has been studied by means of autopsy and histological examinations.

Abdominal compartment syndrome (ACS) is broadly defined as organ dysfunction derived from increase in intra-abdominal pressure. Prolonged, unrelieved increased intra-abdominal pressure at more than 20 mm Hg can produce pulmonary compromise, renal impairment, cardiac failure, shock, and death. This presentation discusses the clinical-pathologic features, the postmortem findings and microscopic features of a fatal case due to ACS.

Case Report: A 35-year-old Caucasian female went to the emergency room with increasing abdominal pain. The woman, admitted to the surgery unit, underwent a physical examination. It showed a sharply distended and painful abdomen, no peristalsis, and rebound tenderness. At abdominal ultrasonography, stomach and bowel loops appeared distended with corpuscolated liquid material. Abdominal x-ray showed small bowel distended with air-fluid levels. Three years before, the woman had undergone an appendectomy. She was taken into the operating room for intestinal occlusion due to adhesions. On the first postoperative day, the patient had shock with numbness, cutaneous pallor, sweating, cutaneous marbling on upper and lower limbs, tachycardia, tachypnea, peripheral pulselessness, oliguria, and severe metabolic acidosis. After another day of continuous deterioration of her clinical condition, she was moved to the Intensive Care Unit. Her abdomen seemed distended, with no peristalsis; CT-scan confirmed bowel distention due to fluid and gas, with perihepatic and perisplenic fluid collections. Laboratory tests demonstrated leukopenia, neutropenia, and metabolic acidosis. Gynecologic examination revealed a rectocele. On the second day in the Intensive Care Unit the woman continued to get worse. She had anuria and hypotension; her intra-abdominal pressure, measured inside the urinary bladder by means of an ordinary Foley catheter, was 35 cm H_2O. Taken into the operating room for surgical abdominal decompression, the woman died. A complete autopsy was performed 48 h after death.

At autopsy the body was that of a well-developed adult with pale and dehydrated skin, ostia, and oral and scleral mucosae. The brain was congested and edematous. The left pleural cavity contained 200 ml of red liquid; the right pleural cavity contained 400 ml of the same liquid. The lungs were hypoexpanded and atelectatic. The peritoneal cavity contained 1000 ml of red liquid. The intestines appeared distended, with brown liquid material and pseudomenbranes in the large bowel. Examination of other organs was unremarkable.

The histological findings of the liver revealed necrosis in acinar zone 3. The kidney showed characteristics of shock: collapse, swellings of endothelial and surface cells, broadening of the basal membrane, and impairment of the loops in the glomeruli. The epithelia of tubules were flattened, and their nuclei were enlarged. The bowel wall showed areas of epithelial necrosis, fibrinous stratification, and inflammatory infiltration spread up to the muscularis mucosae.

It was concluded that the cause of death was fatal shock due to Abdominal Compartment Syndrome (ACS).

ACS is a clinical syndrome that occurs as a consequence of intra-abdominal hypertension. ACS is characterized by a tensely distended abdomen, elevated peak airway pressure, and impairment of cardiac and renal functions, leading to oliguria or anuria. Any insult that causes an acute increase in intra-abdominal volume can trigger ACS, including trauma to the abdomen as well as to distant sites, pancreatitis, hemorrhage, intestinal occlusion, ruptured abdominal aortic aneurysm, massive fluid resuscitation, and burns. The syndrome usually occurs in critically sick patients after major abdominal trauma or operations. Several cases were described where the syndrome developed without direct abdominal insult. These cases, however, were associated with severe hemorrhagic shock, burns, massive ascites, ileus, ovarian mass, or the use of anti-shock trousers.

According to clinical symptoms and measuring of intra-abdominal pressure, it is possible to make a timely diagnosis of ACS and operate for a prompt abdominal decompression. Clinical studies show a significant difference in mortality between ACS patients undergoing abdominal decompression and untreated patients (59% vs 100%). Further studies point out that a timely abdominal decompression and early treatment reduce both the incidence of ACS (64% vs 43%) and mortality of ACS (44%vs 28%) in patients at risk.

Abdominal Compartment Syndrome, Histological Findings, Postmortem Diagnosis

G9 Cane Corsos Attack: Two Fatal Cases

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The goal of this presentation is to present the case of two spouses who were slaughtered by their three pet Cane Corsos. Investigations of the death scene and autopsy findings are described.

Although dog bite related fatalities on humans appear to be a breed-specific problem (Rottweiler and Pit Bull), other breeds may bite and cause fatalities at higher rates. Here the authors present the cases of spouses slaughtered by their own three Cane Corsos, an Italian Molossoid dog breed. This presentation will impact the forensic community and/or humanity by confirming the inadequacy of breed-specific ordinances.

The most common animal bite injuries in the United States are inflicted by dogs, accounting for 80-90% of all bites. It is estimated that between 1 and 4 million Americans are annually bitten by "man's best friend;" approximately 1 in 20 dogs will bite a human being during the dog's lifetime. The vast majority of these dog bite wounds produce minor injuries, and the victims never seek medical attention, but serious sequelae, and even death, may occur. In 2001, the U.S. Centers for Disease Control and Prevention (CDC) estimated that 368,245 persons were treated in U.S. hospital emergency departments (EDs) for dog bite-related injuries (rate: 129.3 per 100,000 population). Bite wounds, in fact, account for approximately 1% of all emergency department visits and more than $30 million in annual health care costs.

Annual mortality rates from dog attacks are reported at7.2 cases for 100 million inhabitants. Many victims of these fatalities, unfortunately, are young children (often <1-year-old), and old people (mainly women); in fact, these two groups are made up of weak and defenseless individuals, generally unable to protect themselves properly.

There is a strict relationship between the victim's age, severity of injuries, and injury site. The majority of dog bites to adults are directed to the extremities; conversely, the most frequent targets of dog attacks towards children are head and neck. This explains why the highest mortality is seen among children.

About 50% of fatal attacks towards human beings involve two or more dogs; on the contrary, non fatal bites almost always involve only one dog. In fact, belonging to a pack usually makes dogs behave more aggressive, and increases the probability of causing the victim's death.

The most commonly reported breeds are Pit Bull, Rottweiler, German Shepherd, Golden Retrievers, Husky, and Akita. Presented the case of a couple slaughtered by their three Cane Corsos, in the garden adjacent to their own house. The husband, a 76-year-old man, was found lifeless, lying face down in the bloodstained ground, completely covered with blood. He wore trousers and a pair of shoes, but his legs were hidden by leaves. His trunk was completely naked, but numerous shards of clothes were scattered

all around the area of aggression, abundantly blood stained. Injuries were localized to head, neck, trunk, and upper limbs, while the genitalia and lower limbs remained intact. The scalp was almost totally absent, so that the frontal, part of the temporal, parietal and occipital bones lay bare. The left lower eyelid and the left zygomatic region showed a stretch laceration of 4.5 x 3.2 cm, with exposure of the underlying bones; the left external ear presented a grossly semicircular recision of 3 x 2.5 cm. On the left supra-clavear region there was a deep oval shaped laceration of 5.4 x 4.7 cm, with the exposure of the clavicle, muscles, nerves, and resected vessels. There were numerous lacerations on the right side of the neck, the main one was a deep oval shaped gaping wound of 9.2 x 8 cm, which exposed part of the mandible, lacerated musculature and vessels. The left upper arm showed numerous gaping wounds, in particular the deepest were localised on the upper and lower part of the arm, on the elbow, and on the radial face of the forearm exposing, respectively, the humerus and the radius, lacerated muscles, tendons, nerves and vessels. Similar injuries were on the right upper arm, and in particular in the axillary cavity and on the elbow, where underlying tissues appeared completely destroyed. All these torn wounds presented ragged and irregular margins with adjacent puncture wounds, the so called a-hole-and-a-tear combination. In the vicinity of the bites described, but in particular on the back, were found the typical claw-marks: narrow, superficial, linear abrasions, parallel to each other, four or five in number. The wife, a 70-year-old woman, presented similar wounds over the upper extremities, neck and trunk. The internal examination of both deceased revealed mainly multiple transmural vessels tears. Deaths were attributed to exsanguination by external bleeding.

These represent unique cases, because, there appears to be no previous reports of fatal attacks with the involvement of the Cane Corso, an Italian breed of Molossoid dog. This confirms that all types of dogs may inflict injuries–even fatal–to people, and reveals the inadequacy of breed-specific ordinances.

Dog Bite, Fatal Dog Attack, Cane Corso

G10 Fatal Dog Maulings Associated With Infant Swings

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After attending this presentation, attendees will become familiar with the phenomenon of dog bite-relatedfatalities involving children left unattended in infant swings. In addition, attendees will become familiar with the epidemiological, medical, and forensic aspects of fatal dog maulings in children.

This presentation will impact the forensic community and/or humanity by suggesting an as yet undescribed association between infant swing use and dog attacks, which may have significant child safety implications. It will also impact the forensic community by increasing its awareness of the general features of dog-bite-related-fatalities.

Two cases of fatal dog maulings of children left unattended in wind-up infant swings are presented, an event not previously described in the literature. In addition, a review of dog bite fatalities in children autopsied in Baltimore over the last ten years and a review of the existing literature on this topic will be presented.

Case 1: A two-and-a-half-week old male infant was left in a wind-up swing by his parents, who went outside to smoke cigarettes. The family dog, a one year-old pit bull named "Jigga," remained in the room with the infant. Upon their return, the parents discovered that the swing was overturned and the infant was on the floor, unresponsive, with bite marks to the body and face. Postmortem examination revealed multiple injuries, including contusions, abrasions, lacerations, and puncture wounds of the head and torso, fracture of the parietal skull, subarachnoid hemorrhage, multiple anterior and posterior rib fractures bilaterally, contusions of the lungs and heart, and lacerations of the liver.

Case 2: A three-month-old male infant was asleep in a wind-up swing when his parents went to bed in a separate bedroom. Three hours later, the mother awoke and, upon checking the infant, found him on the floor unresponsive with the swing tipped over. The family dogs that were present, an eight year-old Chow Chow named "Sandy" and a nine year-old Dachshund named "CoCo," were removed by Animal Control. Postmortem examination revealed multiple injuries consistent with attack by a medium to large sized dog, including numerous contusions, abrasions, lacerations, and puncture wounds of the skin; damage to the atlanto-occipital joint; fractures of the skull, mandible, clavicle, and ribs; rupture of the spleen and left kidney; laceration of the liver; and contusions of the lung.

Dog bite-related fatalities are uncommon events. Children are at particularly high risk, because the majority of dog bites occur in children and children are more susceptible to severe injury from dog bites. Other known risk factors for fatal dog attacks include male gender of the victim and dog breed; a majority of attacks occur on the dog-owner's property and often without any known provocation.

Canine aggression is a well-described behavioral phenomenon and has been subdivided into various types; of these, predatory aggression refers to the hard-wired instinctual drive to chase, catch, and kill prey. A distinguishing feature of predatory aggression is that it is usually triggered by movement, often with little change in the dog's mood. In each of the above cases, infants were left unattended in mobile wind-up swings in the presence of trusted household pets. These cases not only underscore the importance of not leaving young children unattended in the presence of pet dogs, but also raise the possibility that mobile swings may trigger a predatory response in dogs and thus may represent an additional risk factor for dog attack.

Dog, Infant, Swing

G11 Contribution of Burn Injury in a Blunt Trauma Case With Incineration

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The goal of this presentation is to discuss a complex case in which incineration, not the primary cause of death, may have occurred just prior to death from blunt head trauma, in a homicide. In addition, the authors review recent literature on significance of carbon monoxide, traces of tracheal soot, and other findings, in determining whether incineration occurred antemortem or postmortem.

This presentation will impact the forensic community and/or humanity by discussing the issues involved in determing whether incineration of a body, on which lethal blunt head trauma had been inflicted, occurred before or after death.

Assailants in homicide have often made use of incineration in an attempt to conceal the evidence of the crime. Incineration usually occurs postmortem. Accelerants are sometimes used. This case illustrates the questions that arise when autopsy findings suggest that burn injury may have begun before death.

The Virginia Beach Fire Department responded to a rubbish fire in a field. On extinguishing the blaze, they discovered the unburned shoes and lower legs of an unidentifiable, partially incinerated decedent, extending from the burned rubbish. Local law enforcement was called to the scene, and the body was transported to the Medical Examiner's Office.

The body proved to be that of an adult male, with charring present over most of the body surface area, but with sparing of both lower legs and

portions of the upper arms. There was exposed muscle, partial skeletonization of the face, and a postmortem epidural hematoma. In addition to the charred body, a distinct odor of accelerant was noted on the debris and clothing transported with the body. Autopsy revealed blunt impact trauma to the right side of the victim's head, traces of soot in the trachea, and cherry red discoloration of the muscles.

Investigation suggested that an assailant had attempted to destroy evidence of homicide by pouring an accelerant over the victim's body and igniting it after inflicting blunt trauma to the head. The literature states that traces of soot in the trachea may occur postmortem. The contribution that burning may have made to this blunt trauma homicide, the role of carbon monoxide determination in flashover burns, and evidence in general for antemortem vs. postmortem incineration, will be discussed.

Incineration, Antemortem Burn Injury, Blunt Trauma Homicide

G12 A Field Study of the Foraging Behavior of Blowfly Maggots

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After attending this presentation, attendees will understand the possibility that the largest blowfly maggots found on a body may be relatively recent arrivals, having crawled over to the fresh remains when their initial food source (e.g., a dead mouse) became depleted, resulting in the risk of significant errors by investigators attempting to calculate postmortem interval.

This presentation will impact the forensic community and/or humanity by alerting the forensic community to the possibility that if foraging behavior by food-deprived blowfly maggots is a reasonably common phenomenon, larger (older) blowfly maggots that have managed to find their way to a fresh body can be a source of large errors when investigators attempt to calculate postmortem intervals based on published rates of maggot development times. On the other hand, foraging by food-deprived blowfly maggots could also provide a possible explanation for the presence on bodies of anomalous maggots that are larger than expected according to other independent evidence.

It is generally assumed that the largest, and presumably the oldest, blowfly maggots (i.e., larvae of Calliphoridae) found on a body initially arrived as eggs deposited by flies attracted to the remains. There is the possibility, however, that at least some of the large maggots crawled over to the body from some other piece of carrion in the immediate environment. For example, if a body is dumped in a field near the remains of a dead mouse, and if the mouse remains had been nearly consumed by blowfly maggots, at least some of the maggots may abandon the depleted mouse remains and crawl over to the fresh food source, greatly complicating the situation for forensic entomologists. During the late summer of 2003 and the late spring of 2004, field studies were conducted of the foraging response of blowfly maggots feeding on a depleted, or nearly depleted, food source. The field studies were conducted in cages that excluded vertebrate scavengers but not blowflies and other invertebrates. The experimental situation was manipulated such that the maggots were presented with three choices: (1) remaining on a low quality and rapidly deteriorating food source, (2) abandoning the deteriorating food source and crawling approximately 45 cm across bare soil to a shelter containing a moist cloth and a fresh food source, or (3) abandoning the deteriorating food source and crawling approximately 45 cm across bare soil in the opposite direction to a shelter containing a moist cloth but no food.

In every cage at least some maggots remained on the deteriorating food source until it had either been consumed, dried out, or the experiment was terminated. However, during the late summer experiment of 2003, in 6 of 12 test cages, early third instar maggots of *Lucilia* sp. abandoned a deteriorating food source (i.e., a nearly consumed and/or rapidly desiccating piece of liver), and crawled across the bare soil to reach the shelter containing the fresh food source (approx. 40 gm of fresh beef liver) and began feeding. Similarly, during the late spring experiment of 2004, in 6 of 12 cages, early third instar maggots of *Phaenicia* sp. exhibited the same foraging behavior. The number of foraging maggots that crawled into the food shelters varied greatly, ranging from 1 – 2 individuals (4 cages) to more than 100 (3 cages). In one cage at least 387 maggots, as confirmed by rearing the adult flies (*Lucilia* sp.), had crawled into the food shelter. Although there were 7 cases where maggots crawled into shelters that contained only a moist cloth, the numbers were much lower. In 5 cages where maggots had crawled into the food shelters, one maggot in each cage moved in the opposite direction and crawled into the non-food shelter. In two cages where no maggots had crawled into the food shelters, a single maggot in one cage, and two maggots in the second cage, crawled into the non-food shelters. Finally, in 10 cages no maggots crawled into either shelter.

Blowflies, Maggots, Foraging

G13 Cavotricuspid Isthmus Rupture and Hemopericardium: A Delayed Complication of Cardiac Radiofrequency Catheter Ablation

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After attending this presentation, attendees will become aware of delayed fatal complications of cardiac radiofrequency ablation.

This presentation will impact the forensic community and/or humanity by providing heightened awareness of potential complications of cardiac radiofrequency ablation that may occur weeks or months following the procedure.

Radiofrequency ablation (RFA) has been used in humans since 1981 for the treatment of cardiac dysrhythmias. Numerous studies have shown that it has a high success rate with infrequent complications. The indications for RFA include atrioventricular (AV) nodal re-entrant tachyarrhythmias, accessory pathway dysrhythmias, focal atrial tachycardia, atrial flutter and idiopathic ventricular tachycardia. Reported complications include AV block, post-pericardiotomy syndrome, atrio-esophageal fistula, coronary artery stenosis, acute hemopericardium, and delayed right ventricular aneurysm.

A 47-year-old woman had a history of atrial flutter and underwent radiofrequency ablation with an 8-mm catheter. The initial ablation line consisted of 17 radiofrequency applications (maximum power 70 watts and maximum temperature 70 degrees), most for 60 seconds. The line of block extended down from the cavotricuspid region to the inferior vena cava (IVC). A procedural follow-up study showed unidirectional block with a questionable area near the IVC. An additional 20 RFA applications were applied superior to the previous line but the applications were also extended into the IVC. A repeat follow-up study showed successful RFA of her atrial flutter and bidirectional block across the cavotricuspid isthmus at baseline and following an isoproterenol challenge.

Six weeks following her cardiac RFA she presented to another hospital complaining of chest pain. Troponin levels, a cardiac stress test and an echocardiogram were described as normal and she was discharged. Five days later she had a witnessed collapse at home. Emergency medical services responded and found her asystolic. Further resuscitative efforts

were unsuccessful and she was pronounced dead in the emergency department.

At autopsy, she had a cavotricuspid isthmus disruption with a 450 mL hemopericardium. Microscopically, the site of disruption had homogenization, necrosis, fibrosis and extravasated blood. Associated with the fibrosis and necrosis were chronic inflammatory cells and granulation tissue. Elastic fibers were disrupted near the site of rupture and hemosiderin laden macrophages were present.

The authors were unable to find a previous report of delayed cavotricuspid rupture and hemopericardium following cardiac radiofrequency ablation; however, in experimental animal studies damage to the tricuspid valve and IVC occurred most frequently with high energy pulses and 8-mm catheters.

Radiofrequency Ablation, Cardiac Dysrhythmias, Complications

G14 Sudden Death of a Fourteen-Year-Old Female With Hb S-C Disease

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The goal of this presentation is to review the sudden death of a child with sickle cell anemia – Hb S-C type. The attendees will learn the different genetic forms of sickle cell disease, their complications, and the potential mechanisms of death with sickle cell anemia.

This will impact the forensic community and/or humanity by demonstrating an unusual sudden death in an adolescent with an element of past physical abuse.

According to her caretakers (mother and a grandmother), this 14-year-old black female child had been complaining of vague headache and back pains for several days. At the morning of her death she had complained of her "eyes turning color," increased headache "behind her eyes," and difficulty in "straightening out the fingers of her left hand." Her mother interpreted her daughter's complaints as predominantly an attempt to avoid school that day, and dismissed them from having any serious medical implications. At 1:00 p.m. that day, she was found lethargic and unresponsive. The mother and grandmother attempted to help her stand up, but failed. Of note, despite the grandmother's wish to immediately call for help, the mother rejected such initially, and the 911 call was not placed until some time later when the mother "could not feel a pulse." Paramedics arrived at 3:30 p.m., and she was pronounced dead after resuscitative efforts.

On initial external examination at the Medical Examiner's Office healed, patterned loop-type scars were noted on the deceased's torso, buttocks, and extremities. No acute injuries were present. Autopsy examination revealed a well-developed, well-nourished young adolescent female with scleral icterus and an overall slight jaundice appearance. Internal examination was remarkable for bilateral pulmonary edema, massive splenomegaly (spleen weight of 1,190 grams), and evidence of extreme anemia. No internal injuries were present. Microscopic examination was remarkable for extensive sequestering of sickled red blood cells within the spleen and a hypercellular bone marrow with areas of scarring. Postmortem toxicology was negative for alcohol or drug/medication substances other than a small quantity of acetaminophen. Vitreous electrolytes were unremarkable. Postmortem viral and bacterial cultures were negative, although a blood sample was positive on immunoassay for parvovirus B 19 antibodies IgM and IgG.

Sickle cell anemia is an autosomal recessive disease caused by a point mutation in beta hemoglobin gene chromosome 11p 15.4 (Hb S; 6 Glu leads to Val and Hb C; 6 Glu leads to Lys.). Approximately 8% of black Americans are heterozygous HbS. The carrier rate for HbC in is about 2% to 3%. HbC has a greater tendency to aggregate with HbS that does HbA, and hence those with HbS and HbC (designated HbSC) have a more severe disease than do whose with HbS and HbA. On deoxygenation, abnormal hemoglobins undergo aggregation and polymerization. This converts the hemoglobin from freely flowing liquid to viscous gel and results in distortion of the red cells, which acquire a sickle shape. Patients have to deal with problems ranging from severe anemia, vaso-occlusive complication, and chronic hyperbilirubinemia to severe infection. In children painful vaso-occlusive crises are extremely common, as well as hand-foot syndrome. An aplastic crisis represents a temporary cessation of bone marrow activity usually induced by parvovirus infection of erythroid cells. Sequestration crisis may occur in children with splenomegaly. With modern treatment approximately 90% of patients survive to the age of 20 years, and close to 50% survive beyond the fifth decade. No reported case of rapid death from Hg S-C type sickle cell anemia was found in the literature.

In this case the child had an acute infection with parvovirus B19, which was confirmed by blood serology. It is believed the cause of death was acute sequestration of blood with an aplastic crisis induced by the parvovirus, and thus ruled the death as natural. The mother of the deceased did not promptly call for medical help. She acted such in fearing the discovery of previous child abuse – which does suggest possible medical neglect and, thereby, a potential for other interpretations as to manner of death.

Sickle Cell Anemia, Hb SC Type, Parvovirus B19

G15 Interpreting Lesions to the Conduction System of the Heart in Case of Death Pursant to Cocaine Ingestion

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The goal of this presentation is to evaluate the potential role of the pathological lesions of the conduction system in the pathomechanism of death in cocaine users and to demonstrate the difficulties of forensic investigations when death is preceded by cocaine ingestion.

This presentation will impact the forensic community and/or humanity by presenting several cases in which it was concluded that pathological lesions in the conduction tissue may play a role in the occurence of death attributed to intoxication following cocaine ingestion

Since 2000, there has been a considerable increase in cocaine use and cocaine traffic in Switzerland. This trend is matched by an increasing number of deaths attributed to intoxication in the presence of cocaine and of its metabolites. However, it is not always clear whether intoxication is the sole cause of death.

Any forensic scientist will agree that death can be attributed to intoxication only after a complete autopsy, which includes histological analyses. Potentially lethal levels of a drug must be found and any other cause of death must be excluded. A rigorous approach is especially important in the case of drug users, which may occasionally present very high levels of certain substances without any sign of severe intoxication.

In the case of death after cocaine ingestion, the interpretation of the results of toxicological analyses carries an additional difficulty. Some victims present pathological lesions, such as cardiovascular lesions, that may or may not be linked to repetitive cocaine ingestion. The long-term and short-term cardiovascular toxicity of cocaine is well established. Some pathologies, caused by cocaine ingestion and which may in fact explain the observed death, can be identified through a macroscopic examination. Such is the case for a cerebral hemorrhage or the rupture of an atheromatous plaque in the coronary artery.

Cocaine use is also known to cause cardiac rhythm disorders, some of which have morphological substrates that can be detected through a microscopic examination. A survey of the literature shows that there have been few investigations of the conduction system of the heart in cocaine users and that no studies have ever examined conduction tissue in chronic users whose drug ingestion was confirmed by hair analysis. It thus appeared of interest to identify pathological lesions in the conduction system of the heart in chronic cocaine users that may explain cardiac rhythm disorders and even some deaths.

This presentation focuses on the different lesions found in the conduction system of the heart in cocaine addicts. Many authors believe that such lesions may be the cause of sudden death. The most frequently observed lesions consist of severe thickening of the atrioventricular node artery, intranodal and perinodal fibrosis, and microscopic foci of myocarditis.

Several cases with observable pathological lesions will be presented. The victims were young subjects: all were known to the police as long-term drug users, and some were undergoing a methadone treatment. In each case, a forensic autopsy and toxicological analyses were performed, including hair analysis to establish chronic drug use in general, and cocaine use in particular. This study included only cases in which toxicological analyses revealed the presence of cocaine in the blood, in the urine and in the hair.

It was concluded that pathological lesions in the conduction tissue may play a role in the occurrence of death attributed to intoxication pursuant to cocaine ingestion.

Cocaine, Conduction System, Hair Analyses

G16 Defibrillator/Pacemaker Evaluation in the Los Angeles County Medical Examiner Office

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After attending this presentation, attendees will be updated on the usefulness of soliciting cardiology consultations on deaths involving Implantable Cardioverter Defibrillator (ICD)/Implantable Pulse Generator (IPG) (pacemaker) as they relate to determination of cause/manner of death; and will be provided guidelines on disposition of equipment.

This presentation will impact the forensic community and/or humanity by providing examples of quality evaluation on implanted ICD and pacemakers. Mortuaries/medical examiners/coroners are provided with vital information related to their safety in handling decedents with implantable ICD/pacemakers, and disposition of same.

LA County Coroner's Office uses the services of a cardiologist/electrophysiologist to conduct forensic evaluations of implanted defibrillators/pacemakers. In some cases the device is explanted by the medical examiner and the cardiologist conducts interrogation with the programmer testing of the pulse generator. This provides information of device function, events, and whether the battery is depleted.

In other cases the device and lead system is intact in the decedent, in which case the integrity of the lead system can be verified by the cardiologist with similar interrogation techniques. The cardiologist also reviews the clinical records and pacemaker tracings, and provides opinions on the pacing system.

Implantable cardioverter defibrillators have to be turned off using a programmer to prevent morticians getting a shock. Pacemaker and ICDs should be removed prior to cremation because of sealing techniques, they will rupture during cremation due to pressure buildup.

In California, the IPG/ICD is the property of the family. If removed for evidentiary and cause of death reasons they have to be returned to the family or, after testing is completed, disposition by the coroner needs family consent. They cannot be reused or refurbished, as U.S. Federal law prohibits it. Nuclear pacemaker must be removed to satisfy nuclear regulatory agency requirements for 100% removal of all radioactive modules. Pacemakers have been used for identifying decedents. Several case examples from the LA County Coroner will be discussed. A newly developed pacemaker policy will be shared.

Pacemaker Evaluation, Cardiology Consultation, Defibrillator Disposition

G17 Traumatic Cardiovascular Complications of Catheter-Based Procedures: Relevance to Medicolegal Death Investigation

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After attending this presentation, attendees will be aware of potential traumatic cardiovascular complications of catheter-based procedures and will be able to recognize them at autopsy and determine their significance in the context of a medicolegal death investigation.

This presentation will impact the forensic community and/or humanity by underscoring the scope and utilization of catheter-based procedures. The forensic community must be aware of these uncommon but well-recognized adverse events because many of these deaths become medicolegal death investigations due to their often unexpected nature related to a medical procedure.

Using several case examples, the audience will become aware of potentially life-threatening traumatic cardiovascular complications that can result directly from a wide variety of catheter-based procedures.

There are a wide variety of procedures, both diagnostic and therapeutic, which involve catheterization of the heart and great vessels. These include standard, well-established procedures such as central venous catheterization for fluid, nutrition or medication administration, and pulmonary artery catheterization for pulmonary pressure monitoring. Specific cardiac interventions include endomyocardial biopsy, radiofrequency endocardial ablation for arrhythmia control, cardiac pacemaker and implanted defibrillator placement, diagnostic coronary angiography, and angioplasty procedures. These all carry with them a low but well-recognized risk of traumatic perforation. In addition, more novel procedures, including intravascular ultrasound, and laser and rotational atherectomy, continue to be developed.

The following autopsy case examples will be presented: brachiocephalic vein perforation by a central venous catheter in a dialysis patient resulting in fatal hemothorax, right ventricular perforation by a pacemaker electrode in an elderly woman with heart failure, coronary artery dissection caused by diagnostic coronary angiography, and pulmonary artery perforation by a pulmonary artery catheter after open heart surgery.

When perforation occurs, the outcome may be fatal and–due to the nature of such deaths–many are investigated in a medicolegal context. The pathological findings at autopsy must be properly recognized and then interpreted. Factors impairing pathological recognition may include a delay from the time of intervention to the time of death, no prior clinical awareness of the adverse event, prior removal of the catheters, inadequate availability of clinical history, and medical examiner or pathologist unfamiliarity with the nature of the procedure. When such events are identified, it may be difficult to determine the relative contribution of the resultant hemorrhage or damage to the cause of death in the presence of other major co-morbid conditions. Furthermore, it may be difficult to decide upon the manner of death, whether accidental or natural, when other significant disease is present. Proper investigation requires careful review of the medical record and a complete autopsy. Care must be taken to leave catheters and lines in place so that they can be properly inspected in-situ.

Associated hemorrhage should be quantified, and photographs should be taken. Microscopy may aid in dating lesions if healing reaction has developed at the site of injury.

Medical examiners and pathologists who perform autopsies in a hospital-based setting should familiarize themselves with the ever-expanding array of catheter-based endovascular procedures so that when adverse complications occur, they will be properly recognized. It is noted that potential complications are not limited to vascular perforations. As new procedures and equipment are introduced, vigilance for adverse events may assist in assessing their overall safety.

Cardiovascular, Catheter, Complications

G18 Increasing Heart Valve Donation by Utilization of a Cardiovascular Registry

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After attending this presentation, attendees will understand the benefits of utilizing established cardiovascular registries to increase the number of heart valve donations by medical examiners/coroners.

This presentation will impact the forensic community and/or humanity by providing the forensic community details of how an office in a large metropolitan area was able to allow a significant number of heart valve donations by requiring that the remnant myocardium be examined by a cardiovascular pathologist. There were no significant delays in time to sign the death certificate nor in determination of the cause of death by requiring this specialized review.

The Minnesota Regional Coroner's Office (MRCO) is the smallest of four offices covering the greater Minneapolis/St. Paul area, serving a population of 642,000 persons, the second smallest in the area. The other three offices have a combined jurisdictional population of 2,489,600. Two of these offices also have large numbers of referral cases from rural Minnesota.

MRCO made the decision to allow heart valve donations whenever possible and to require the tissue services organization to document cardiac findings and to send the remnant myocardium to the Jesse E. Edwards Cardiovascular Registry for examination by a cardiac pathologist.

This study examines the result of this change in practice. The number of heart valve donations was 15 in 2002 and 23 in 2003. The total number of heart valve donations from other offices combined was 11 in 2002 and 6 in 2003.

There was no significant increase in the average number of days until death certificate completion (14 vs. 21 days).

Heart valves were donated in 21 accidental death cases. The age range was 15 to 54 years. Significant cardiac findings included: atherosclerotic coronary artery disease (4), cardiomegaly (3), myocarditis (2), moderate myxomatous change of mitral and/or tricuspid valves (3), focal subendocardial fibrosis (1), and 80-90% stenosis of a large intramyocardial artery (1). Six of the hearts were normal.

Heart valves were donated in 10 suicidal death cases. The age range was 16 to 54 years. Significant cardiac findings included atherosclerotic coronary artery disease (4), cardiomegaly (2), probable arrhythmogenic right ventricular cardiomyopathy (1), biventricular hypertrophy (1), and focal subendocardial fibrosis (1). Two of the hearts were normal.

Heart valves were donated in seven natural death cases. The age range was 23 months to 58 years. Significant cardiac findings included atherosclerotic heart disease (2) and one case each of possible arrhythmogenic right ventricular cardiomyopathy, healing myocarditis, and myocardial small vessel disease. One heart was normal.

Four of the seven natural deaths were cardiac related and three were non-cardiac related. The structurally normal heart was found in a 23-month-old child with severe developmental delay and microcephaly. In one case, the cause of death was due to a pulmonary thromboembolus. In the third case, the only cardiac finding was medial hypertrophy of intramyocardial arteries. This particular case involved a witnessed arrest 30 minutes after ingestion of sildenafil citrate (Viagara). The cause of death in this case was certified as "sudden cardiac death."

The practice of utilizing cardiovascular pathologists at a cardiovascular registry for examination of post valve recovery hearts has lead to significant numbers of heart valve donations at the authors' institution. This process has not resulted in a delay in death certification and has not compromised the determination of the cause or manner of death. In fact, it has been beneficial in several areas. There are some inheritable cardiac conditions that are well known to cause sudden death. Recognition of these conditions is sometimes subtle, but the diagnosis may have enormous implications for family members. Examination of the remnant heart by cardiovascular pathologists who are accustomed to studying cases of sudden death and working with families also provides the pathologist with additional physician resources. Furthermore, as seen by review of these cases, many cases of non-natural deaths have a significant cardiac abnormality. These conditions may not have been evaluated completely without donation, if a complete autopsy had not been required. Some of these conditions also may have genetic implications for family members.

Tissue Donation, Cardiovascular Pathology, Cause of Death

G19 A Review of Pathologic Findings in Specimens Following Heart Valve Donation

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After attending this presentation, attendees will understand cardiopathologic examination of hearts following heart valve donation is beneficial and may yield important information in determining cause of death.

This presentation will impact the forensic community and/or humanity by increasing awareness of the forensic community in the nationwide shortage of cardiac tissue grafts and the role of the Medical Examiner in tissue donation.

The Cardiovascular Registry was founded in 1960 by Dr. Jesse E. Edwards in St. Paul, MN, for the purpose of studying, classifying, and categorizing heart disease. The Registry, under the direction of Dr. Edwards, was very involved in describing congenital and acquired heart disease. Since its formation, the Cardiovascular Registry has examined over 27,000 cardiac specimens and cardiovascular surgical specimens.

In 2001 the Cardiovascular Registry was approached by one of the nation's largest tissue donation procurement agencies for the purpose of performing cardiovascular pathologic examinations of post valve recovery hearts. This collaboration began in 2001.

The current study was undertaken to review the type of remnant hearts received and to tabulate the abnormalities identified. All remnant hearts received over the period of 33 months were included in the study, for a total of 492 cases.

The information received for each case includes the body height, weight and suspected cause of death. Comprising the 492 cases were 206 accidents, 75 suicides, 91 natural deaths, 5 homicides, and 116 cases in which the cause of death was undetermined at the time of heart valve procurement.

Of the suspected natural deaths, 13 were classified as non-cardiac related. The remaining 78 were suspected cardiac deaths. Seventy-seven of the 78 cases had significant cardiac findings; some had more than one major abnormality for a total of 83 significant cardiac findings. Only one heart was structurally normal.

Significant atherosclerotic coronary artery disease with a >75% stenotic lesion was identified in 59 cases. One decedent was less than 25 years of age. Thirty-six of the 59 did not have infarction; 22 had myocardial infarction. Other significant cardiac abnormalities in the natural group included: myocarditis (6), cardiomegaly (4), bicuspid aortic valve with stenosis (3), arrhythmogenic right ventricular cardiomyopathy (2), acute aortic dissection (2), anomalous origin of a coronary artery (1), aneurysmal coronary artery (1), hypertrophic cardiomyopathy (1), dysplastic intramyocardial arteries (1), mitral valve prolapse (1), coronary artery thrombo-emboli (1), and prior valvular disease with mechanical valve replacement (1). In the natural death group, 33 incidental cardiac findings were identified including: moderate atherosclerotic coronary artery disease, myocardial bridge, acute angle of origin of the coronary artery, cardiomegaly, myxomatous change of a valve, patent foramen ovale, and post inflammatory mitral valve disease.

Accidental death constituted the largest group, with 205 cases (42%). Fifty-one had significant cardiac abnormalities and 107 had incidental cardiac findings, including 9 congenital abnormalities. Twenty-three had traumatic injuries, which were either contusions or lacerations. Injuries were found only in this accidental group of cases. One hundred and three of the remnant hearts were normal.

Of the 75 suicides, 22 had significant cardiac abnormalities including two cases of arrhythmogenic right ventricular cardiomyopathy, an inheritable condition. A third case of possible arrhythmogenic right ventricular cardiomyopathy and one case with focal areas of myocyte disarray were present in this group. Twenty-three incidental cardiac abnormalities, including congenital abnormalities, were also identified.

Five remnant hearts were from homicides. Three cases had severe atherosclerotic coronary artery disease or cardiomegaly. One case had mitral valve prolapse. Only one heart was structurally normal.

The second largest group of cases, 116, were those in which the manner of death was undetermined at the time of heart valve procurement. Included in this group were cases in which only the mechanism of death was reported. In 93 of the cases the cause of death was listed as "pending." In this group were 63 with significant cardiac abnormalities including severe atherosclerotic coronary artery disease (33), myocarditis (12), cardiomegaly (11), and one case each of hypertrophic cardiomyopathy, bicuspid aortic valve with stenosis, non-infective endocarditis, severe coarctation of the aorta, acute angle of origin of a coronary artery, thromboembolus, and dysplastic intramyocardial arteries. Thirty-eight cases had normal hearts. In 58 cases, incidental cardiac findings were identified including 5 congenital abnormalities.

The study demonstrates that significant and/or incidental cardiac abnormalities may be identified following heart valve donation.

The study also demonstrates that potentially inheritable conditions such as hypertrophic cardiomyopathy and arrhythmogenic right ventricular cardiomyopathy may be present when death was due to other causes. The diagnosis of these conditions is critical, with significant implications for surviving family members.

In summary, due to the nation wide shortage of bioprosthetic materials, tissue donation is critically needed. A thorough cardiopathologic examination remains possible in remnant hearts and may be beneficial in determining the cause of death.

Tissue Donation, Heart Disease, Sudden Death

G20 Sudden Death in a Calipatria State Prison Inmate With a Single Coronary Artery

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After attending this presentation, attendees will understand how to determine the presence of a "true" single coronary artery and to utilize this cardiac malformation as the cause of sudden and unexpected death in the absence of other pathophysiology.

This presentation will impact the forensic community and/or humanity by demonstrating the pathophysiology with a single right coronary artery, and by classifying the finding of a "true" single coronary artery as a pathological entity of functional significance potentially leading to sudden death in the absence of other cardiac malformations.

This presentation is the case of a 31-year-old black man who had been incarcerated for approximately six years prior to his death. The decedent was an inmate at the Calipatria State Prison located in Southern California. He was in the midst of doing exercises in the exercise yard when he suddenly collapsed. He was subsequently taken to the prison infirmary and transferred to a local hospital for treatment, however, was pronounced dead despite resuscitative efforts. The decedent had no significant past medical history and no history of any drug usage. Postmortem examination revealed a slightly enlarged heart with a single right coronary artery and complete absence of the left coronary artery and corresponding circulation. Gross and microscopic evaluation of the heart revealed subendocardial fibrosis of the anterior and anteroseptal left ventricle characteristic of chronic myocardial ischemia. Also grossly and microscopically evident was superimposed acute myocardial infarction in the same region of the heart. Changes consistent with poor vascularization, lack of blood flow and oxygenation of the myocardium of the heart in the distribution of the absent left anterior descending coronary artery were identified.

A brief review of congenital malformations of the coronary artery circulation will be presented, including criteria for a true single coronary artery. A single coronary artery without other cardiac malformations should be considered as a pathological entity potentially leading to sudden death. Training and experience have demonstrated that this entity is usually of no functional significance unless the single artery becomes occluded. This is usually reported as an "incidental" finding, not contributing to death. This rare pathological entity may in itself lead to acute and chronic myocardial ischemia, myocardial infarction and sudden death. In this particular case, the decedent had a six-year history of incarceration during which time he had a history of chronic exercise, which apparently exacerbated the cardiac ischemia and ultimately resulted in acute myocardial infarction with sudden death.

Single Coronary Artery, Sudden Death, Myocardial Ischemia and Infarction

G21 An Accident Waiting to Happen: The Chicago Porch Collapse of 2003

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After attending this presentation, attendees will understand the various injuries, both traumatic and asphyxial, associated with a structural porch collapse.

Disasters with multiple fatalities are common, and this presentation will impact the forensic community and/or humanity by assisting medical examiners and forensic pathologists to understand injuries that are sustained in a porch collapse, the mechanism of the injuries, and how best to certify the cause of deaths based on autopsy and death scene investigation findings.

The authors present a mass casualty during a party in the upscale Lincoln Park neighborhood of Chicago. On the warm summer evening of June 29, 2003, a party was underway within the upper two floors of a 3-story building that spilled out onto the two attached wooden porches. At approximately 12:30 a.m., the 3rd floor porch began to shake. Some partygoers exited the porch into the adjacent apartment. Others remained on the porch and began to jump up and down. The porch floor separated from the building and the side vertical supports and "pancaked" down onto the second floor porch. The second floor porch floor likewise separated and collapsed onto the first floor porch, which then collapsed to the ground and into a basement stairwell. Approximately 50 people were on the 2nd and 3rd floor porches at the time of the collapse; no one was on the first floor porch or in the basement stairwell.

Emergency medical services responded quickly and extricated victims from the debris. Fifty-seven people were injured at the time of the collapse, and of these, 12 were pronounced dead at the scene. One person died after surviving approximately 19 hours in the hospital. The body positions of the victims on the two decks when they collapsed are not known.

Five of the victims were female and eight were male. They ranged in age from 19 to 30 years. At autopsy, all subjects had extensive cutaneous injuries consisting of abrasions, lacerations and contusions. All subjects also had identifiable petechiae on or over more than one body surfaces, including face (12/13), conjunctiva (10/13), oral mucosa (2/13), laryngeal/epiglottic mucosa (3/13), visceral pleura (3/13) and epicardium (1/13). High cervical spine fracture/dislocation were found in 5/13. Bony fractures were identified in four subjects. Visceral injury was identified in one. The cause of death in 5/13 cases was compressional asphyxia due to porch collapse, with a significant contributing factor of cervical spine fracture/dislocation. The cause of death in 6/13 was compressional asphyxia due to porch collapse. One of 13 had extensive skull fractures with brain injury and the cause of death was multiple injuries due to porch collapse. The one delayed fatality died from anoxic encephalopathy due to compressional asphyxia due to porch collapse. The wooden porch remnants were torn down and quickly replaced with a steel porch. Structural engineering analysis of the porch was performed, with the results to be summarized during the oral presentation.

Traumatic asphyxia, originally described by Ollivier and later refined by Perthes, is currently defined as asphyxia caused by external pressure to the thorax, inhibiting respiration. The main anatomic finding is cutaneous, mucosal and serosal petechiae of the head, chest and upper extremities. The term compressional asphyxia is a more descriptive term, better understood by the lay public as a relatively gradual compression as opposed to a sudden crushing mechanism.

Following the accident, the city of Chicago revised its inspection criteria for building porches, and in a 2-month sweep, inspected 4,000 porches. Approximately 1,200 building owners were cited for construction faults. There are an estimated 300,000 porches within the city of Chicago. At the one-year anniversary of the collapse friends and family held a candlelight vigil for the victims at the collapse site. Nineteen days after the one-year anniversary of this deadly porch collapse, another smaller, similar wooden porch in the same neighborhood collapsed, causing seven people to fall 8 – 10 feet. Fortunately, no one was injured or killed.

Traumatic Asphyxia, Porch Collapse, Compressional Asphyxia

G22 Forensic Medicine in France

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After attending this presentation, attendees will understand the organization of forensic medicine in France and the interest in clinical forensic medicine.

This presentation will impact the forensic community and/or humanity by highlighting new fields for forensic doctors.

Medicolegal activity: Fewteams perform the whole scope of medicolegal activity: "classical" forensic pathology, but also "clinical forensic medicine." These teams are based in CHUs (Centre Hospitalier Universitaire, or university hospitals, of which there are 25 in France) where usually forensic toxicology from biological samples, DNA, physical anthropology, and forensic histology are also available. Entomology and diatom identification are only done in one center for each. Several of these teams are also in charge of medical care to detainees.

Around 7,000 forensic autopsies are performed yearly for a population of more than 60 million people. This low level of autopsy performance is not only due to a low crime rate, but also to French judicial particularities. Only in four cities is more than one autopsy is performed every working day.

When possible, a forensic doctor will be called to the death scene; 14,000 to 25,000 scene examinations per year in France seems a reasonable hypothesis.

Clinical Forensic Medicine includes the examination of people in custody (around 250,000 per year nationally) and also of living victims: child abuse, battered women, assaults, and rapes cases. It is estimated that 45,000 living victims are examined each year by forensic physicians.

Forensic Doctors: Two hundred fifty physicians are employed full time in forensic medicine throughout the country. As a result of this limited number, only in some university hospitals will it be possible to have a forensic doctor on duty around the clock every day of the year, for all the types of clinical forensic activities mentioned above. In smaller cities and rural areas, forensic doctors will focus on serious penal case such as rape, homicide, and child abuse, the rest being done by general practitioners.

A majority of forensic doctors are now trained through a national diploma called "**Capacité des Pratiques Medico-Judiciaires**." The diploma requires that during 2 years, the students will have 30 days practical instruction per year in an accredited hospital unit. The other possibility is **D.E.S.C**. (Complementary Specialized Study Diploma) reserved to the medical interns; after 4 years of internship in any speciality, the candidate becoming a forensic medicine specialist will need 2 more years of practical and full time training in a medical forensic unit plus 200 hours of lectures. The graduate will be able to perform all types of forensic medicine activities (including autopsies).

A recent survey showed that around 750 forensic doctors were needed to provide the appropriate and basic emergency forensic medicine services (clinical and crime scene examination) to each local judicial court.

Teaching and Research: INSERM (National Institute of Medical Research) has no forensic medicine section (nor a forensic science section) and there is no PhD program in forensic medicine.

State funded research programs in forensic medicine are limited to scattered projects (fewer than 10 so far). During the medical curriculum of general practitioners, between 20 to 40 hours of lectures will be dedicated to forensic medicine (medical certificates about living victims and death certificates, principles of medical liability, and medical confidentiality).

Conclusion: The role of forensic medicine in France is increasing as the forensic doctors are turning to "Violence Medicine" specialists. The relative importance of autopsies is decreasing, a rather positive point with regard to the (worldwide) difficulties for funding this activity, but has an adverse effect on the experience of practitioners. Concentrating forensic autopsies in regional hospital-based centers seems to be the only solution, for the sake of quality.

Forensic Medicine, France, Organization

G23 Near Miss Incidents: Feasibility Studies Assessing Forensic Physicians' Perceptions of Near Misses in Police Custody Suites in London, United Kingdom

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After attending this presentation, attendees will gain an understanding of the causes of near miss incidents and how they may be applied to the care of prisoners in custodial settings.

This presentation will impact the forensic community and/or humanity by raising awareness of the need for further research into the care of prisoners in custody, in order to try and prevent harm or death occurring.

Background: Deaths of prisoners in police custody are tragedies for all those involved. Potentially preventable deaths in police custody include those which involve illicit drugs, alcohol and deliberate self-harm. Near miss incidents (NMI) that did not result in death have a crucial role in understanding risk factors in custody. A program of research has been developed to study near miss incidents. For the purposes of this research NMI, have been defined as 'an unplanned and unforeseeable or unforeseen event that could have resulted, but did not result, in human death or may have resulted in injury or other adverse outcomes."

Aims & Methods: An initial study was undertaken with pilot interviews of 3 forensic physicians (FP) practising in London, U.K., to create a structured questionnaire for all forensic physicians working in London. The questionnaire was the basis of a retrospective recall survey of all FPs working in London as Forensic Medical Examiners (FME) designed to assess numbers of NMIs, patterns in occurrence and relevant learning points within the previous 6 months. A cover letter, background questionnaire (exploring the background of the medical practitioner), copies of NMI survey, and reply paid envelopes were sent to each FME (n = 134) in London, working for the Metropolitan Police Service. Data about all incidents were anonymised.

Results: There was an overall response rate of 73% (n=96). Of FME respondents, 18% were Principal grade, Senior (24%), Standard (35%) and Assistant (23%). 20% of FMEs had specific mental health training and qualification. 52% had forensic qualifications such as the Diploma of Medical Jurisprudence, and the Diploma of Forensic Medical Sciences. FMEs had been qualified in medicine for a mean of 27 years and had been FMEs for a mean of 11 years. Thirty-eight NMIs were reported by 27 FMEs (of all levels) although the retrospective method meant that some data are incomplete. The reason for police contact was recorded as alcohol (n=8), theft and robbery (n=7), warrants (n=4), violence (n=3), traffic violations (n=2) and single cases of drugs, murder and immigration offences. Twenty-seven NMIs involved white Caucasians, 4 involved Asians, and 2 involved blacks (origin not known). Form 57M (a screening questionnaire used in police custody to identify medical and mental health problems) was positive in 12 cases, and the Police National Computer had warnings in 6 cases. Of the main perceived cause of each NMI, illicit drugs were involved in 12/38; alcohol in 17/38; deliberate self-harm in 11/38; problems with searches, checks or rousing in 8/38; failure of inter-agency communications in 5/38; and insufficient resources in 4/38. In a number of cases more than one factor was involved. Examples of type of NMIs were: illicit drugs – overdose, drug swallowing, drug concealment, theft of drugs from FME; alcohol – self-harm, physical injuries (ruptured spleen, head injury), hypoglycemia; self-harm – concealed knife, self-hanging on paper suit, drug swallowing).

Summary and Conclusions: Using the figures generated by this study, the reported rate of NMIs is 0.4 NMI per FME which gives a total annual rate of 107 NMIs in this setting. These data reflect the incidence of NMI in one of 43 police forces in England and Wales. These data are broadly consistent with documented patterns of deaths in police custody that would appear to reinforce the validity of the data. The need for a prospective study is supported. The next stage is a prospective 6 month study in which NMIs will be recorded around the time of occurrence, with analysis of each incident subsequently conducted by a research team, in order to learn lessons which may be utilised to attempt to prevent potentially avoidable deaths in police custody.

Deaths in Custody, Forensic Physicians, Near Miss Incidents

G24 Fatal Pulmonary Thromboembolism and Hereditary Thrombophilias

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The goal of this presentation is to present to the forensic community the role that hereditary thrombophilias may play in deaths due to venous thromboembolism (VTE). Forensic pathologists will understand the availability and usefulness of postmortem DNA testing for hereditary thrombophilias in deaths due to thromboembolic events.

This presentation will impact the forensic community and/or humanity by showing how any and all data generated by increased postmortem testing could bring illuminating information to the medical literature, allowing forensic practice the ability to keep pace with this important and rapidly developing field, and potentially contribute to the reduction of morbidity and mortality and the enhancement of public health.

The autopsy dissection, personal and family medical histories, and ancillary studies pertaining to pulmonary embolism (PE) are important components in the investigation of these deaths. But, the detection of a PE at autopsy and even that of apparent underlying risk factors do not necessarily signify the end of the investigation. Molecular analysis for genetic risk in selected cases might further explain fatal outcomes in persons in whom causality is inadequately explained. Also, on occasion, no apparent predisposing conditions are identified. Hereditary thrombophilias may play a causal role in the development of PE in some of these deaths. With the availability of postmortem molecular testing, their significance in such deaths may be better understood. Most importantly, beyond more accurate death certification, these tests have the potential to reduce morbidity and mortality for surviving family members.

Pulmonary thromboembolism is commonly diagnosed in forensic pathology practice, as it often causes sudden death. It is attributed to a wide variety of predominantly acquired etiologies. Although likely etiologically multifactorial, some commonly diagnosed proximate causes include: surgery, pregnancy, injury or relative inactivity of any cause, cancer, obesity, or serum hyperviscosity. On occasion, no apparent predisposing conditions are identified. In these instances, occult hereditary thrombophilias may play a contributory causal role.

Currently, there are DNA techniques that allow for the postmortem diagnosis of some hereditary thrombophilias. These include Factor V Leiden (FVL), Prothrombin (PT), and Methylenetetrahydofolate reductase (MTHFR) mutations. Less common abnormalities involving antithrombin III, protein C and S, plasminogen, dysfibrinogenemia, hyperhomocysteinemia, and antiphospholipid antibodies were not tested for, as functional and serologic diagnostic assays are ill-suited for postmortem blood.

Resistance to activated protein C, the most potent endogenous anticoagulant, is due to a mutation of the factor V gene (i.e., the Leiden mutation) which results in decreased control of thrombin generation. The G20210A autosomal dominant mutation in the prothrombin gene is associated with an increased amount of prothrombin, which promotes the formation of thrombin. Hyperhomocysteinemia (plasma homocysteine concentration >15 ?mol/L) is a risk factor for venous (and arterial) thrombosis. Increased concentrations of homocysteine are partly determined by enzymes involved in its metabolism. Some mutations in methylenetetrahydrofolate reductase (MTHFR) and cystathione-B-reductase (CBS) are associated with elevated concentrations of homocysteine.

At the Office of Chief Medical Examiner of the City of New York, 124 deaths (of 15,280 undergoing autopsy) were caused by PE between December 2000 and September 2003. Of those, 34 postmortem blood samples from persons having one or more of the selection criteria were analyzed by a molecular fluorescence method (FRET) for FVL, PT, and MTHFR mutations. Characteristics of decedents who were candidates for these tests were based on widely used clinical criteria and included: age < 45 years, pregnancy-related deaths, history of recurrent or unexplained stillbirths, oral contraceptive pill use, hormone replacement therapy, treatment with chemotherapy, weak risk factors (long flights, car rides, or slight obesity), or deep venous thrombosis of undetermined etiology.

Heterozygous mutations involving FVL (1 case), PT (3 cases), and MTHFR (8 cases), as well as a single homozygous mutation for MTHFR, were detected, a total of 35% of those tested. Five deaths were clearly causally related to one or more of these mutations. The possibility of causal relationships in the remaining 29 deaths is discussed.

Venous Thromboembolism, Thrombophilia, Hereditary

G25 An Expert Witness Requests Re-evaluation of SOP in Autopsy Reporting, Supported With Case Examples

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After attending this presentation, attendees will gain an appreciation for the importance of listing all breached arteries by name and injury on autopsy reports.

This presentation will impact the forensic community by suggesting a standard operating policy revision in autopsy reporting where arterial injury is ignored if absent from direct cause and/or manner of death.

Medical experts should name all breached arteries and include interpretation of injury to facilitate reconstruction of criminal events. This presentation will illustrate with case examples where knowledge of arterial injury, even if not listed in the autopsy report, could have saved time and concern for justice and assisted reconstruction of incidents from bloodstain pattern evidence.

Arterial injury is often encountered in casework, yet not all injuries are mortal. Breach may occur to the carotid, temporal, brachial, and deltoid arteries, which may project considerable arrays of blood drops without resulting in death. On the other hand, even minor arterial vessel injury may shift results from a survivable assault to death from homicide, suicide, or accident via hypovolemic shock. When reconstructing crime events, it is essential to know that arterial blood vessels were breached. The identification and interpretation of arterial injury requires medical expertise.

For example, a gunshot wound to the head which nicks the temporal artery may be reported as GSW to the head, without listing arterial injury. This omission may limit time and detail in reporting, but can create inconvenience and embarrassment later when investigators attempt to place the origin of an assault. Without specific information regarding arterial damage, reconstruction conclusions may err. Three less than satisfactory ways in which information regarding arterial damage may be obtained after the autopsy report:

1. Law enforcement representatives attending the autopsy may ask the pathologists technical questions.
2. The bloodstain pattern experts may interview the pathologist at a later date.
3. Attorneys may bring out the information during direct or cross examination at trial.

The least desirable consequence may be ignoring the distinct arterial damage bloodstain patterns because no arterial injury was mentioned in the autopsy. Arterial damage from even minor injury may contribute to rapid blood loss. In such cases the cause of death may be listed as exsanguination. Identifying where the artery was breached positions the victim where the crime emphasis of survival (assault) versus death (homicide) occurred.

Three case examples are shown to emphasize the essential information possible when arterial damage is recognized.

Case 1: A homicide occurred in a dormitory building. Bloodstain patterns were found at two locations: in the victim's room and along the hall outside the room. An expert was hired to answer the question of where the fatal assault began. The identification and position of the injured artery, and behavior of blood drops distributed best answered the question.

Case 2: Statements of an assailant placed a victim over a large pool of blood when the assailant left the scene. When photographed, the victim's body was in an entirely different position with evidence of considerable arterial rain between positions. Information obtained during the investigation suggested that a second assailant could have committed the murder after the first one left. Because no interpretation of the bloodstains was initially made, and the police took the confession without verification, it is possible that justice was not served in this case.

Case 3: An alleged drive-by shooting was shown to be a homicide within the vehicle when the tracking of the blood was aligned with arterial damage to the carotid artery. Death was by hypovolemic shock 24 hours later.

In conclusion, adding the name and injury of breached arterial blood vessels to autopsy reports will supply essential information and prevent later inconvenience and possible reverses of justice.

Arterial Injury, Autopsy Reporting, Bloodstain Patterns

G26 Sudden Death Following Brief Compression of the Neck

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The goal of this presentation is to present a well-documented case of sudden death following brief compression of the neck, and to discuss the possible mechanisms for this phenomenon and methods to evaluate these mechanisms.

This presentation will impact the forensic community and/or humanity by providing a well-investigated case of a type of death which has been poorly documented in the past, and has caused extensive debate

in the forensic pathology community and court system. The presentation will emphasize proper procedures in investigating this type of death.

Nearly all forensic pathology texts make reference to sudden death following brief compression of the neck; these deaths are attributed to a hypersensitive carotid sinus reflex. Review of the medical literature, however, reveals that reports of death by this mechanism refer to elderly individuals with significant cardiovascular disease or other factors that could explain their deaths independent of the neck compression. The vast majority of references to a hypersensitive carotid body discuss only fainting as opposed to sudden death. A case recently investigated in which the death of a 14-year-old youth following brief neck compression was witnessed and thoroughly investigated.

Three reliable witnesses reported that there was a brief tussle with another youth, during which the decedent attacked the other youth and held his neck with both hands. The other youth pushed the decedent against a wall and compressed his neck with one hand while he faced the decedent. The compression continued for 15 to 30 seconds, at which time the decedent collapsed. He was pulseless and apneic; cardiopulmonary resuscitation by a trained bystander as well as paramedics and emergency room personnel continued for nearly an hour before he was declared dead.

A thorough autopsy was performed. This included a complete gross examination with layered, *in situ* dissection of the neck structures, and complete histological and toxicological examination. Multiple microscopic sections of the heart and serial sections of the conduction system were examined during the initial autopsy and re-examined by a cardiac pathology consultant. In addition the carotid bodies and adjacent arteries were serially sectioned and examined by this consultant. None of these procedures revealed an anatomic cause of death or any significant disease or injury. Molecular autopsy for long Q-T syndrome is underway.

The presentation will include detailed history and autopsy results, a review of the pertinent literature, a discussion of possible mechanisms of death in this and similar cases, and a discussion of procedures to be followed in performing a complete investigation of these deaths.

Sudden Death, Neck Compression, Long Q-T Syndrome

G27 The Spontaneous Oesophagus Perforation: A Forensic Point of View

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After attending this poster, attendees will understand a case report of forensic autopsy of an unusual cause of death.

This presentation will impact the forensic community and/or humanity by demonstrating the contribution of Boerhaave syndrome to sudden death.

An autopsy was performed on a young adult, who apparently died during his sleep. Mediastinitis was established and empyema was also found in the left pleural cavity. The esophagus examination showed a tear in left side. The lesion occurred in the distal esophagus and showed the leak communicating freely with the left pleural space. Esophageal perforation was the cause of empyema, and death resulted from barotrauma to the lower oesophagus during the effort of vomiting. The disease is Boerhaave syndrome, a serious and rapidly fatal spontaneous esophagus rupture. Forceful ejection of gastric contents in an unrelaxed esophagus against a closed glottis is the mechanism described. The tear thus produced is vertical, akin to the "Mallory-Weiss" tear. The poster discusses the historical, statistical, pathophysiological, diagnostic and therapeutic aspects of Boerhaave syndrome.

Spontaneous Oesophagus Rupture, Autopsy, Death

G28 Human Wicks: The Almost Complete Destruction of Major Portions of the Human Body by Fire Fueled at Least Partly by the Body Fat of the Victim

Phillip M. Burch, MD, Office of the Medical Examiner, 1300 Clark Avenue, St. Louis, MO 63117*

After attending this presentation, attendees will to be able to assess a fire scene that involves a human body that provided its own fuel for the fire.

This presentation will impact the forensic community and/or humanity by assisting the attendee in the reconstruction of a fire scene to establish if a human body was a source of fuel for the fire.

The charred remains of an adult human female were discovered in an abandoned house in St. Louis, MO, in early January of 2004. The female was determined to be the victim of a blunt trauma homicide. Much of the torso and lower extremities were basically destroyed by the fire, in some places even down to the bones (not even the hot, prolonged fire of the kind applied at crematoriums totally destroys the bones). Although it is thought that the fire occurred where the body was discovered, nothing else at the scene was altered by the fire. How such a fire could occur and go undetected by passersby during the fire will be discussed. The remains of this case, and others like it, resemble those described in cases of so-called "spontaneous human combustion" and this phenomenon or myth will also be discussed.

Scene Reconstruction, Body Fat, Human Wick

G29 DNA Extraction and Anthropological Aspects From 6th to 7th Century A.D. Bone Remains

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After attending this presentation, attendees will be able to implement the knowledge of the DNA extraction.

This presentation will impact the forensic community and/or humanity by proposing a modified protocol for DNA extraction.

In the archeological site of the early Christian Episcopal complex of Saint Peter, in Canosa di Puglia (Bari, Italy), during the operations of archaeological excavations, tombs were discovered. They were dated between the 6th and 7th centuries A.D. with Carbon 14 methodology. Five skeletons were found in the five tombs:

28A: male individual, 43 years old. The height was 170 cm, the biomass was 65.7 kg. The analysis of the bones indicated several noteworthy pathologies, such as a number of hypoplasia lines of the enamel, the presence of Shmorl hernias on the first two lumbar vertebras, the outcome of subacromial impingement syndrome.

28E: male individual, with a biological age of death between 44 and 60 years. The height was 177 cm. He had a post-traumatic fracture callus of the medial third of the clavicle with an oblique fracture rima.

29B: female individual, 44-49 years old. The height was 158.8 cm, the biomass was 64.8 kg. There was Wells' bursite on the ischial tuberosity, on both sides.

29E: male individual, 45-50 years old. The height was 169.47 cm, the biomass was 70.8 kg. The third and the fourth vertebrae showed the Baastrup syndrome (compression of the vertebral spine). There were radiological signs of deformity on the higher edge of the acetabula and results of frequent sprains of the ankles.

31A: male individual, 47-54 years old. The height was 178.65 cm, the biomass was 81 kg. The vertebral index showed a heavy overloading in the thoracic- lumbar region. There were bony formations under the periosteum on both on the higher and medium facets of the first metatarsus, and on the higher and lateral facets of the fifth metatarsus on both sides. As the topographyindicates, these small ossifications coincided with the contact points between the back of the foot and parts of the upper of the shoes.

From the osseous remains, in particular from the teeth (central incisors), the DNA was extracted and typed in order to identify potential family ties among all the subjects. The extraction technique used came from the DNA Promega technique, partially modified by the authors. Stay times of the sample in the extraction buffer were increased and were increased the PCR cycles.

Ancient Bone Remains, DNA Extraction, DNA Fingerprint

G30 Risk Factor Analysis and Characteristics in Community Acquired MRSA

Julia M. Braza, MD, Karoly Balogh, MD,; and Anthony Martyniak, MD, Beth Israel Deaconess Medical Center at Harvard Medical School, 330 Brookline Avenue, Boston, MA 02215*

The goal of this presentation is to increase awareness of community acquired methicillin resistant *Staphylococcus aureus* (MRSA) infections, and its shift in epidemiology. It is relevant to the medicolegal and public health fields to identify such cases, especially in younger individuals, as it is a reportable disease and a cause of sudden death.

This presentation will impact the forensic community and/or humanity by identifying the risk factors for community acquired MRSA infection in patients without underlying chronic illness, and discussing different and atypical presentations, so that the forensic community can better recognize MRSA in individuals who acquire the agent outside of a hospital setting.

The focus of this case report is patient J.V., a 28-year-old Puerto Rican man who presented to the Emergency Department with a two day history of increasing shortness of breath, chest pain, and bloody sputum. His past medical history was significant for previous herpes infection, and a right thigh abscess that was drained two weeks prior to admission. The patient's social history was significant for incarceration for 5 years (he was released one year prior to admission) and being a smoker. The patient denied intravenous drug use, and maintained a negative HIV status. J.V.'s hospital course initially manifested as a pulmonary process (consistent with necrotizing pneumonia), with an almost complete opacification of the left lung on chest x-ray. On the third day of admission, J.V. deteriorated with septicemia, shock, acidosis, anuric renal failure, disseminated intravascular coagulopathy, paralysis, and a purpuric rash involving his face, anterior chest, right arm, lower extremities, and back. Blood cultures revealed gram positive cocci in pairs and clusters, consistent with the organism *Staphylococcus aureus*. Histologic findings at autopsy revealed extensive bilateral acute pneumonia with multiple pulmonary infarctions, hemorrhage, and necrotizing vasculitis.

The patient had a rapidly progressive course (6 days) of methicillin resistant *Staphylococcus aureus* infection, with no known underlying chronic illness or health-care associated risks factors such as recent hospitalization, recent outpatient visit, recent antibiotic exposure, chronic illness, diabetes, or malignancy. Therefore, by exclusion, this is a case of community acquired MRSA. However, the severity and very rapid progression of the infection, which led to his death, raises the question of the possibility of other risk factors, such as intravenous drug use, underlying HIV infection, or contact with a person or persons with the above-stated risk factors. There is also an associated chance of increased MRSA transmission in certain community clusters such as in correctional facilities, athletic teams, and nursing homes (JAMA, 2003). Such populations have a higher incidence of sharing common personal objects or facilities that would make transmission of MRSA (especially via cutaneous and respiratory inoculation) more common. The patient's history of five years of incarceration places him within this risk category.

MRSA was first acquired outside of a hospital setting in the 1980s when intravenous drug users in Detroit were reported to have a MRSA bacteremia, according to Collins *et al.* (*Medical Journal of Australia*, 2002). Currently, the Centers for Disease Control (CDC) is conducting an active population-based surveillance for community acquired MRSA (CA-MRSA) in selected regions of the U.S.to help characterize the incidence and risk factors for MRSA in the community (*JAMA*, 2003). Iyer *et al*. have studied local outbreaks of CA-MRSA, specifically related to cutaneous presentations, with the finding that cutaneous abscesses were the most common presentation, (*J Am Acad Dermatol,* 2004). This finding is pertinent to the patient presenting with a cutaneous abscess on his thigh 2 weeks prior to his pulmonary symptoms.

In conclusion, J.V.'s clinical picture and autopsy findings demonstrate a case of CA-MRSA. MRSA is now emerging as a community based agent, and with its varied presentations, such ascutaneous abscesses, shock, and pneumonia, clinicians and pathologists need to include MRSA in the differential diagnosis.

MRSA, Risk Factors, Community Acquired Disease

G31 Commotio Cordis: Sudden Death Among Young People During Sporting and Recreational Activities

Sunil K. Prashar, MD, and Karoly Balogh, MD, Beth Israel Deaconess Medical Center, 330 Brookline Avenue, ES-112, Boston, MA 02115*

After attending this presentation, attendees will have an improved understanding of sudden deaths due to commotio cordis including its definition, demographics, mechanisms, treatment, prevention, and potential medicolegal consequences.

This presentation will impact the forensic community and/or humanity by improving awareness among the forensic community of sudden deaths due to commotio cordis. Increased understanding of commotio cordis may lead to more accurate determination of cause of death by forensic professionals, improve preventive and safety measures in the community, and help avoid inappropriate charges and convictions in the criminal justice system.

A 21-year-old white man with no significant medical history was hiking and rock climbing with friends and sustained a 15-foot fall which led to immediate loss of consciousness. A policeman was the first rescuer to the scene. He found the young man to be apneic and pulseless. The policeman administered defibrillation and cardiopulmonary resuscitation. The man was airlifted to a local hospital where he was pronounced dead shortly after admission. The case was referred to the medical examiner's office. At autopsy, multiple horizontal abrasions were observed on the face, thorax, and legs. There was no intracranial or spinal pathology. There was no evidence of cardiomyopathy and the coronary arteries had normal anatomy. There was focal petechial hemorrhage on the posterior epicardium. Blood toxicology was positive for cannibinoids and ethanol (0.010 gram %). The cause and manner of death were determined to be commotio cordis and accident, respectively.

Commotio cordis is defined as cardiovascular collapse secondary to cardiac arrhythmia caused by low energy impact blunt trauma to the chest without structural injury to the sternum, ribs, or heart.

Maron *et al*. (JAMA, 2002) reviewed 128 cases entered into the U.S.Commotio Cordis Registry. The ages ranged from 3 months to 45 years with a median age of 14 years. Seventy-eight percent were under 18 years old and 95% were male. Eighty-one percent involved precordial blunt impact from a projectile, most commonly a baseball, softball, or

hockey puck. Twelve percent involved a fight, play fighting, or parental discipline. One case involved a fall on playground monkey bars. It is thought that the narrow, compressible chest of youth increases the risk for commotio cordis.

Link *et al*. (Prog Biophys Mol Biol, 2003) conducted a series of experiments on a swine model to improve understanding of the mechanisms of commotio cordis. Using projectiles fired at anesthetized juvenile swine, the researchers found that ventricular fibrillation could be consistently produced when impact occurred 10-30 milliseconds prior to the T-wave peak. Impacts led to premature ventricular depolarization. Ventricular fibrillation was most consistently produced by impacts at the center of the left ventricle. The authors found that early defibrillation was a critical factor in survival.

It has been suggested that soft core baseballs, improved chest protection, and the presence of defibrillators at organized sporting events may decrease commotio cordis events and deaths.

Of particular importance to the medicolegal community, Maron *et al*. (American Journal of Cardiology, 2002) described six cases of commotio cordis which entered the criminal justice system. The cases involved parental discipline, domestic dispute, and gang initiation. In all cases, there was no intent to cause death and none of the victims showed sufficient trauma to cause death. Convictions ranged from reckless homicide to first degree murder, with sentences from 8-20 years. The authors purport that criminally negligent homicide is not the appropriate charge in many cases of commotio cordis and that it is the responsibility of the physician community to educate the justice system regarding the nature of commotio cordis deaths.

Commotio cordis is an important cause of sudden death in young people during sporting and recreational events. It is caused by low energy impact blunt trauma to the chest which causes fatal cardiac arrhythmia. Rapid defibrillation is critical to survival. Protective measures may decrease commotio cordis events and deaths. It is of great importance to increase awareness of commotio cordis within the medicolegal community to prevent inappropriate criminal charges and convictions.

Commotio Cordis, Sudden Death, Cardiac

G32 Guidelines and Medical Malpractice in Minor Head Injury Management

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This presentation will impact the forensic community and/or humanity by showing the limitations of guidelines used in the management of minor head injuries.

The use of therapeutic-diagnostic protocols and guidelines is spreading more and more within healthcare systems. The guidelines are based upon the latest scientific discoveries of Evidence Based Medicine, and oriented to suggest the most appropriate procedures, optimal recovery time, and tools and resources for every patient in order to identify the best clinical practice and the best possible treatment for that patient.

According to some experts' opinions, the international standardization of the best possible treatment of the most widespread pathologies implies some negative aspects, such as the restriction in being free to make diagnostic and therapeutic decisions by doctors.

Regarding forensic medicine, these guidelines are gaining significant importance: from defensive medicine to medical malpractice. In the forensic medical field, protocols and guidelines are used as scientific references to confirm or contest the doctors' behavior in the cases in which there is the suspicion of professional error.

As minor head injuries (1.6 million victims per year in U.S.A.) may have grievous disabling consequences, the guidelines on this topic have great importance. They provide that patients without neurological signs and symptoms and with a Glasgow Coma Score of 15 should not be hospitalized.

This study is aimed at verifying the effective reliability of these guidelines in order to make them more complete and to prevent potential malpractice events.

For this purpose, 1,035 case histories, representing all the hospitalizations occurring during the year 2002 in all seven hospitals in a province in Southern Italy, were examined. Two hundred fifty-eight hospitalized people (25%) were negative for loss of consciousness, vomiting, amnesia, cephalea, and risk factors (clotting pathologies, use of anticoagulant drugs, alcoholism, use of narcotics, previous surgery of the cranium, disabled elderly people), and the physical examination at admission showed a Glasgow Coma Score of 15. All of these patients were admitted to the hospital contrary to guidelines. In fact, for this kind of patients the guidelines suggest discharge, with an instruction sheet in case of the onset of neurological symptoms. An observation period in the hospital and C.T. scanning by the first six hours would be for the patients with loss of consciousness only.

During hospitalization, these patients underwent plain film radiography and/or CT scanning of the head that documented cranial fractures in 7 cases and intracranial lesions in another 5.

Conclusions: the study shows that in the 5% of the patients with minor head injury, noanamnesia, and normal neurological examinations–patients that should not be submitted to any medical treatment in accordance with the guidelines–performing additional diagnostic tests could reveal the presence of lesions more serious than initially suspected. The non-diagnosis of these lesions could produce forensic-medical problems resulting in potential malpractice allegations.

Guidelines, Medical Malpractice, Minor Head Injuries

G33 Sudden Death Due to Bilateral Spontaneous Pneumothoraces in a Marijuana User

Joseph A. Felo, DO, Cuyahoga County Coroner's Office, 11001 Cedar Avenue, Cleveland, OH 44106*

After attending this presentation, attendees will realize the rare, and potentially fatal, complications of chronic marijuana smoking.

To the author's knowledge, there have been no previous reports in the medical literature of sudden death due to bilateral spontaneous pneumothoraces in an individual known to use marijuana. This presentation will impact the forensic community and/or humanity by demonstrating the adverse pulmonary effects of marijuana smoking, and focusing on a rare complication that may result in sudden death.

Marijuana remains the most commonly smoked illicit substance in American society. There is a public perception that marijuana smoking has little adverse effect on physical health. However, habitual marijuana smoking may produce lesions in the conducting airways and lung parenchyma similar to those lesions caused by repeated inhalation of tobacco smoke. 9-tetrahydrocannabinol and combustion products of *Cannabis sativa* are respiratory irritants. Compared to tobacco smoke, marijuana smoke causes a fivefold greater increment of blood carboxyhemoglobin level, a threefold increase in the amount of tar inhaled, and retention of one-third more inhaled tar in the respiratory tract. The pulmonary effects of chronic marijuana smoking include epithelial remodelling of airways and barotrauma.

Inhalation of marijuana smoke involves deep, sustained inspiratory effort, often followed by frequent and prolonged Valsalva maneuvers. As a consequence of increased intraalveolar pressure, there may be rupture of alveoli with air leakage into the septal connective tissues. Peripheral dissection of air within the pulmonary interstitium may lead to the formation of visceral pleural blebs or bullae.

Rupture of the visceral pleural bullae may result in a pneumothorax, which is rarely fatal. The reported case documents the gross and micro-

scopic autopsy findings of a 23-year-old male who was a known habitual user of marijuana, whose sudden death was due to bilateral spontaneous pneumothoraces with bilateral apical bullous lung disease. Although giant bullae and nonfatal pneumothoraces have been documented by chest x-ray and CT scan in smokers of marijuana, there have been no known previous reports in the medical literature of sudden death due to bilateral spontaneous pneumorthoraces in an individual known to use marijuana.

Marijuana, Pneumothorax, Bullous Lung Disease

G34 Venous Bullet Embolism of a Large Caliber Bullet From the Right External Iliac Vein to the Heart: Case Report and Review of the Literature

Mary G. Ripple, MD, and David R. Fowler, MD, Office of the Chief Medical Examiner, State of Maryland, 111 Penn Street, Baltimore, MD 21201*

After attending this presentation, attendees will understand the importance of pre-autopsy radiographs in the evaluation of gunshot wounds, become aware of the possibility of large caliber bullets embolizing through the venous system, and become familiar with the literature on venous bullet embolism.

This presentation will impact the forensic community and/or humanity by emphasizing the importance of pre-autopsy radiographs in the evaluation of gunshot wounds, providing the forensic community with a recent literature review on venous bullet embolism, and highlighting the possibility of a large caliber bullet embolizing through the venous system.

This poster will report a case of an unusual venous embolism of a large (.45) caliber bullet from the right external iliac vein to the right ventricle of the heart, and present a literature review of venous bullet embolism to better familiarize the forensic pathologist with this rare entity.

Arterial embolism of a bullet is rare; however, venous embolism is an even more rare occurrence. In both circumstances the bullet is usually a low velocity, small caliber bullet. The literature to date has not reported a case of a .45 caliber venous bullet embolus.

A 30-year-old African-American male was found lying on the floor in a storage room of a convenience store with a gunshot wound to the left lower quadrant of the abdomen. The victim had been standing in front of the store when an unknown suspect approached the victim and began shooting at the victim. The suspect chased the victim into the store and fired additional shots at the victim inside the store. The victim was taken to University of Maryland Shock Trauma and surgery was performed, which revealed a very large hemoperitoneum and retroperitoneal hematoma emanating from the pelvis. Complex vascular injury to the pelvis was repaired, as were the stomach and small bowel, including resection of two portions of the small bowel. The victim arrested on the operating table two hours into the surgery. A preoperative x-ray revealed a large bullet projecting over the right cardiophrenic angle. By report, the victim was supine from the time of the shooting until the autopsy was performed. Autopsy showed a typical gunshot entrance wound on the left side of the front of the abdomen with no soot or gunpowder stippling on the skin surrounding the wound. The bullet traveled front to back, left to right and downward, injuring the stomach, multiple loops of small bowel, the confluence of the left common and external iliac veins and arteries, the bifurcationof the aorta, and the right external iliac vein just proximal to its bifurcation. A minimally deformed, .45 caliber, copper-jacketed bullet was recovered from the right ventricle of the heart.

Bullet embolization should be suspected when there is an entrance wound and no exit wound and the bullet cannot be located in the suspected region after following its path either by visual or x-ray examination. The pattern of bullet embolization depends on body position during and subsequent to the injur; gravity; muscular and respiratory movements; the missile's size, weight and shape; the diameter of the vessel lumen; blood flow; and the blood volume status at the time of injury. Venous bullet emboli usually end up in the right side of the heart or the pulmonary arteries, with the origin most commonly being the vena cavae or iliac veins. The literature has documented 76 cases of venous bullet embolism from 1834 to present. The vast majority of literature describing venous bullet emboli has been surgical, and therefore items of forensic importance, such as the caliber of the bullet, tend not to be reported. The largest review of 53 cases of venous bullet embolism did not report the calibers of any of the bullets. Of those cases reviewed, the largest caliber bullet found that resulted in a venous embolism was a .38 caliber.

This case emphasizes the importance of pre-autopsy radiographs in the evaluation of gunshot wounds, and points out that one cannot exclude the possibility of a venous bullet embolus simply because of the use of a large caliber bullet.

Venous, Bullet, Embolism

G35 Factors Affecting the Formation of Adipocere in Soils

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The goal of this presentation is to demonstrate to the forensic community the effect of particular burial factors on the formation of adipocere in a soil environment.

The presentation will impact the forensic community by promoting the significance of adipocere formation in burial environments and encouraging further studies in the field of forensic taphonomy.

This presentation will discuss particular factors that are regularly identified in a burial environment and their effect on the formation of adipocere. The research represents a major component of a three year study investigating adipocere formation in grave soils.

Adipocere refers to a soap-like substance that can form during the decomposition process. It is well known as a later postmortem change, particularly in burial environments. Adipocere formation occurs by the alteration of the soft, fatty tissue of a cadaver into a greyish-white substance which comprises mainly saturated fatty acids. The occurrence of adipocere in a burial environment leads to the inhibition of postmortem changes which subsequently preserves the human remains. The degree of decomposition and differential preservation observed depends on the surrounding environment.

Various conditions associated with the burial environment are believed to contribute to the formation of adipocere in soils. Conditions include temperature, moisture, soil type, soil pH, anaerobic environment and the presence of factors such as clothing, coffin, and lime. In the past there have been numerous observational studies commenting on these particular physical factors and methods of burial. However, the literature demonstrates a distinct lack of chemical studies confirming these observations. As a result, a three-year study was conducted to chemically investigate the effect of individual burial factors on adipocere formation in a soil environment.

In order to determine the effect of particular burial conditions on adipocere formation, experiments were conducted in a laboratory environment so that the individual variables could be adequately controlled. The experiments utilized porcine adipose tissue collected from the abdominal region of pigs (*Sus domesticus*) reared on identical diets for commercial use. The fatty tissue samples were buried in soil environments and allowed to decompose for a period of 12 months under individual burial factors. At the completion of this period the samples were analyzed to confirm the formation of adipocere and compared with control samples to determine the effect of the burial factors on its formation.

This presentation will discuss the results of the chemical study and identify those factors which accelerate and retard adipocere formation. Adipocere samples collected from grave exhumations and forensic cases were also analysed and the results will be compared with the controlled laboratory experiment. The research findings will highlight the effects of adipocere formation, particularly with regard to overcrowding in cemeteries due to its regular occurrence in grave sites, and its forensic implications when present in shallow burials or mass graves.

Adipocere, Burial Factors, Grave Soils

G36 Seasonal Distribution and Abundance of Forensically Important Flies in Santa Clara County

Adrienne Brundage, MS, 1250 A Edgewood Road, Redwood, CA 94062*

The goal of this presentation is to identify any seasonal or geographical patterns among forensically important flies within the county that may be important to future investigations using a simple and cost-effective method.

Entomologists working with local law enforcement often encounter gaps in the collective entomological knowledge due to local variation within and among important fly species. This presentation will impact the forensic community and/or humanity by attempting to help close such a gap within Santa Clara County, California.

Forensic entomology has become relatively common in criminal investigations. As insects become more common as indicators of post-mortem interval, gaps in information at the local level become apparent. While flies as forensic indicators are well studied, they exhibit great variation in both successional patterns and seasonal abundance due to microclimates. It is this variation that causes the forensic entomologist the most difficulty. The entomologist must adapt data from studies that have taken place miles away or create new, tailored studies to gather data specific to the current case. While the second option is ideal, time and monetary constraints can make it impossible, leaving the scientist to glean what general information is available in the literature. This does yield acceptable postmortem interval estimation, but accuracy suffers. These issues were brought to the forefront in the bay area by two cases in which general data had to be used due to a lack of local studies. The cases were completed successfully, but the entomologists on the cases identified several glaring gaps in the entomological data specific to Santa Clara County, California. The existence of these cases led to a two-year study of seasonal distribution and abundance of forensically important flies in Santa Clara County, designed to identify and quantify any patterns of fly succession that may be useful in future investigations.

Local homicide investigators were consulted, and three areas within the county were identified as the most common dump sites for human remains: urban areas (specifically within the city of San Jose, California), mountainous areas, and along rivers or streams. Four traps baited with beef liver were placed in each of these areas, one mile apart, and checked for flies once a week for two years beginning in 2001. The liver was changed as needed, and temperature data was collected for all corresponding days from the local airport. The insects collected were then pinned and stored for identification. The resulting collection consisted of over 16,000 flies and 3,000 beetles representing several families. In order to expedite the identification process, only flies belonging to the family *Calliphoridae* were identified, although any other insects were preserved in San Jose State's Entomology Museum for future reference and study. The identification process lasted one year, and the results were entered into a database where seasonal and geographical patterns were easily recognized. The results supported the findings in the two cases that prompted the study, while giving additional insight into current investigations within the county.

Entomology, Calliphoridae, Succession

G37 Establishing a Protocol Between Clinical and Forensic Institutions to Treat and Investigate Violence Against Women Cases

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After attending this presentation, attendees will understand that most aggression against women are not treated correctly because they are unknown, although this does not mean that symptoms are not visible. Only 10% of cases are reported, but 100% of them go to medical institutions asking for assistance for symptoms direct or indirectly related to violence. This study highlights this situation, and underscores the need to coordinate and collaborate through a protocol between forensic and clinical institutions to solve medical and forensic issues and to avoid victimization.

The forensic and clinical medical community must consider violence against women as a global problem. This presentation will impact the forensic community and/or humanity by giving an integral answer that helps the forensic investigation and the recovery of victims.

Introduction: Violence against women is not only a crime, but a social behavior rooted in cultural values given by a patriarchal conception of society and couple relationships. This means that when a case occurs, any of these cultural values may arise to explain and justify the aggression. Only a small percentage of cases (no more than 10%) are reported, and only these cases can get social help. However, all these women go to clinical institutions with symptoms related direct or indirectly to domestic violence.

Material and Methods: The study was performed in medical institutions (Emergency Service and General Practitioner Service) using different questionnaires about domestic violence (physical and psychological) and recording social and demographic features of the patients. The sample was all the women that went to the institutions a period of time of two months, and the tests were reviewed by a physician during a regular consultation.

Results and Discussion: There is no significant difference among the social and demographic features. Of this group of women (patients), 17.9% complained of domestic violence, but paradoxically 51.8% considered their relationships as "good" or "very good." Asking all of women if they would like doctors to ask regularly about family and couple matters, they answered "yes" in 88.5% of cases Asked if they would like doctors to ask if they suffer violence and aggression, they answered "yes" in 88.6% of cases. But at the same time, 35% of women would not confirm domestic violence if the doctor reported the case.

Legal regulations on this subject need to be reviewed to try to help women and solve the cases. In this sense, a global approach needs to be introduced that considers not only the legal and forensic implications, but also the clinical and the health issues behind this violence. A protocol under this global perspective would help women recover, avoid victimization, assist in answering forensic questions, and ensure appropriate legal action against the aggressors.

Violence Against Women, Domestic Violence, Protocol of Assistance

G38 Analytical Electron Microscopic Detection of Aluminum Received Intravenously

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The goal of this presentation is for the attendees to realize the feasibility of detecting and identifying postmortem heavy metals in non-environmental exposure cases (i.e., mineral pneumoconioses).

This presentation will impact the forensic community and/or humanity by illustrating the utility of applying alternative methods, specifically scanning electron microscopy with electron dispersive spectrometry, for demonstrating the presence of aluminum intravascularly.

This presentation details the postmortem detection of aluminum inadvertently received intravenously. Careful consideration of investigative details can occasionally generate hypotheses that are difficult to conclusively prove using conventional forensic methods; however, focused collaboration with specialists from other fields can yield definitive causes of death as in this case of postmortem detection of aluminum as a result of a therapeutic misadventure.

A 77-year-old man with a past medical history of coronary artery disease and prior brachytherapy for localized prostate cancer was admitted to the hospital for continued urinary bleeding following direct visual internal urethrotomy for urethral stricture. At surgery, a persistent clot in the bladder and an inflamed prostate were discovered. The clot was removed and the prostate resected.

Alum bladder irrigation, containing aluminum ammonium sulfate, aluminum potassium sulfate, ammonium alum and potassium alum, was ordered, prior to and following the operation. The morning following the operation the man was discovered unresponsive. Both a nurse and doctor noted during resuscitative efforts that a bladder irrigation bag was connected to the man's intravenous catheter. In such cases, the involvement of hospital risk management is paramount; however, risk management from the hospital in this case could not conclude whether the Alum solution had infused intravenously, and if so, how much he had received.

The deceased underwent an autopsy. Gross autopsy findings were those of hypertensive and atherosclerotic coronary artery disease. Microscopic findings were most notable for thrombi in pulmonary arterioles and capillaries, which stained with periodic acid-Schiff stain.

Scanning electron microscopy (SEM) with back scattered electronic imaging (BEI) and energy dispersive spectrometry (EDS) was performed on the lung sections. The forensic community is more familiar with the role of analysis of gunpowder primer residues with SEM/EDS. These techniques are more often used on lung sections to determine composition of intrapulmonary materials that cause the different pneumoconioses. These same techniques were used in this case to determine if the aluminum-containing bladder irrigation material was present intravascularly. Smudgy material within some of the blood vessels demonstrated distinct peaks for aluminum with energy dispersive spectrometry.

Nitrogen and sulfur are commonly seen as endogenous tissue components; aluminum is not. It was concluded that the deceased had received intravenous Alum bladder irrigant solution and that this therapeutic misadventure was his underlying cause of death. This case demonstrates the benefit of selective use of non-conventional methods to solve a forensic case by the use of SEM with BEI and EDS in order to demonstrate intravascular aluminum.

Aluminium, Intravascular, SEM/EDS

G39 Evaluation of Clinical Diagnostic Accuracy in Post-Coronary Artery Bypass Graft Surgery Mortality

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The goal of this presentation is to demonstrate the medical and legal value of autopsy in non-forensic deaths, specifically those occurring after coronary artery bypass graft surgery.

This presentation will impact the forensic community and/or humanity by examining the value of performing autopsies in post-surgical deaths. The commonly held view amongst clinicians is that autopsies are of value for plaintiffs in medical malpractice suits. This paper shows that the autopsy can answer questions and provide valuable information on surgical technique, thereby decreasing the chances of litigation.

This presentation compares the accuracy of clinical diagnoses in post-coronary artery bypass grafts (CABG) mortalities to those made via postmotrem diagnosis.

In accordance with relevant Australian legislation, all deaths within 24 hours of surgical anesthesia must be reported to the coroner. As part of this notification, detailed medical, surgical and anesthetic information is provided, medical charts are perused and a postmortem examination is conducted. Clinicians who treated the decedent are required to provide an opinion on the likely cause of death prior to being informed of the autopsy findings. The autopsy pathologist is therefore in an ideal position to ascertain the accuracy of clinical diagnoses after a comprehensive postmortem examination is performed.

A total of 140 deaths within 24 hours of CABG surgery were identified in the Department of Forensic Medicine in Central Sydney, Australia database spanning an 8 year period between 1996 and 2003. Of these, detailed information was available in 134 cases. Comprehensive autopsies, including histology, and–where relevant–toxicology and a range of other investigations, were conducted in all cases. Deaths were examined from seven hospitals, and all hospitals providing a cardiac surgery service in the Department's geographic coverage area were represented.

At autopsy, 23% of cases demonstrated clear discordance between clinical and pathological diagnoses. These deaths occurred despite intensive care monitoring, which presumably supplies exceptional vigilance in post-surgical care. Commonly misidentified conditions included pump failure, peri-surgical myocardial infarction, aortic dissection, and arrhythmia. Clinicians were more likely to diagnose acute myocardial infarction than autopsy pathologists. Errors in cause of death formulation were identified in the vast majority of cases on the basis of gross pathological findings, with histologic examination being of assistance in supporting the diagnosis rather than identifying a different or additional cause of death. Though there is a significant rate of diagnostic error in determining cause of death in post-CABG deaths, fewer than 1% of study deaths were a result of surgical error. The single error identified was a case of iatrogenic rupture of the iliac artery.

Hospital autopsy rates have fallen from a high of 30-40% in the 1960s to single digit rates today. This precipitous decline represents a myriad of lost opportunities to improve post-surgical outcomes. A reason frequently given for the decline in autopsy rates is a fear that the autopsy could be used as a tool to assist the plaintiff's attorney in malpractice litigation. Studies like this one suggest the opposite. Not only are autopsies an important clinical and post-surgical audit tool, but helpful in minimizing uncertainty in relation to possible errors in clinical management and surgical technique. The findings of this study suggest that the postmotrem examination is far more likely to shield a clinician from liability than to expose technical mistakes.

Autopsy, CABG Surgery Deaths, Postmortem Diagnosis

G40 Adolescent Death: A 15-Year Retrospective Study

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After attending this presentation, attendees will know the most common causes and manners of death in the adolescent population; understand the typical victims, perpetrators, and trends in violent deaths; and be aware of the most common drugs of abuse in the adolescent age group.

This presentation will impact the forensic community and/or humanity by providing a thorough classification of adolescent deaths which could be useful in various ways to coroners, medical examiners, pathologists, and investigators when confronted with an adolescent death. Knowing common relationships of perpetrators to victims in violent deaths could help to find and convict the perpetrators. Also, understanding the typical victim and circumstances surrounding his or her death could help to prevent future violent adolescent deaths. A review of the toxicology in these cases could help delineate any trends in drugs of use and abuse in the adolescent age group, making it possible to prevent some accidental deaths through public heath and safety measures. Finally, a review of natural deaths will demonstrate the most common natural disease processes, which could help in determining the causes of sudden, unexpected deaths in this population.

Adolescents, defined by the World Health Organization (WHO) as children ages 10-19, are a diverse group of people undergoing many changes in life as they develop, mature, and become adults. Still, pediatric forensic literature is dominated by reports, reviews, and studies of fetal, infant, and early childhood death. Previous studies have looked at specific aspects of adolescent death, but there remains a paucity of literature reporting the most common causes and manners of death along with other pertinent demographics of these victims.

The authors reviewed all cases of pediatric death referred to the Medical University of South Carolina Forensic Pathology section over the fifteen years between January 1989 and December 2003. In accordance with the WHO definition, only children 10-19 years of age were included. In all, 542 of 9540 total cases were studied. The authors examined the cause and manner of death along with the age, sex, and race of the victim. The toxicology results, perpetrator identification, death scenario and location, and victim traits were also analyzed. Homicides and suicides were due to gunshot wounds, blunt force trauma, sharp force injury, and asphyxia. Accidents were subdivided into environmental exposure, drug/inhalation toxicity, vehicle collision, and other. Natural deaths were classified by organ system. Adolescents comprise an eclectic mix of people vitally important to society, yet long-term comprehensive studies on the circumstances of their deaths are lacking in the literature. With a solid understanding of these circumstances it may be possible to predict, and hopefully prevent, future cases of adolescent death. The authors present their findings in this 15-year retrospective study to better aid forensic pathologists, death investigators, law enforcement, and epidemiologists.

Adolescent, Death, Forensic Medicine

G41 Heightened Awareness of Bioterrorism: Three Cases of Unusual Skin Lesions

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Attendees will learn of the heightened awareness of bioterrorism since the terrorist attacks in 2001, and how this has raised the suspicion of law enforcement and medical personnel in evaluating skin lesions. The attendee will also learn the cutaneous manifestations of several bioterrorist agents.

This presentation will impact the forensic community and/or humanity by providing an increased understanding of how recent historical events involving terrorism and bioterrorism have affected the law enforcement and medical communities. They will gain an understanding through the case reports presented of how these events have increased the suspicion of bioterrorism when evaluating unusual skin lesions. They will increase their understanding of, and ability to recognize, the cutaneous manifestations of bioterrorist agents through the review of those agents.

The goal of this presentation is to discuss three cases of unusual skin lesions that presented in February of 2004, to the OCME in Baltimore, MD, and how the recent heightened awareness of bioterrorism affected the medical community and handling of these cases. In addition, skin lesions associated with bioterrorism will be reviewed.

Since the terrorist attacks on September 11, 2001, and the anthrax attacks that began two weeks later, there has been an increased awareness of possible terrorist and bioterrorist attacks throughout the United States. The media, in particular, has elevated this awareness not only with reports on the anthrax attack, but with reports of other possible agents that could be used in a bioterrorist attack, such as smallpox or plague. This increased awareness has lowered the threshold of the medical community in the suspicion of bioterrorist attack in the evaluation of skin lesions. The following three cases illustrate this heightened awareness and suspicion of bioterrorism, and also reinforce the role of the medical examiner in public health biosurveillance.

Case Report: A previously healthy 40-year-old Hispanic female had complained of rash and shortness of breath for one week. Her family found her on the floor and transported her to the Emergency Department. There she was noted to be asystolic, with fixed and dilated pupils and no respirations. Numerous crusted and scabbed lesions varying in size and stage of healing were noted on her face, torso, and extremities. The Emergency Department expressed concern about Varicella lesions other than Varicella-zoster (chicken pox), and the body was sent to the medical examiner's office to rule out smallpox.

Case Report: A previously healthy 46-year-old white male was found facedown in the hallway of the lower level of his home. The residence was secure and the family entered the dwelling after not being able to reach him for several days. According to a coworker, several days earlier, the decedent said that he would be out of the office for a week after being diagnosed with a viral infection at a local walk-in clinic. At autopsy, multiple crusted ulcers on his head, chest, left upper thigh, and anterior aspect of the right leg were noted. There was also a crusted eschar noted on his abdomen, and multiple non-crusted necrotic ulcers on his right buttock, right posterior medial thigh, left axilla, back of the neck, lower lumbar spine, and left upper chest. Law enforcement officials expressed concern about possible cutaneous anthrax because the deceased was employed by the National Security Agency.

Case Report: A previously healthy 61-year-old Chinese female that reportedly arrived from China 20 days earlier collapsed in her bathroom. Her family, who called 911, heard the fall. Upon EMS arrival she was found to be asystolic and ACLS was initiated. She was pronounced dead upon arrival to the Emergency Department. While in China she had contracted a pruritic skin disease of unknown cause, and since her arrival had also reportedly felt weak and experienced a gradual decline in appetite. The disease started on her right arm and spread to the rest of her body. For

the three days prior to her death she was bedridden. At the hospital multiple skin lesions in various stages of healing ranging from bullae to ruptured bullae, raw erosions, dried erosions, crusted lesions, and hypopigmented scars were noted. The local health department expressed concern about possible bioterrorism.

The heightened awareness of bioterrorism has stimulated an increased response to unusual and aggressive appearing skin lesions among the medical and law enforcement communities. These three cases illustrate that response, and also provide examples of possible mimickers of bioterrorism for comparison to the cutaneous bioterrorist agents reviewed.

Bioterrorism, Skin Lesions, Case Reports

G42 Amended Cause and Manner of Death Certification: A Six-Year Review of the New Mexico Experience

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After attending this presentation, attendees will understand the state medical examiner office's experience with the amendment of cause and/or manner of death on death certificates, including frequency of amendment, time between original certification and amendment, reasons for amendment, and in what way death certification was changed. This presentation will impact the forensic community and/or humanity by providing information about how, why, when, and how often the cause and/or manner of death is/are amended on death certificates completed by forensic pathologists. While the answers to these questions are of value to the forensic community, little formal study has been undertaken in this area.

At the end of June 2003, the New Mexico Office of the Medical Investigator (OMI) computer database was searched for all amended death certificates signed by OMI pathologists from 1997 through 2002. Each case file was reviewed in order to identify only those death certificates (DCs) with amended cause and/or manner of death fields. Cases that were initially external examinations only and subsequently became autopsies, DCs originally signed out by someone other than an OMI pathologist, "brain only" research-oriented autopsies, and DCs originally signed out as "pending" were excluded. Cause of death (COD), amended cause of death (ACOD), manner of death (MOD), amended manner of death (AMOD), the time elapsed (TE) between the original and amended DCs, and the reasons for the changes were recorded for the remaining cases. The reasons for the changes were categorized as medical records review, histology, investigations, family concerns, microbiology, or error. "Family concerns" included any family member, as well as third parties such as friends, caretakers, or primary physicians. Statistical analyses were performed using SAS version 8.02 statistical analysis software for Windows and EpiInfo 2002.

The database search identified 108 cases that fit the above criteria, 0.86% of all cases handled at OMI over the study period. This total included 81 autopsies and 27 external examinations. One of the 108 cases was amended twice, increasing the total number of amended DCs to 109. Autopsy DCs from 1997 to 1999 were significantly more likely to be amended than those from 2000 to 2002 (P=0.02). COD was amended on 62 of these 109 DCs. Twenty-three different CODs were used in these 62 DCs, with arteriosclerotic cardiovascular disease (ASCVD) accounting for almost a quarter. Twenty-nine different ACODs were used on the resulting 62 amended DCs, with intoxicant(s) comprising nearly a third. MOD was amended on 72 of these 109 DCs. Natural deaths had the greatest percentage of amended DCs (1.39%), followed by suicides (1.22%). Overall, there was a significant association between manner of death and the number of DCs amended (P<0.001). For external examinations, natural and suicide DCs were significantly more likely to be amended than accidents (P=0.0002 and P=0.019, respectively). Natural-to-accident (N-A) was the most common direction of change (28 DCs), followed by suicide-to-undetermined (S-U; 14 DCs). The mean TE between the original DC and amended DC was 3.83 months (SD 6.6 months). DCs amended secondary to investigations went the longest between signatures, with a mean of 8 months. The direction of change was significantly associated with TE (P=0.04). The directions most associated with an increasing TE were N-S, U-H, N-U, A-U, S-U and N-A. Toxicology was the most common reason for DC amendment (40 DCs) and MOD amendment (28 DCs), followed by family concerns (23 and 19 DCs, respectively) and investigations (13 and 12 DCs, respectively). Toxicology was also the most common reason for amending COD (26 DCs); histology was the second most common reason for COD amendment (11 DCs), followed by both family concerns and medical records review (8 DCs each). Of the fourteen DCs that changed from suicide-to-undetermined, eleven were triggered by family concerns. Of the twelve DCs in which MOD was amended secondary to investigations, nine moved to a MOD of undetermined. Twelve of the 109 DCs had "gunshot wound of head" as the COD, all but one of which had suicide as the MOD. Eight of these eleven suicides were subsequently amended to undetermined, and in ten the impetus was family concerns.

In conclusion, approximately 1% of death certificates signed by OMI pathologists had either cause or manner of death amended, with a slightly higher amendment percentage for external examinations than autopsies. ASCVD was the most commonly amended COD, and intoxicant(s) was the most common ACOD. There was a significant association between MOD and number of amended DCs. By percent, natural and suicide DCs were the most frequently amended. Natural-to-accident and suicide-to-undetermined were the most common directions in which MOD changed. Toxicology was the most common reason for amendment; family concerns were the impetus behind most suicide-to-undetermined amendments, with most of these cases involving gunshot wounds of the head. The average time to amendment was just under 4 months, and direction of change was significantly associated with the time elapsed. This information on how, why, when, and how often cause and/or manner of death certification is amended is both interesting and useful to the forensics community.

Death Certificate, Manner of Death, Autopsy

G43 The Relationship of Drug Abuse to Unexplained Sudden Death

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The goal of this presentation is to define the relationship between drug abuse and deaths where neither anatomical nor toxicological cause for death is found.

This presentation will impact the forensic community and/or humanity by recommending that decedents with a convincing history of drug abuse and no other anatomical or toxicological findings at autopsy have their cause of death certified as being due to chronic drug abuse.

Rationale: Cases of young adults with a history of drug abuse who have died suddenly and unexpectedly in whom neither anatomical nor toxicological cause for death is found at autopsy are received regularly. The common presence of a history of drug abuse, however, has led researchers to hypothesize that drug abuse not only induces some change that increases the risk of sudden death, but that this change persists after the drug is no longer detectable in the body. The first part of this study was presented at the 2004 Annual Meeting of the American Academy of Forensic Sciences in Dallas, Texas, where it was shown that deaths certified as undetermined

in cause and manner have an increased likelihood of having a history of drug abuse when compared to a control group of medical examiner cases. In this second part of this study was tested the null hypothesis, "There is no difference in the frequency of drug abuse in a study group dying of undetermined cause when compared to the frequency of drug abuse in a matched control group of patients admitted for cholecystectomy," with the intent of establishing whether a history of drug abuse increases the likelihood of sudden death.

Methods: A retrospective case-control study conducted of deaths investigated by the Jefferson County Coroner/Medical Examiner Office, Alabama between 1986 and 2003. The study group consisted of decedents between 10 and 70 years of age whose cause and manner of death remained undetermined following an autopsy and toxicological analysis for ethanol and drugs of abuse. The control group was chosen from living patients who underwent cholecystectomy at the indigent care hospital serving Jefferson County, Alabama, a population similar to that seen in the medical examiner office. Three controls were matched to each study group member to within 5 years of the age of the study decedent and within two calendar years of the date of death of the study decedent (to keep social trends and testing methods comparable). The charts of both the study group (decedents) and of the control group (patients) were reviewed for evidence of drug abuse. All toxicology results were noted in the decedents, including the presence of cocaine, any other drugs or medications, and ethanol. Decomposed remains were included in the study group. The charts of the living control group were reviewed for a history of drug abuse and hypertension in accordance with the hospital Institutional Review Board.

Results: The study group of undetermined deaths consisted of 62 decedents, 24 of whom had some evidence of drug abuse (history, physical signs, positive toxicology for cocaine or its metabolites in urine or bile, opiates, or methamphetamine). In the matched control group 9 of 186 patients had a known history of drug abuse. Cases in the study group were seven times (odds ratio 7.0; 95% confidence interval 3.5-14.1; $p<0.0001$) more likely to have a history of drug abuse than the controls. In other words, given the design of this study, an individual with an undetermined cause of death is seven times more likely to have a history of drug abuse than is a living patient chosen from a similar population. Given the small p-value, chance is an unlikely explanation for these results. Heart disease can cause sudden death by dysrhythmia, and should be considered as a cause of death in the decedents, but cases with heart disease sufficient to account for death were not considered undetermined as to cause of death and were thus excluded from the study group. This exclusion is reflected by statistical analysis that showed hypertension was less common in the study group than in the control group of cholecystectomy patients.

Conclusion: This is the second study to show that a history of drug abuse is far more common in decedents with an undetermined cause of death than it is in a control group chosen to represent a random sample of the population. Epidemiological theory indicates that for rare events, such as the death of an individual with a history of drug abuse, the measure of the association between the risk (here drug abuse) and the event (here death) is a valid and accurate predictor of the incidence of death due to a given risk factor. In other words, individuals who abuse drugs are at increased risk of dying suddenly because of their habit of abusing drugs, even if not acutely intoxicated at the time of death. Based on these findings, the authors recommend that decedents with a convincing history of drug abuse and no other anatomical or toxicological findings at autopsy have their cause of death certified as being due to chronic drug abuse.

Drug Abuse, Sudden Death, Pathology

G44 Natural Causes of Death Among a Federal Medical Center Prison Population

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The goal of this presentation is to review the natural causes of death among federal prisoners treated at a Federal Medical Center during the period 1986-2004, in order to understand the spectrum of complicated natural disease present in the federal prisoner population and to use that knowledge towards a more accurate determination of manner and cause of deaths that occur while in custody.

This presentation will impact the forensic community and/or humanity by adding to the available knowledge base concerning natural causes of death in prisoner populations. Because of the referral medical center population studied, particular attention will be paid to complicated and severe natural diseases. An understanding of complex disease patterns present in prisoners will assist in accurately determining manner and causes of deaths in custody.

Outcome: To understand the spectrum of complicated natural disease present in the federal prisoner population and to use that knowledge towards a more accurate determination of manner and cause of deaths that occur while in custody.

Deaths that occur while in custody are routinely investigated, and often require an autopsy to determine the manner and cause of death. A thorough medicolegal investigation protects the interests of the prisoners, the custodians, and the general public by assisting in the prosecution of prison homicides, documenting natural causes of death when unnatural causes may be suspected, and identifying contagious diseases that may pose a public health risk to prisoners and facility personnel. As in non-incarcerated populations, the task of determining manner and cause of death in an apparently unnatural death is sometimes complicated by potentially lethal natural disease present in the deceased. Therefore, it is important for forensic pathologists and death investigators to understand the unique patterns of natural disease that occur in prisoner populations.

This paper will review natural causes of death among federal prisoners who were treated at the Rochester Federal Medical Center during the period 1986-2004. The Federal Medical Center system is a network of seven specialized medical centers located throughout the U.S. and operated by the Federal Bureau of Prisons. The Rochester Federal Medical Center is a major medical and mental health referral center for male prisoners. In some instances, consultations are provided through the Mayo Clinic.

Since 1986, the Mayo Clinic has performed 323 autopsies on deaths occurring at the Rochester Federal Medical Center. Of the 323 deaths, 320 were natural deaths and 3 were suicides, all by hanging. The vast majority of natural deaths could be attributed to one of 4 general categories, cancer-related (148), liver disease-related (63), AIDS-related (57), and cardiovascular disease-related (37). The average age at death for each category was: cancer-related, 54.2 years; liver disease-related, 49.6 years; AIDS-related, 39.9 years; and cardiovascular disease-related, 57.0 years. Less common natural causes of death included pulmonary embolism (3), stroke (3), sepsis (2), end stage renal disease (2), aspiration pneumonia (2), chronic obstructive pulmonary disease (1), warfarin toxicity (1) and sarcoidosis involving the heart (1). Among the cancer-related deaths, the five most common primary sites were lung (45), hemato-lymphoid (17), colon (16), pancreas (12) and head and neck (10). In addition, hepatocellular carcinoma was identified in 17 prisoners who died of liver disease. Some of the more unusual tumors included malignant fibrous histiocytoma (1), gallbladder carcinoma (1) and osteosarcoma (1). Among the 37 cardiovascular causes of death, 34 were due to ischemic heart disease and 3 were due to idiopathic dilated cardiomyopathy. Among the 63 liver-disease related deaths, 55 were associated with chronic hepatitis C infection, 3 with alcohol abuse without evidence of hepatitis C infection, 3 with no known cause, and 2 due to primary sclerosing cholangitis. The highest number of liver-related deaths occurred in 1999, accounting for 12 of 29 deaths that

year. AIDS-related deaths peaked in the year 1995, accounting for 11 of 23 deaths that year.

This study differs from previous studies of prison deaths because the study population consisted only of prisoner deaths occurring at a Federal Medical Center. Unnatural and sudden deaths are notably lacking due to the population studied, but the three suicides by hanging corroborate previous reports of an increased risk for suicide while incarcerated; the preferred modality being hanging. The over-representation of cancer-related deaths reflects the referral center population of this study. Previous studies have found cardiovascular disease to be the most common natural cause of death among prisoners. The distribution of cancer types suggests an increased number of deaths from hemato-lymphoid and head and neck cancers, and a decreased number of deaths from prostate cancer, compared to the general population.

Overall, the spectrum of disease present in federal prisoners appears to be as wide as would be expected in a prisoner population numbering over 2 million in 2003. With frequent allegations of prisoner maltreatment bringing increasing scrutiny into deaths occurring while in custody, further studies of natural disease in prisoners will assist in determining manner and cause of deaths in custody.

Natural, Deaths, Custody

G45 Distribution Pattern of Pulmonary Surfactant Protein A (SP-A) in Drowning and Opiate-Related Deaths

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After attending this presentation, attendees will understand the immunohistochemistry of pulmonary surfactant and the usefulness of SP-A staining as diagnostic marker of alveolar injury in drowning compared with agonal changes such as pulmonary edema in opiate-related deaths.

This presentation will impact the forensic community and/or humanity by demonstrating to the forensic pathology community a finding supporting the final diagnosis of drowning by routinely using SP-A staining.

Pulmonary surfactant covers the surface of the alveoli and prevents alveolar collapse by lowering surface tension. It is composed of phospholipids (90%) and proteins (10%). Four surfactant-associated proteins (SPs) have been identified: hydrophilic SP-A and -D, and hydrophobic SP-B and -C. SP-A is the most prevalent form, and is produced in the alveolar type II cells. Under normal conditions, SP-A is immunohistochemically detected in the alveolar type II cells, but also on the alveolar interior surface since a small quantity of SP-A is secreted into the alveoli. The immunohistochemical distribution pattern of SP-A in the intra-alveolar space has been previously reported as a useful tool to distinguish mechanical asphyxia from other hypoxic cases (Zhu *et al*., 2000). It can also be considered a valuable marker of the pulmonary dysfunction in drowning, showing partial differences in pulmonary pathophysiology depending on the immersion medium (Zhu *et al*., 2002). Many prominent, massive aggregates of granular SP-A staining observed in the intra-alveolar space have been considered the result of an enhanced secretion caused by strong forced breathing that often takes place in the mechanical asphyxia, or by over-excitement of the autonomic nervous system or, even more, by the Ca^{2+} ions in the edema fluid. The above-mentioned aggregated form may also indicate an early biochemical alteration of SP-A in asphyxial deaths.

To evaluate the role of plasma components exuded into the alveolar space and its relationship with the distribution pattern of SP-A, the authors have retrospectively investigated a total of 48 forensic autopsy cases. They have been divided into three main groups: 18 cases of drowning (12 in salt water and 6 cases in fresh water), 20 cases of opiate-related deaths showing gross pulmonary edema and, as a control group, 10 cases of rapid deaths by gunshot injuries to the head without pulmonary edema. The study was carried out on paraffin tissue blocks from which serial sections (4 ?mthick) were used for hematoxylin-eosin and immunostaining. For immunohistochemistry, anti-human SP-A mouse monoclonal antibody (Novo Castra Laboratories Ltd; U.K.) was used at 150-fold dilution, with a 1-hour incubation at room temperature, using the universal Avidin-Biotin Complex (ABC). The expression of the SP-A staining was scored semiquantitatively based on two staining patterns: membranous or linear staining on the interior surface of alveolar epithelia, and the interface of intra-alveolar effusion and granular staining showing many prominent massive aggregates of SP-A within the intra-alveolar space.

The results show that aggregated granular SP-A staining in the intra-alveolar space was frequently observed in drowning victims. A high intensity of this pattern was frequently found in these victims, suggesting a molecular alteration caused by a direct effect of aspirated water and/or subsequent metabolic disturbance in the alveolar type II cells. Granular deposits of SP-A in the intra-alveolar space were never observed in the control group of non-asphyxial deaths (10 cases of fatal gunshot injuries). The group of gross pulmonary edema observed in narcotic deaths showed a prevalent distribution of membranous or linear pattern staining and only scattered SP-A aggregates in the intra-alveolar space. The granular SP-A staining detected in pulmonary edema is consistent with previous findings of SP-A positive staining in lungs with secondary damage such as acute respiratory distress syndrome (ARDS) or a bronchial lavage causing both a biochemical alteration of pulmonary surfactant. These results suggest some molecular alterations of SP-A due to abnormal surfactant metabolism caused by edema fluid. Based on the comparison of SP-A distribution pattern between drowning, agonal changes such as pulmonary edema, and non-asphyxial deaths, the expression of intra-alveolar SP-A aggregates can significantly support the final diagnosis of drowning.

Pulmonary Surfactant, Drowning, Opiate-Related Deaths

G46 Drowning vs. Trauma and Other Causes of Asphyxia in Deaths in Water

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The goal of this presentation is to review three cases which reveal the necessity of looking more closely at cases that involve water. They are ideal instances where the cause of death appeared obvious, but because a body of water was involved things were not what they seemed. These cases reinforce the need to perform autopsies on any case involved with submersion in water.

This presentation will impact the forensic community and/or humanity by reinforcing the need to closely evaluate violent deaths that involve water.

Drowning appears to be an easy cause of death to diagnose whenever a person is found not breathing in water. In reverse, drowning is not the first diagnosis that comes to mind when only a little amount of water is present at a scene. These three case histories illustrate some of the difficulties in evaluating the role of drowning in complicated cases, particularly when autopsy findings are found to be inconsistent with initial impressions gained from scene investigation. External examination of bodies in such cases may be misleading.

Case One: A 47-year-old male was standing on a dock pier performing martial arts exercises. He had a history of violence and substance abuse. A bystander witnessed this man finish warming up, tuck a necklace into his shirt, and dive off the pier head first. The man rose to the surface of the water, and floated as if unconscious. He was rescued within five minutes of the incident, but could not be resuscitated. External examination revealed a small abrasion along the vertex of his head. His face was congested, and he had some jugular venous distension. There were no other obvious external traumatic injuries. Death was initially attributed to drowning, with consideration of a cardiac event, possibly related to intoxication with cocaine.

Case Two: A 39-year-old male was driving alone in his sports car, without seat belt restraint, along a two-lane road. He lost control of the vehicle, which went off the roadway, flipped into the air, and landed on its roof in a ditch that contained four inches of water. It is not known how long the man was in the car prior to the arrival of the first bystanders who attempted to render aid, but the time interval was less than 10 minutes. The first bystanders attempted to pull the man from the passenger window of the car. When police arrived at 10 minutes from the time of the initial accident, the man was found face down outside the passenger window of his car. Emergency medical personnel failed to find a pulse, and he was pronounced dead. External examination of the body revealed adherent leaves and mud, with dicing injury to the forehead, left flank, and left thigh. Lacerations and bruising were apparent on the chin and lower extremities. Conjunctival and intraoral petechiae were identified. No other major trauma was obvious on external physical exam. Drowning was not considered among the causes of death at initial examination. Positional or traumatic asphyxia was considered.

Case Three: A 46-year-old male with a history of alcohol abuse was riding his bicycle at night along a street. He was struck by a motor vehicle, thrown into the air, and landed in a ditch, face down, in 6-7 inches of water. He remained in the water for several minutes, because the woman whose car had hit him was unable to pull him out unassisted. Ultimately, other bystanders pulled the man out of the water, but by that time emergency personnel could not revive him. External exam was remarkable for lack of injury, other than superficial abrasions on his hip and thigh. Cervical fracture was considered the likeliest possibility at initial examination.

These three cases underscore the difficulty in identifying what role drowning may play in death. Evaluation of the scene, the body, and the history may suggest a misleading cause of death. Autopsy may be required to make an ultimate diagnosis.

Drowning, Asphyxia, Violence

G47 Study of the Diagnostic Value of Iron in Freshwater Drowning

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After attending this presentation, attendees will be able to test the diagnostic value of iron (Ir) in freshwater drowning by investigating the postmortem levels of hemodilution in drowning cases compared to control cases.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of postmortem biochemistry for the diagnosis of freshwater drowning.

Material and Methods: Twenty-six typical freshwater drowning cases were selected from all immersion cases autopsied in the Department of Forensic Pathology between 1998 and 2004 (n=128). The exclusion criteria were a long postmortem interval (more than one week) and causes of death other than drowning (acute intoxication or trauma). For all selected cases, the diagnosis of drowning was based on the presence of autopsy findings (including overinflated lungs, pulmonary edema, frothy contents in the airways) and positive diatom test. The diatom test was performed after treatment of the samples with Soluen-350. The test was considered positive when a significant number of diatoms were detected in lungs and other internal organs (liver, kidney, bone marrow) and when concordance of diatom types recovered from organs and the putative drowning medium were found. A control population of 12 cases was also selected. For each case, age, sex, manner of death, postmortem interval, and resuscitation attempts were reported from the postmortem records. For each drowning and control case, blood iron levels were measured in the left ventricle (LV) and right ventricle (RV) of the heart. The mean difference of iron concentration (RVIr-LVIr) between the drowning group and the control group was compared. Furthermore, iron measurements were performed in 19 drowning cases showing advanced putrefaction.

Results and Discussion: The mean age of the drowning cases was 43.2 years. The mean age of the control population was 36.2 years. In the majority of the drowning cases, manner of death was suicide (n=14). The mean difference of iron concentration was significantly higher in the drowning cases compared with age and sex-matched controls ($p<0.001$). All drowning cases showed hemodilution. Four control cases showed hemoconcentration. No overlap was found in the RVIr-LVIr levels between the two groups. In the control group, the maximal RVIr-LVIr level was equal to 11 micromol/l. In the drowning group, the difference levels ranged from 12 to 387 micromol/l. Resuscitation seemed to have no effect on the results. In cases of drowning showing advanced putrefaction, the iron test was not reliable because biochemical iron measurement was often prevented by inability to obtain postmortem blood.

Conclusion: According to the results, iron seems to be a good biochemical marker for freshwater drowning with a short postmortem interval.

Drowning, Iron, Postmortem Biochemistry

G48 Elder Abuse and Neglect Death Review: Use of an Interagency Team

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After attending this presentation, attendees will understand the organization and implementation of an elder death review team, using the San Diego experience as an example.

This presentation will impact the forensic community and/or humanity by providing general awareness of efforts of local governments to address the issue of elder abuse and neglect deaths. The experience of San Diego County's elder death review team may be helpful to other jurisdictions in developing teams.

There is a growing national concern about abuse and neglect of the elderly. San Diego was one of the first counties in California to develop an Elder Death Review Team in response to legislation enacted in 2001. The California law provides for the development of an interagency review team "to assist local agencies in identifying and reviewing suspicious elder deaths and facilitating communication among persons who perform autopsies and the various persons and agencies involved in elder abuse or neglect cases." The law lists suggested team membership, including experts in the field of forensic pathology, experts in geriatrics, coroners and medical examiners, district and city attorneys, law enforcement, public administrators, ombudsmen and representatives from adult protective services.

San Diego County chose to set up the committee through a Memorandum of Agreement (MOA) between the District Attorney's Office, the Sheriff's Office, the Medical Examiner's Office, and the Health and Human Services Agency (which includes Aging and Independence Services). Representatives of these agencies are permanent members of the committee and rotate the chairmanship. The MOA provides guidelines for

membership of the committee, objectives, recommendations, and confidentiality. The objectives include identification of risk factors and the facilitation of communication between agencies in order to reduce the number of elder deaths due to abuse and neglect.

The Elder Death Review Team borrowed ideas from existing Domestic Violence and Child Fatality review teams. All information is considered confidential, and all members must sign a confidentiality agreement. Paperwork is kept to a minimum. The committee has opted to discuss only one case per meeting. Discussion goals include determination of the nature of the abuse or neglect, if any, whether it played a role in the death, and an assessment of its preventability. A case review-investigative report form was developed to summarize each case. The committee discussions conclude with recommendations, which can range from changing individual departmental policies to public education to proposing legislation.

The committee has had its share of growing pains, and some issues have yet to be resolved. However, the authors believe the development of a County Elder Death Review Team is one step in raising awareness of elder abuse and neglect and reducing its prevalence.

Elder Abuse, Elder Neglect, Elder Death Review

G49 Adolescent and Young Adult Suicide: A Ten-Year Retrospective Review of Kentucky Medical Examiner Cases

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The goal of this presentation is to present a comprehensive review of findings gleaned from postmortem examinations on suicide victims between the ages of 11 and 24 in Kentucky between 1993 and 2002, and to offer strategies aimed at the prevention of adolescent and young adult suicide.

This presentation will impact the forensic community and/or humanity by showing how adolescence represents a tumultuous period in a young individual's life as the youth strives to gain independence and flourish into a productive member of society. This period of transformation is often associated with anxiety and stress, encouraging feelings of hopelessness, personal failure, and suicidal ideation. The prevalence of youth suicide by firearm necessitates restricting unsupervised household access to firearms and identifying adolescents and young adults who are at risk for suicide.

According to the *National Vital Statistics Report* in 2001, suicide, as a manner of death, ranked as the third leading cause of death in the United States between the ages of 15 and 24 and accounted for 3,971 deaths. The rate of completed suicide in this age group has tripled since 1950. The estimated ratio of attempted suicides to completed suicides for adolescents is 200:1, which is significantly higher than that of the general population, with an estimated 10-25 attempts for every completed suicide. A host of biopsychosocial factors contribute to adolescent suicidal behavior. The majority of adolescent suicide victims suffer from either single or combined psychiatric disorders, including affective and personality disorders, substance abuse, anxiety or conduct disorders, eating disorders, and aggressive and antisocial tendencies. Youths often display risk-taking behaviors, including reckless motor vehicular operation, running away from home, auto theft, gun carrying, lack of seatbelt use, assault, and truancy. A lack of a cohesive family unit may provoke suicidal ideation; specifically, poor parent-child communication, parental violence, and loss of a primary caregiver. Suicide clusters are most commonly associated with youths ages 15 to 24, precipitated by either experiencing the suicide of a member of a young individual's peer group or gaining media exposure and imitating suicidal behavior.

This study presents 466 medical examiner cases of suicide ages 11 to 24 in Kentucky between 1993-2002, with 108 victims ages 11 to 17 and 358 victims ages 18 to 24. The majority of victims in both age groups were males (88.9% and 87.4%) and Caucasian (88% and 90.8%). A paucity of black females committed suicide, consisting of only 0.92% and 0.84% of victims in each group, respectively. The leading causes of death were the same for the two age groups, specifically, firearm injury (72.2% and 70.7%), hanging (22.2% and 18.7%), and drug intoxication (2.8% and 5.3%). The head was the most likely target of the firearm wound for both males and females, accounting for 93.6% and 85% of victims in each age group, respectively. Suicide peaked in September for group ages 11-17, most likely reflecting the tension associated with the initiation of a new school year. The highest percentage of cases for the group ages 18-24 was documented in January. Ten (9.2%) subjects ages 11-17 had previously attempted suicide, in most cases, by incised wounds of the upper extremities; 60% of these victims fatally succumbed to a cranial firearm wound. Of the 35 (9.8%) victims ages 18-24 who had previously attempted suicide, 48.6% died as a result of a firearm injury to the head and 31.4% selected hanging.

Toxicological studies constitute an important component in the investigation of a suicide. In the suicide group ages 11 to 17, blood and urine were collected in 93.5% and 72.2% of cases, respectively. Approximately 62% of victims in this group had negative blood toxicology, and 71.2% of urine toxicology screens yielded no drugs. The blood alcohol concentration (BAC) was negative in 83.2% of cases, while 7.9% had a BAC ? 0.1 mg%, and 8.9% < 0.1 mg%. A minority of victims had been prescribed psychoactive medications as discerned in the blood, specifically, benzodiazepines in 4.9% and antidepressants in 3.9%. Cannabinoids were detected by urine screen in 23.1% of the decedents. Of the victims ages 18 to 24, blood and urine were collected in 92.4% and 71.8% subjects, respectively. The blood toxicological results were negative in 40.3% of cases. The BAC was negative in 59.2% of cases, ? 0.1 mg% in 26.9%, and < 0.1 mg% in 13.9%. The following prescription psychoactive medications were quantitated in the blood: benzodiazepines (8.4%), opiates (6%), and antidepressants (5.1%). Urine screen revealed cannabinoids in 31.5% and cocaine in 8.2%.

This comprehensive analysis incorporates a myriad of factors that may have contributed to suicidal behavior, specifically, psychiatric illness, domestic turmoil, employment unrest, and legal difficulties.

Suicide, Adolescent, Firearm

G50 Which Field Method is Best? A Comparative Study of Four Entomological Methods for Sampling Forensically Important Arthropods on Human and Porcine Remains at the Anthropology Research Facility in Knoxville, Tennessee

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The goal of this presentation is to present to the forensic sciences community the latest findings from the Anthropology Research Facility (ARF) in Knoxville, Tennessee, on the topic of which field sampling methods, when used singly and in combination, yield the largest fraction of forensically-important insect species from human and porcine remains.

This presentation will impact the forensic community and/or humanity by providing recommendations on which field methods forensic entomologists and crime scene investigators should use when sampling forensically-important arthropods from human remains in medicolegal death investigations.

The obvious constraints imposed on the scientific study of human corpses speak to the urgency for forensic entomologists to have comparative field data on human and surrogate (non-primate) remains to insure that the recommendations offered for one are valid for the other. In 1989, the on-campus Anthropology Research Facility (ARF) at the University of Tennessee, Knoxville, became the site of the first comparative field test of four arthropod sampling methods used by forensic entomologists.

Over a 35-day period in summer, aerial sweep nets, pitfall traps, sticky traps, and hand collections were taken from one unembalmed, unautopsied human cadaver and two freshly-euthanized 50-lb pigs. (Due to limitations in procurement, replicate human corpses were unavailable in this study.) A third pig, also placed at the site, was not sampled in order to monitor possible sampling effects on rates of decay and arthropod succession. Depending on carcass age, the daily sampling schedule included up to four collections (early morning, noon, afternoon, early evening), for a total of 96 sampling periods and 1,370 individual samples; by season's end, the corpses at this site became the most intensively sampled remains of any previous study. Where arthropod life stages and taxonomic keys permitted, specimens were identified to the lowest possible taxon (family, genus or species). From the arthropod counts, the fraction of forensically-important arthropods captured by each method and combination of methods was calculated. Forensically-important taxa include members of the sarcosaprophagous fauna (e.g., blow flies, flesh flies, hide beetles) and certain predators (e.g., rove beetles, clown beetles, ham beetles), both of which have been used as forensic indicators in medicolegal death investigations.

Based on analysis of 16 days of samples, different sampling methods captured between 35 and 100% of the forensically-important taxa and between 30 and 100% of the sampled individuals. Hand collection, when performed by an experienced forensic entomologist, was found to be the single best method for sampling forensically important insects at a crime scene, followed by aerial netting, pitfall traps, and sticky traps. Hand collection and aerial net sampling were found to offer the best combination of methods for sampling forensically-important insects. This ranking held regardless of whether the remains sampled were human or pig. Human-pig comparisons revealed a high degree of similarity in catch statistics, regardless of method, leading researchers to conclude that enough elements of the forensically-relevant fauna were found on pig carcasses in southeastern Tennessee to reflect what crime scene investigators are likely to find there on human remains in future death scene investigations.

The authors gratefully acknowledge the logistical and field assistance of the Anthropology Department of the University of Tennessee, Knoxville, and financial support of the National Institute of Justice (Grant #94-IJ-CX-0039).

As forensic entomologists they hope to see future field-tests and eventual adoption of these recommendations by crime scene investigators and other members of the forensic sciences community.

Forensic Entomology, Anthropology Research Facility (ARF), Field Sampling

G51 The Decomposition of a Pig Carcass in a Mesophytic Biotope, Oahu, Hawaii

Anthony R. Russo, PhD, Chaminade University of Honolulu, Forensic Science, 3140 Waialae Avenue, Honolulu, HI 96816*

The goal of this presentation is to assist in the understanding of the stages of decomposition and the succession fauna on decomposing carcasses, an aid to estimation of postmortem interval.

This presentation will impact the forensic community and/or humanity by providing additional information confirming successional stages of decomposition and allied fauna.

The decomposition of an exposed pig carcass *(Sus scrofa)* was monitored for approximately 43 days. The carcass progressed through fresh (2 days), bloat (3 days), decay (5 days), post decay (30 days), and skeletal (2 days) stages and attracted suites of necrophagous species as well as predators, parasites and opportunistic feeders. The calliphorid blow flies *Chrysomya rufifacies* and *C. megacephala* were initial colonizers and made up the bulk of the initial arthropod abundance; the coleopterans of families Histeridae, Dermestidae, Trogidae, Staphylinidae, Tenebrionidae and Cleridae appeared in later stages. Most maggot activity occurred during the bloat and decay stage, which lasted from day 3 through day 9 of exposure. By this time only 25% of the carcass remained. During peak maggot activity, the difference between internal carcass temperature and ambient air temperature peaked. The greatest number of taxa (22 of 27) and the lowest total abundance of arthropods were observed during post decay. A total of 27 taxa were identified, of which about 64% were dipterans and coleopterans combined. The suite of arthropod taxa identified in this study was not significantly different from other outdoor pig decomposition studies done in Hawaii.

Arthropod Succession, Maggot Masses, Forensic Science

G52 A Comparison of Pig and Human Tissue in Studies of Decomposition: Can Flies Tell the Difference?

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The goal of this presentation is to provide preliminary studies that demonstrate how some forensically significant fly species may be attracted to different types of carrion in varying degrees and to determine if blowflies are differentially attracted to human or porcine carrion via olfaction.

This presentation will impact the forensic community and/or humanity by providing preliminary studies which indicate that currently practiced research methods may not deliver the most accurate results.

These studies asked whether adult scavenger insects respond differently to volatile compounds emanating from human or porcine remains, in an effort to determine if porcine surrogates may legitimately be substituted for human remains in forensic entomology research. No difference in the arthropod fauna attraction to either type of carrion was anticipated.

Natural insect populations were exposed to odors from human or pig tissue samples contained in traps that bar visual cues. Traps consisted of a small tub filled with carrion suspended within a covered five-gallon plastic bucket or 35-gallon plastic trashcan and above propylene glycol poured four centimeters deep. Holes six centimeters in diameter were drilled six centimeters below the rim of the outer bucket or trashcan to allow insects to have access to the carrion. Once inside the trap, insects drowned in the propylene glycol. They were periodically sieved from this preservative then rinsed and stored in ethanol. For identification to species, forensically significant insects were first rinsed in acetone then pinned.

In a preliminary experiment, equivalent weights of pig or human thigh and forearm tissue in five-gallon bucket traps were used. Eight species of

flies arrived at either carrion. Five were common to both types of carrion. Three species of flies were recovered solely from traps baited with human carrion, and no species were recovered exclusively from porcine carrion.

In the later experiment, employing 35-gallon trashcan traps, the plastic tubs were baited with a human or pig cephalic specimen. These tissues attracted a greater diversity of fly species, totaling 15. Eight of these were common to both types of carrion, three were found associated only with human tissue, and four only with porcine material.

Over both experiments, a total of 16 species of flies were collected and identified. Of these, 11 were found on both types of carrion. Two were consistently identified only on the human specimens, and four species were found solely on the porcine tissue.

Although the results of these experiments remain preliminary, they suggest that adult fly populations on human or porcine carrion may be qualitatively different. The impact on current methods of postmortem index (PMI) can only be determined through the collection of additional data sets.

Olfaction, Forensic Entomology, Carrion

G53 Inter-Observer Variability in Entomology-Based PMI Estimates: A Single Blind Study

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Attendees will develop an understanding of the variability in current techniques used to estimate the postmortem interval based on entomological evidence. The primary goal of this presentation is to open a dialogue within the forensic entomology community regarding the development of uniform protocols.

This presentation will impact the forensic community and/or humanity by demonstrating a need within the forensic entomology community to standardize its methods and practices.

Although reports of the utility of arthropods in forensic investigation date as early as 1235 AD, the field of forensic entomology remains in its adolescence, with many avenues of basic research largely unexplored. In particular, the method by which the postmortem interval (PMI) is estimated, one of the most important applied methods in forensic entomology, remains a highly controversial and problematic process. Indeed, it would seem that there might be as many such methods as there are forensic entomologists. Herein the authors acknowledge the need for standardization of this process within the community, investigate the variation in methods employed by forensic entomologists in a single-blind study, and suggest elements of a uniform protocol. Accordingly, a simulated crime scene was arranged in which fresh human remains were exposed to insects at the outdoor decomposition facility operated by the University of California, Davis, Institute for Medicolegal and Surgical Sciences (IMSS). Following an undisclosed period of exposure (herein referred to as the PMI), researchers sampled insects from the remains, recorded typical crime scene and meteorological data, and photographed and videotaped the scene and data collection efforts. Copies of all materials were sebt to a number of practicing forensic entomologists in North America who had previously agreed to participate and render a PMI estimate. The degree to which these estimates vary and bracket the actual PMI will be discussed.

Forensic Entomology, Postmortem Interval, Standards

G54 Viral Testing of Adult Mosquitoes Collected in West Virginia for West Nile Virus Using NASBA Assay

Justin M. Godby, BS, Marshall University, 1401 Forensic Science Drive, Huntington, WV 25701*

After attending this presentation, attendees will understand the collection methods for mosquitoes, testing of mosquito samples for viral RNA, and how forensic equipment and methods can be used for viral testing.

This presentation will impact the forensic community and/or humanity by demonstrating the use of forensic methods and procedures that can be used to implement viral testing of field collected samples.

Since its discovery in the United States in 1999, West Nile Virus has spread across North America. Though not endemic to the continent, mosquitoes of the genera *Culex* have become vectors of the serocomplex that causes West Nile. Public health concerns have prompted laboratories across the nation to develop reliable and rapid tests to detect the virus in order to initiate surveillance methods. By combining efforts between public health and forensic agencies, testing protocols can be developed and performed on not only possible vectors but also infected individuals. Current microbial forensic techniques and equipment can be manipulated to detect viral pathogens using analytical extraction methods. The West Virginia Department of Health and Human Resources, Division of Surveillance and Disease Control (WVDHHR/DSDC) in conjunction with the West Virginia Office of Laboratory Services (WVOLS), and the Marshall University Forensic Science Center (MUFSC), collected adult mosquitoes for viral RNA testing. Viral RNA was isolated and detected by Nucleic Acid Sequence Based Amplification (NASBA) to ensure appropriate quality control measures necessary in microbial forensics applications.

West Nile Virus, TaqMan®, RNA

G55 An Instructional DVD on Collecting Entomological Evidence for Court

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After attending this presentation, attendees will learn that there is now available a training video on how to properly collect, preserve, and process entomological evidence for court. This training aid will benefit law enforcement agencies, death scene investigators, medical examiners, and forensic entomologists.

This presentation will impact the forensic community and/or humanity by standardizing the practices which are critical to the development of postmortem intervals and the utilization of insects as evidence during criminal investigations.

This DVD was created by forensic entomologists to fulfill the immediate need to standardize practices for collecting entomological evidence. The material is intended to instruct forensic investigators on how to collect specimen samples and field data in a way that will be scientifically valuable and credible in court. The DVD includes an overview of forensic entomology and the decomposition of an animal model has been time-lapsed to demonstrate the association of insects with various stages of decay. Insects commonly found with human remains are shown and factors that influence

insect activity and development are described. Crime scene photographs and video are used to aid in the recognition of what information should be collected during death investigations. A list of equipment needed to process entomological evidence is given, and the collection and preservation of insect specimens is clearly demonstrated in a step-by-step procedure. The main purpose of this DVD is to standardize the practices that are critical to the development of postmortem intervals, and demonstrate the utilization of insects as evidence during criminal investigations. The entire training video is 25 minutes; however, the multi-media format provides self-paced instruction and allows the viewer to select specific modules for quick referencing.

Forensic Entomology, Collection, Evidence

G56 How Cadaver Decomposition in Soil is Affected by Moisture: Part I: A Field Experiment to Investigate Seasonal Effects

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After attending this presentation, attendees will understand how the rate of cadaver decomposition in soils can differ according the soil texture and season of burial.

This presentation will impact the forensic community and/or humanity by demonstrating the influence of seasonal variation in moisture on decomposition processes associated with cadavers buried in soils of contrasting texture.

Soil moisture resulting from rainfall affects decomposition processes by directly influencing the activity of soil organisms and the leaching of soluble materials. The amount and distribution of moisture in association with an organic resource, such as a cadaver, is dependent upon precipitation, uptake by vegetation and losses via evapotranspiration and drainage. These factors are, in part, influenced by soil texture (which is defined by the soil particle size distribution). The predominance of large soil particles (sand) results in greater pore space (the area between soil particles) and increased rates of drainage and aeration. Thus, a soil that is dominated by small soil particles (clay) may be subject to waterlogging. The most accurate assessment of the availability and distribution of moisture is the measurement of matric potential (the pressure with which moisture is held between soil particles). This measure can be used to determine the ease with which soil microorganisms can take up moisture.

In order to investigate the effect of soil texture and seasonal moisture variation on cadaver decomposition, a field experiment was conducted at two disparate field sites. Site 1 comprised a sandy loam soil (84% sand, 11.1% silt, 4.9% clay) and was located in Yabulu, Queensland, Australia (19°12'S, 146°36'E). Site 1 receives an average rainfall of 995 mm during the wet season (November-April) and 140 mm during the dry season (March-October). The mean maximum/minimum temperature during the wet season is 30.5 °C/27°C. Dry season mean maximum/minimum temperature equals 22.9 C/16.7°C. Site 2 comprised a loamy sand soil (97.7% sand, 1.3% silt, 1% clay) and was located in Pallarenda, Queensland, Australia (19°11'S, 146°46'E). On average, Site 2 receives 1005.1 mm rainfall during the wet season and 120.3 mm rainfall during the dry season. The mean maximum/minimum temperature during the wet season is 30.7 °C/23.1°C. Dry season mean maximum/minimum temperature equals 26.9 °C/16.4°C. The resulting vegetation at the two sites was dominated by grasses with scattered trees. These characteristics are typical of a savannah ecosystem. Cadavers (*Rattus rattus*: ~18 g) were buried at a depth of 2.5 cm. Each cadaver was located in the centre of a 2 m^2 plot. Cadaver mass loss, soil microbial activity and nutrient concentration was measured over a period of 28 days in order to determine if an increase in soil moisture during the wet season would result in an increased rate of cadaver decomposition. This experiment was replicated six times and controls (soil without cadaver) were used.

The soil at Site 1 reached a matric potential of –0.03 megapascals (MPa) (equivalent to 15% moisture content v/v) during the wet season and was a constant -1.5 MPa (55% v/v) during the dry season. The soil at Site 2 reached a matric potential of –0.005 MPa (25% v/v) during the wet season and –1.5 MPa (3% v/v) during the dry season. All decomposition processes were greater during the wet season as demonstrated by the quantification of cadaver mass loss, microbial activity and nutrient concentration. This is most likely due to an increase in the activity of soil organisms and the leaching of soluble cadaveric materials as an effect of rainfall. Some differences were observed between soils within seasons.

Cadaver Decomposition, Soils, Seasonal Effects

G57 How Cadaver Decomposition in Soil is Affected by Moisture: Part II: A Controlled Laboratory Experiment

David O. Carter, MSc, School of Pharmacy and Molecular Sciences, James Cook University, Douglas, QLD 4811, Australia; Mark Tibbett, PhD, Centre for Land Rehabilitation, School of Earth and Geographical Sciences, University of Western Australia, Crawley, WA 6009, Australia; and David Yellowlees, PhD, School of Pharmacy and Molecular Sciences, James Cook University, Douglas, QLD 4811, Australia*

After attending this presentation, attendees will understand the interaction between soil moisture and soil texture can have a significant effect on processes associated with cadaver decomposition in soils.

This presentation will impact the forensic community and/or humanity by demonstrating the influence of moisture on processes associated with cadaver decomposition in soils of contrasting texture.

Decomposition processes associated with an organic resource, such as a cadaver buried in soil, can be affected by the nature of the soil physico-chemical environment (e.g., soil texture, moisture status) and the activity of soil organisms. In a laboratory setting, matric potential (as defined in Part I) can be manipulated in order to test the effect of soil moisture status on decomposition processes associated with a cadaver buried in soil. Other measurements of soil moisture status, such as a simple gravimetric moisture content (g H_2O g^{-1} dry soil) and the estimation of moisture content in relation to saturation or field capacity (% water holding capacity), do not provide an assessment of the availability of moisture to soil microorganisms. Hence, the calibration and maintenance of matric potential can be used to exclude the activity of larger organisms such as protozoa and nematodes. Peak soil microbial activity is typically associated with a matric potential of approximately –0.01 megapascals (MPa).

Soil from the sites described in Part I were sampled (0-10 cm depth) and sieved (2 mm) field fresh. The soil from Site 1 was a sandy loam soil. The soil from Site 2 was a loamy sand soil. Sieved soils (500 g) were weighed into sealable 2 L polyethylene incubation chambers and calibrated to a matric potential of –0.3 MPa (to simulate dry conditions) or –0.01 MPa (to simulate wet conditions). Following an equilibration period of seven days, juvenile cadavers (*Rattus rattus*: ~18 g) were buried at a depth of 2.5 cm and incubated at 22°C. Cadaver mass loss and soil microbial activity were measured over a period of 28 days in order to determine if an increase in soil moisture would result in an increased rate of cadaver decomposition. The present experiment also tested the hypothesis that burial in loamy sand soil will result in an increased rate of decomposition. This experiment was replicated 4 times and controls (soil without cadaver) were used.

In the sandy loam soil a matric potential of –0.3 MPa resulted in an increase in the rate of all decomposition processes. Conversely, increased decomposition was observed in the loamy sand soil calibrated to a matric potential of –0.01 MPa. Significant differences in the rate of decomposition processes were observed between soils of similar matric potential.

These contrasting results demonstrate that the rate of cadaver decomposition can be affected by an interaction between soil texture and moisture content. Reduced activity in the loamy sand calibrated to –0.3 MPa may be due to the inability of the soil microbiota to utilize the little water that is tightly bound between soil particles under dry conditions. Reduced activity in the sandy loam is likely due to a decreased diffusion coefficient of gases (e.g., O_2, CO_2) associated with an abundance of moisture and a high microbial demand for O_2 during the aerobic catabolism of an organic resource. These conditions may lead to anaerobiosis. Greater cadaver mass loss took place in the field experiment described in Part I. This phenomenon may be due to the presence of arthropods in a field setting. Unlike the findings from the field experiment in Part I, cadaver decomposition in soil from Site 1 decreased with an increase in moisture. This might indicate that the aerobic threshold for the sandy loam soil following cadaver burial is between –0.005 MPa and –0.001 MPa.

Cadaver Decomposition, Soil, Moisture

G58 Clinically Stable Skull Fracture and Fatal Acute Pneumonia: An Unexpected Combination

Christie L. Elliott, MD, Forensic Pathology Consultants, PO Box 12815, Reno, NV 89510-2815*

After attending this presentation, the forensic pathologist and treating clinician will be aware of an unexpected and rare complication of head injuries.

This presentation will impact the forensic community and/or humanity by educating the pathologist and the treating clinician about a rare but serious complication of clinically mild head injuries, and stimulating more studies in the area of possible treatments for this complication.

Aspiration pneumonia and acute meningitis are well-recognized complications in head-injured patients.[1-3] Most commonly, the pneumonia results from aspiration of gastric and oropharyngeal material into the lungs because of unconsciousness and/or altered gag and swallowing reflexes from the head injuries. Acute meningitis most often occurs in the presence of basilar skull fractures, which result in communication between the underlying sinuses and the CSF. Very little information is available in the medical literature addressing the issue of blood aspiration in head-injured patients, particularly those with maxillofacial injuries. The following case report will illustrate an unexpected complication of such an injury.

The patient was a 13-year-old female involved in a single car motor vehicle accident. She had epistaxis and abrasions and contusions of the face, but suffered no loss of consciousness or neurological symptoms. A CT scan showed non-displaced facial fractures, a small basilar skull fracture, and a right temporal cephalohematoma. She was admitted for observation and released the following day. Two days after discharge she returned to the emergency room with complaints of pain, dizziness, and weakness. Repeat CT scan of the head showed no acute changes. Chest x-ray was normal. She was afebrile, but mildly hypotensive (98/50) and tachycardic. This resolved with a fluid bolus. She was discharged home with pain medications. She was found semi-responsive the following morning and arrested shortly after. She was pronounced dead at the scene. An autopsy was performed the following day.

The postmortem examination revealed a normally developed adolescent female with soft tissue swelling and resolving contusions and abrasions of the face. Reflection of the scalp showed purulence of the right temporal soft tissues. Pertinent intracranial findings included hairline skull fractures across the orbital and ethmoid plates and the anterolateral left petrous ridge up into the left temporal bone. Grossly, the lungs were heavy, mottled red/tan, and slightly firm and edematous. Microscopic examination showed acute pneumonia, edema, and frank blood within the alveolar spaces. Cultures of lung tissue, CSF, and right temporal soft tissue were positive for β-hemolytic Group A Streptococcus. The final autopsy diagnosis was acute bacterial pneumonia due to blood aspiration from blunt force craniocerebral injuries. The facial sinuses were thought to be the source of infection.

Review of the literature reveals no data or case reports specifically addressing the issue of blood aspiration and pneumonia in the head-injured patient, though several studies address the increased risk of pneumonia, and one explores the increased risk of pneumonia in head-injured patients who were carriers of Staphylococcus aureus.[4,5] The method of inoculation was felt to be aspiration at the time of injury and/or from intubation. The patients in this and other studies suffered from severe head injuries and had been intubated, some requiring prolonged ventilator support. This case differs, in that the head injury was not severe. The patient experienced no loss of consciousness, neurological symptoms, or airway compromise. No information was found regarding studies of the use of prophylactic antibiotics in this patient population. Prior to this case, the standard of care at the treating medical center for patients with clinically stable maxillofacial and skull fractures did not include prophylactic antibiotic therapy. This case suggests that further study in this area is warranted.

[1]Marion, DW. Complications of head injury and their therapy. *Neurosurgery Clinics of North America* 2:April 1991, 411-24.

[2]Severyn FA, Fenn J. Overwhelming S. pneumonia meningitis after basilar skull fracture: A Case Report. *Air Medical Journal* 19:3, 2000, 102-4.

[3]Kingsland RC, Guss DA. Actinobacillus ureaea meningitis: Case report and review of the literature. *The Journal of Emergency Medicine* 13:5:1995, 623-627.

[4]Campbell W, Hendrix E, Schwalbe R, et.al. Head-injured patients who are nasal carriers of Staphylococcus aureus are at high risk for Staphylococcus aureus pneumonia. *Critical Care Medicine* 27:4:1999, 798-801.

[5]Bronchard R, Albaladejo P, Brezac G, et.al. Early onset pneumonia: Risk factors and consequences in head trauma patients. *Anesthesiology* 100:2004, 234-9.

Skull Fractures, Pneumonia, Head Injuries

G59 The Dangers of Dumpster Diving: Deaths Associated With Garbage Collection in the Tidewater Region of Virginia

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After attending this presentation, attendees will be able to recognize characteristics of crush and asphyxial injury inflicted by garbage collection machinery on persons within dumpsters. Pertinent considerations in such deaths of the contribution of toxicology, natural disease, and history, and the effect on diagnosis of antemortem from frequently seen decomposition artifact will be reviewed. Public policy consequences of such deaths will also be briefly reviewed.

This presentation will impact the forensic community and/or humanity by reviewing an unusual but recurring situation in which homeless persons or others are crushed to death in garbage dumpsters. The presentation reviews, autopsy findings, mechanism of death, and role of artifacts of decomposition in determining cause of death.

Four cases accumulated over an 11 year period illustrate an infrequent, but recurring, danger for poor or homeless persons, who die during garbage collection.

In 1993, the fully clothed body of a 51-year-old man was found by employees of a sewage and trash processing plant when a garbage truck dumped out the trash collected from a dumpster in Norfolk, Virginia. At initial examination on scene, a gaping laceration was evident in the lower

abdomen, with exposed bladder wall. At autopsy, diffuse changes of decomposition did not obscure extensive crush injury, including cervical spine, femur, and iliosacral fractures, fragmentation of the liver, diaphragmatic rent with traumatic herniation of the stomach into the chest, and a ruptured ileocecal junction. These injuries were consistent with death during trash compaction.

The decedent proved to be a homeless man with a history of heavy alcohol intake, last seen by his family two to three days before his body was found. Although investigation never proved what he was doing in the dumpster, it was possible that he was either looking for recyclable items, or may have fallen asleep there. Toxicology showed ethanol at 0.15 mg %.

In October of 1994, the body of a 48-year-old woman was found in the Hampton, Virginia landfill. At external examination, there were multiple abrasions and contusions, with areas of confluent contusion; the face was suffused, with dark purple contusions of the lips, and surrounding both orbits. At autopsy, there was severe crush injury, with fracture, dislocation, and transection of the cervical spine at both C1 and C7, and bilateral rib fractures with flail chest. There was also a healed myocardial infarct. She proved to be a vagrant from the neighboring city of Virginia Beach, with a history of diabetes and psychiatric problems, who was known to go through trash depots looking for salvageable materials. Toxicology showed a high but not lethal level of carbamazepine, with butalbital and oxazepam. It appeared that she might have climbed into a dumpster, collapsed from the toxic effects of her drugs or from a cardiac event, was later picked up by the trash-compacting truck, and was then crushed.

In November of 1994, the body of a 37-year-old man was found after a non-compacting trash truck dumped out its load at a sewage and trash processing plant. He did not have any crush injuries. Autopsy showed difuse bilateral scleral and conjunctival hemorrhages, purple suffusion of the face, marked edema of the face and lips, epiglottal petechiae, contusions of the neck structure, and further contusions of the chest and back. Death was ascribed to traumatic asphyxia, which he would have sustained when tons of trash were placed over his body. Toxicology showed numerous toluene derivatives. Although investigation did not show how he entered the dumpster, he may have been seeking a place to inhale glue vapors, and could have been overcome by the drug.

In 2004, the crushed and decomposing body of a 60-year-old homeless man was found at a dump site near housing debris. Autopsy was able to show, despite extensive decomposition, that crush injuries had occurred antemortem. He had been known to sleep in an abandoned house that was demolished six days previously. Public reaction to the death caused re-evalution of housing demolition policies.

This discussion will review the mechanism of death, immediate and underlying causes of death, contribution of natural disease and toxicology, and obstacles to determination of cause produced by decomposition, for persons dying in trash compactors. Review of these cases may heighten awareness of the dangers encountered by homeless persons foraging in dumpsters.

Garbage Dumpsters, Crush Injury, Traumatic Asphyxia

G60 The Differential Diagnosis Between Bioterrorism and Zoonosis and Spread to Humans: A Patholical Evaluation

Maurice Rogev, MD, Zamenhof 11, Tel Aviv 64373, Israel*

After attending this presentation, attendees will understand how recent episodes of international unrest have raised the danger of the use of "weaponized microbiological organisms" in terror attacks. At the same time, the ever present danger of the transmission of diseases from either domestic animals or from those who live in natural surroundings creates serious differential diagnostic issues. This presentation will outline an approach to the identification of the infecting microorganism and etiology that the forensic practitioner will be expected to make.

This presentation will impact the forensic community and/or humanity by assisting the medicolegal experts in learning how to identify terrorist attacks using micro-organisms that are naturally present in animals and can infect humans. These organisms having undergone weaponization.

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Differential Diagnosis, Zoonoses Terror Exposure, Human Infection

G61 Suicides Among Youth in Geneva, Switzerland From 1993 to 2002

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After attending this presentation, attendees will understand the importance of knowing the circumstances of deaths in suicides among youth to help clinicians in their work in youth suicide prevention programs. The effort should be made to collect clinical data during medicolegal investigations.

This presentation will impact the forensic community and/or humanity by demonstrating how suicides among youth are such a tragic event, and that it is sometimes difficult to collect complete clinical information or do a full medicolegal investigation. Sparing the family from too many questions might be one of the reasons. In Geneva, Switzerland, lack of crucial information for clinicians who work to prevent suicides among youth is often observed. This study may help to create a close collaboration between suicides prevention programs and forensic medicine.

In Switzerland, suicides represent the leading cause of death in the age group 20 to 24 years, and the second most common cause of death in the 15 to 19 year age range. During the 1990s, the number of suicides in those age groups has remained stable, and has even decreased in Geneva between 1975 and 1996. The aim of this study was to look whether this tendency persisted during the years from 1993 to 2003. The authors analyzed all cases of suicide among youth less than 25 years of age in Geneva during this period. Suicide was defined through police and medicolegal investigations. Sixty-five suicides were found involving 50 male (77%) and 15 female (23%) victims. The minimum age was 12 years, and most of the victims were 18 years old or older (89%). No increase in the number of suicides throughout the years was found in the range being between 1 and 11 cases per year. For males, use of firearms was the most common method (38%), followed by fall from height (30%), hanging (16%), and drowning (10%). For females, fall from height was the most frequent (40%), followed by use of firearms and medication overdose (20% each), hanging (13%), and drowning (7%). Only 43% of the cases had toxicological testing, and the main drugs found were benzodiazepines, cannabis and cocaine. Blood alcohol concentration was analyzed in 53% of all deaths. Among them, 32% tested positive, half of them with a concentration below 52.5 mg/dl. Clinical data in medical charts were often incomplete, lacking in more than 70% of the cases. Although this study has brought very useful in formation about the circumstances of death, helping to better characterize suicide in youth, in Geneva, an effort should be made to collect more clinical data during medicolegal investigations. These data would be of help to clinicians who work in youth suicide prevention programs.

Suicides, Youth, Epidemiology

G62 Suffocation by Mistaken Use of a Biohazard Hood as a "Spit" Hood

K. Alan Stormo, MD, Jeffrey M. Jentzen, MD, Mary K. Mainland, MD, John R. Teggatz, MD, and Victor V. Frolov, MD, Milwaukee County Medical Examiner, 933 West Highland Avenue, Milwaukee, WI 53233*

The goal of this presentation is to document a case of mistaken use of a biohazard hood as a spit hood resulting in suffocation, and show resulting experimental re-enactment of such use including time and oxygen strudies.

This presentation will impact the forensic community and/or humanity by demonstrating the danger of the improper use of the device, and by presenting data related to time necessary to become severely compromised by improper use.

A 20-year-old male was found to be in possession of drug paraphernalia and was arrested. While being transported to the police station he became belligerent, combative, and attempted to spit on the transporting officer. He was restrained with a car seatbelt with his hands cuffed behind him; a biohazard hood was placed over his head to contain the spitting. On arrival at the police department 8-10 minutes later he was found unresponsive; resuscitation was unsuccessful and he was pronounced dead in the local hospital ER.

The Quick 2000 is a widely available biohazard escape hood, which has a nose clip, a mouthpiece for breathing and a tight neck dam. Breathing into the mask without use of the mouthpiece rapidly depletes the oxygen and increases CO_2. Informal experiments demonstrate severe air hunger in two to two and one-half minutes if the mouthpiece is not used. Data from more formal experiments with oxygen and CO_2 studies will be presented.

Asphyxia, Suffocation, Biohazard Hood

G63 Unsuspected Pheochromocytoma Discovered During Autopsy After Sudden and Unexpected Death in an Expectant Mother

Sophie Gromb, PhD, Nadia Khaldi, MD, Larbi Benali, MD, Mathurin Djodjo, MD, and Alain Miras, PhD, Department of Forensic Medicine - EA 3676 - IFR 99 of Public Health, CHU Pellegrin - Place Amélie Raba-Léon, Bordeaux, 33076, France*

The goal of this presentation is to present a case report of sudden death due to pheochromocytoma (PC), and emphasize the necessity of complete autopsy and histological analysis in different tissues in which metastases can develop.

This presentation will impact the forensic community and/or humanity by showing the necessity to perform an autopsy in every case of sudden death in order to determine the cause of death for medical (responsibility), psychological (family), and epidemiological reasons (prevention of disease in the other members of the family); and demonstrating the importance of a complete autopsy and the necessity of histological analysis.

Case Report: An autopsy case of a PC in a 42-year-old asymptomatic and expectant mother is reported, without previously suspected PC. She was pregnant (her last period was 34 weeks ago), and had appointments with her obstetrician regularly. Her last visit to a doctor was 15 days before death, and all had been found normal. She didn't have abdominal pain or hypertension. Several days before death, she suffered asthenia, dyspnea, and chest pain. One morning, during a walk, she felt faint without other symptoms (nausea, vomiting, etc.), and this occurred again several minutes later. A loss of consciousness occurred and, in spite of the intervention of intensive care for more than one hour, she died in heart failure and cardiogenic shock.

Autopsy demonstrated rib fractures consistent with CPR, a normal thyroid gland, gastritis, polyvisceral edema, very intensive pulmonary edema, an enlarged heart, normal coronary arteries, no intravascular coagulation (pulmonary or other), brain edema, and a tumor in the left adrenal gland (60 g). The fetus and uterus were normal. Histological examination confirmed the adrenal tumor was a pheochromocytoma. Toxicology studies were negative.

Discussion : Adrenal PC is usually a benign catecholamine-producing tumor (90%) of the sympathetic nervous system. The incidence is 0.05% in all autopsies (McNeil *et al*., 2000) and sudden death occurred in 8.9% of the cases (Casanaova *et al*., 1993). The PC is bilateral in 505% of cases and left in 635%. The diagnosis is difficult because, generally, PCs develop for a long time with non specific symptoms (or without classical constitutional symptoms), until explosive syndromes appear, related to catecholamine excess, with severe hypertension, acute pancreatisis, hyperacute myocardial ischemia, cerebral hemorrhage, cardiogenic shock, congestive heart failure, and sudden death. Sudden death is the only sign in 1.5% of cases. Several diagnostic methods are available to increase the detection and the diagnosis (meta- and normetanephrine in urine is one of the best sensitive screening tests; abdominal MRI - scintigraphy with meta-iodo-benzyl-guanidine for visualization). It is important to note that the heart weight is increased in 95% of the patients.

Conclusion: Diagnosis is often difficult, and many PCs are not recognized during life. Clinicians should be aware of the symptoms of PC, as early diagnosis is very important in order to perform a laparoscopic adrenalectomy. In addition, some symptoms are the same as acute drug intoxication. PCs are usually curable if diagnosed and treated properly, and, in certain cases, this diagnosis necessitates prompt surgical intervention.

During autopsy, certain tumors are observed with increased frequency in patients with PC, including thyroid carcinoma, liver tumor, prostate carcinoma, malignant melanoma, carcinoma of the uterine cervix, and breast carcinoma.

Pheochromocytoma, Sudden Death, Autopsy

G64 Modeling Languages in Forensic Pathology

Gilbert E. Corrigan, MD, PhD, East Baton Rouge Coroner's Office, 4030 T.B. Hearndon Avenue, Baton Rouge, LA 70807*

After attending this presentation, attendees will understand the importance and utility of modern modeling computer techniques in forensic pathology from Microsoft Word® (MS Word), to Microsoft Visio® (MS Visio), to Universal Modeling Language Two (UML2).

This presentation will impact the forensic community and/or humanity by demonstrating the importance and utility of modeling to solving forensic pathology problems.

In forensic informatics, modeling is an underemployed but important computer technique. Models illustrate concepts, analyze processes and relationships, and communicate with efficiency and clarity. Models show the first definitions of processes at their inception; they precede the formal formulation of the computer application. Current computer applications in MS Word®, MS Visio®, and UML2 may be used by forensic scientists to compose models; however, increasing specificity and precision require more study and attention as the applications mature and enlarge.

Models provide computer programmers with the initial structure of their applications; models also work to provide scientists their first formulations of the details of their work. Models act to provide actual representations of concepts and ideas. Referral by scientists to the available models allows the definition of objects and relationships valuable to extension of their thoughts. Such models teach, communicate, illustrate, standardize, lead thinking, require attention, precede other actions, require syntax, provide transmission and transfer, and act to standardize operations. The models by structural and behavioral analysis are classified as class

diagrams, package diagrams, object diagrams, use case diagrams, sequence diagrams, collaboration diagrams, state charts, activity diagrams, power diagrams, component diagrams, deployment diagrams, engineering diagrams, flow charts, and brainstorming diagrams.

Current applications providing computer modeling activities have been under formal development by computer scientists for over thirty years and are in their third generation of development. Forensic scientists find modeling possible with the word processing application MS Word®, and MS Visio® which is evolving into a more complex, capable and inexpensive modeling tool. The more advanced UML2 applications have the capacity to create and manage large models over the expanse of large organizations and corporations with the precision and accuracy needed in sophisticated scientific activities. Many commercial scientific modeling applications are available; however, to date no formal set of forensic symbols or diagrams are recognized or developed.

Little formal recognition has been given to modeling in the forensic or pathology literature so that the complexities, multiplicities, and composites inherent in the data often are either ignored or not represented.

Forensic models are limited in number and are without the standardization found in UML2. Note that the development of models is not easy work and requires analytic time and clear conceptualization of ideas. Modeling is blocked by poor definitions and is inefficient when topics are diffuse and poorly understood.

Demonstrations of functional models in forensic scene investigation and forensic pathology are presented.

Forensic Informatics, Modeling Languages, Forensic Death Investigation

G65 Polyarteritis Nodosa as a Rare Case of Sudden Death in Postmortem Diagnosis

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After attending this presentation, attendees will understand that, in the correct setting, among the common natural disease causes of sudden death of forensic importance, sometimes very rare diagnoses must be considered. In these cases, systemic vasculitis and systemic autoimmune diseases may play a role. To detect these rare diseases as causes of death, classic histology may need to be supplemented by immunohistochemical and serological examination of tissues and other samples.

This presentation will impact the forensic community by demonstrating the first reported case of polyarteritis nodosa playing a role within the context of a sudden unexpected death.

Worldwide, most unexpected sudden deaths of forensic interest by natural causes are due to cardiovascular diseases. In these cases, acute myocardial infarction and arteriosclerosis of the coronary arteries are the leading entities. In contrast to this, sudden deaths due to vasculitis are a rarity. Polyarteritis nodosa occurs three times more often in men then in women. The diagnosis of the disease is often incorrect.

A 21-year-old old female student from Sweden came to Munich after vacationing in Greece with her parents. She was previously healthy, apart from a cold with fever a few weeks before her holidays which was treated with antibiotics. In Greece she complained of having back pain located near the right kidney and at a disco at Munich she got dizzy and collapsed. The day after, she became increasingly short of breath. In the afternoon she was found lifeless in the apartment of a friend with blood around her nose and mouth. She was brought into a hospital immediately.

She remained unconscious and was diagnosed with hypoxic edema of the brain. The initial presumption of drug intoxication was disproved by toxicological analysis.

She died with unclear symptoms three days after her collapse. As cause of death, the physicians of the hospital signed "Lung failure in pneumonia," as they suspected an atypical infection of the lungs.

The autopsy showed hemorrhagic lung edema. Weights of the lungs were: right 1085 g, left 1040 g. There was abundant bloody mucus in the respiratory passages, with some coagulated blood in the bronchi. Cultures of tracheal secretions were negative.

The histological examination revealed an intra- and extra capillary proliferative glomerulonephritis with crescents and focal segmental necrosis of the glomerular loops consistent with rapidly progressive glomerulonephritis. The lungs showed siderophages indicating older bleeding in addition to the fresh bleeding.

The clinical, laboratory and autopsy findings suggested either Wegener's disease or microscopic polyarteritis nodosa. The diagnosis was made by analysis of autoantibodies; the lack of cANCA indicated the diagnosis polyarteritis nodosa. The differential diagnosis will be critically discussed.

This may be the first reported case of polyarteritis nodosa playing a role within the context of a sudden unexpected death.

Polyarteritis nodosa, Sudden Unexpected Death, Immunohistochemistry

G66 Autopsy Findings in Hypothermia: A Five Year Retrospective Study

Patricia A. Aronica-Pollak, MD, Jack M. Titus, MD, and David R. Fowler, MD, Office of the Chief Medical Examiner, State of Maryland, 111 Penn Street, Baltimore, MD 21201*

After attending this presentation, attendees will understand the anatomic, toxicological, and investigatory findings associated with hypothermia deaths during the past five years in Maryland.

This presentation will impact the forensic community and/or humanity by providing information on the findings associted with hypothermia deaths with special emphasis on the gross autopsy findings.

To date, there are no recognized pathognomonic findings in hypothermia-associated deaths. Certain findings have been seen in greater frequency in hypothermia. These include paradoxical undressing, gastric mucosal ulcers, hemorrhagic pancreatitis, and pulmonary edema. It has been suggested that gastric ulcers and pancreatic changes are seen more frequently following resuscitation. Paradoxical undressing occurs when the body temperature is low, presumably causing mental confusion, possibly giving the sensation of extreme warmth, and leading to the removal of one's clothing. This confusion may also lead to a characteristic pattern of bruising on the extremities (elbows, wrists, hands, knees) as one wanders about in a confused state.

This poster will present the findings from a retrospective review of 145 cases investigated by the Office of the Chief Medical Examiner for the state of Maryland during the years 1999-2003, in which hypothermia was the cause of death or a contributory cause of death. The cases were assessed for association with drowning, natural disease, ethanol and drug intoxication, appearance of gastric ulcers, gross hemorrhagic changes of the pancreas, combined lung weights, evidence of paradoxical undressing, and contusions of the extremities.

Of the 145 cases, 19 were not included due to incomplete available data. Of the remaining 126 cases, 13 (9.7%) were associated with drowning. Only one of the drowning cases showed evidence of gastric ulcers. None had pancreatic changes. As expected, average combined lung weight was increased at 1067 grams (range 410-2310). Five of the 13 (38.5%) had ethanol levels over 0.08 g/dL. Drug intoxication was not noted in any of the drowning cases. Natural disease contributed in one case. Paradoxical undressing and contusion patterns on the extremities were not observed in the drowning cases.

Of the remaining 113 non-drowning cases in which full autopsy examinations had been performed, 83 (73.5%) were male with an average age of 56 years (range 19-91). Natural diseases such as cardiovascular disease, acetonemia, and dementia were associated with 59 (52.2%) of cases. Ethanol levels were over 0.08 g/dL in 33 (29.2%) cases. In 17 (15%) cases, drug intoxication contributed to death. Drugs involved included morphine, cocaine, methadone, meperidine, trazadone, oxycodone and acetaminophen.

Stomach ulcers were seen in 39 (34.5%) of the cases. Of these 39, 11 (28.2%) had been resuscitated. Sixteen (14%) of the 113 cases had gross visible changes in the pancreas. Of these 16, 5 (31.3%) had been resuscitated. Resuscitation occurred in 14 (12.4%) of the 113 cases in which no changes in the pancreas or stomach were noted. The average combined lung weight was 1050 grams, with a range of 400 to 2710 grams.

Paradoxical undressing occurred in 6 cases, with an additional 8 more potential cases (combined 12%). Pink-brown bruising was noted on the upper extremities in 24 (21%) cases and on the lower extremities in 25 (22%) cases. The contusions were often on the elbows, posterior wrists, the backs of the hands, and knees. Of the 14 total cases of potential paradoxical undressing, only 4 were associated with these contusions. Therefore, this pattern of bruising may represent a different type of confusional state possibly different than the thermoregulatory disturbances.

Hypothermia as a cause of death can only be determined through thorough investigation, as there are no autopsy findings which are noted in all cases. However, this study does provide further confidence in the diagnosis with the presence of other findings. The gastric ulcers were the most frequently associated finding. The contusions on the upper extremities and lower extremities, especially on the posterior surfaces of the arms, wrists and hands, are the next most common findings. Gross changes of the pancreas, visible as hemorrhage, were also noted, but less frequently. The pulmonary edema was difficult to assess as many of the hypothermia cases also had heart disease and drug and alcohol intoxication contributing to the cause of death. Paradoxical undressing, while uncommon, remains a real phenomenon that is potentially confused with criminal acts.

Hypothermia, Paradoxical Undressing, Gastric Ulcers

G67 Color Me Guilty: The Role of Paint Transfer in Weapon Linkage

Diane Scala-Barnett, MD, and Julie M. Saul, BA, Lucas County Coroner's Office, 2595 Arlington Avenue, Toledo, OH 43614-2674*

After attending this presentation, attendees will be alerted to examine for the presence of paint transfer onto bone as a means of weapon linkage, and be prepared to modify their specimen preparation techniques accordingly.

This presentation will impact the forensic community and/or humanity by demonstrating how paint transfer is commonly used for forensic linkage in vehicle related cases, although it may be overlooked in analyzing bone trauma.

Transfer evidence can be an important part of an investigation. Transfer evidence may relate to transfer of blood from one object to another, often leaving a distinctive contact transfer pattern that may be linked to a specific weapon.

Paint transfer also yields valuable information. Paint transfer usually relates to paint chips/fragments transferred from one vehicle to another (or onto a victim or structure) during a collision. This information aids in identifying a vehicle model and year based on analysis of the paint. It may even identify a specific vehicle.

Hair and fibers are transferred from one person or place to another – evidence of contact. DNA is transferred from a person to an object or another person. Fingerprints are transferred from one individual to another individual or an object.

Two cases will be presented involving paint transfer onto human bone through blunt force: in one case blue paint from a baseball bat and in the other the black surface (under flaking paint) of an old metal railing. Both cases involve severe blunt force trauma to the head. This is a phenomenon that had not been noted previously.

Case 1: In 1995 a 65-year-old male was found dead, the victim of a severe beating by an assailant who "came in like a raging bull with a baseball bat" (according to the Detective). At autopsy, Diane Scala-Barnett, MD, Deputy Coroner of Lucas County, Ohio, requested that Julie Saul, Director of the Forensic Anthropology Laboratory in that office, reconstruct the fragmented skull and determine what could be learned from the resulting fracture pattern. Blue paint chips and wood splinters were found in the soft tissue at wound edges of the mouth and scalp.

Traces of blue paint were noted on a few small fragments; therefore, initial cleaning was accomplished using only warm water in order to preserve pigment. Ultimately, five fragments were found to have blue paint embedded in the surface. Other bone fragments were cleaned and degreased using normal procedures.

Thirty-six fragments were reassembled. The fracture pattern indicated that the skull had been shattered with one blow, probably administered while the right side of the victim's head was against a hard surface – likely to be the floor. This was confirmed by bloodstain evidence at the scene.

The five bone fragments with embedded blue paint lined up together at one edge of the single impact area, located approximately on the left parietal eminence. The force of the blow at that point had driven blue paint from the baseball bat into the fracture edges.

Case 2: In 2004 a 40-year-old woman was found dead of severe blunt force injuries to the head. At autopsy, several distinctive patterned scalp lacerations were noted, along with bruises on the neck, face, chest and abdomen. A bitemark was present on the left breast. Retraction of the scalp revealed distinctive patterns on the skull beneath the scalp lacerations. These contact transfer patterns (not fractures) were formed by embedded black pigment, and corresponded well to the overlying scalp lacerations.

In this case, the instrument was not a broad, smooth object such as the baseball bat used in the earlier case, but a portion of an old iron fence railing with shapes that corresponded to both the lacerations and pigment contact transfer patterns.

In both cases, transfer of color (and/or pattern) onto cranial bone through blunt force yielded valuable information regarding the instrument used.

Although paint transfer is commonly used for forensic linkage in vehicle related cases, it may be overlooked in analyzing bone trauma.

Blunt Force, Paint Transfer, Trace Evidence

G68 The Role of Forensic Insects in Deposition of Pollen at a Death Scene

Rebecca J. Kirby, Anita L. Guedea, Phillip L. Watson, PhD, Roger E. Mitchell, PhD, and Scott M. Herron, PhD, Ferris State University, Department of Biology, Big Rapids, MI 49307*

The goal of this presentation is to investigate the importance of pollen transfer by insect visitors to a death scene.

This presentation will impact the forensic community and/or humanity by demonstrating the effect, if any, of forensically important insects on the deposition of both anemophilous and zoogamous pollen at a death scene. The importance of the findings could be critical in showing whether pollen evidence is subject to the uncertainty of insect visitors at a crime scene.

This poster will present the evidence of pollen deposition at mock crime death scenes with and without insect involvement. Pollen can be transferred to the death scene by wind (anemophilous) and by animals (zoogamous), particularly insects. It was the original purpose of the experiment to document the normal pollen assemblage in mock crime

scenes. This pollen assemblage at these mock crime studies was compared with the resident pollen on the pigs which were not local.

For over five years, one of the courses in the forensic biology program at Ferris State University has used pigs in a mock crime setting to teach students techniques associated with death scenes, including forensic entomology, botany, and anthropology. These mock crime settings are done under strict animal rights protocols. During these mock crime scenes, pollen collections have been done for baseline data on the pollen assemblages found during different times of the year.

In a series of insect inclusion and exclusion experiments, the pollen assemblages were collected at the mock crime scene. The original question attempting to be answered was the effect, if any, of the insects visiting the mock crime scene and deposition of both anemophilous and zoogamous pollen. The importance of the finding could be critical in showing whether pollen evidence is local or is subject to the uncertainty of insect visitors at a crime scene.

Insect, Pollen, Palynology

G69 Experimental Evaluation of Rigor Mortis - The Influence of the Central Nervous System on the Evolution of the Intensity of Rigor Mortis

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The goal of this presentation is to present the development of the intensity of rigor mortis after the disconnection of different parts of the central nervous system.

This presentation will impact the forensic community and/or humanity by providing a better understanding of the development of rigor mortis under different conditions.

In 1811, the French physician and chemist P. H. Nysten published the first scientific description of rigor mortis. The law named after him states that "Cadaveric rigidity affects successively the masticatory muscles, those of the face and the neck, those of the trunk and arms and finally those of the lower limbs." It is often added that resolution occurs in the same order. The development of rigor mortis is thus descending, a finding thought to be related to the varying distances between the different muscles and the central nervous system. However, Nysten himself noticed that the destruction of the CNS did not affect the order of the development of rigidity.

In 1904, Fuchs described the brain as the initial site of death, followed by the proximal part of the spinal cord, and suggested that the process then progressed towards the caudal spinal cord: the presumed impulsions influencing the development of rigor mortis arose from catabolic changes in the nerve cells.

In 1819, Busch observed that the removal of the brain and spinal cord resulted in an early onset of rigidity; moreover, rigidity was more pronounced and lasted longer.

In experiments conducted on animals, Eiselberg (1881) demonstrated that when the sciatic nerve was sectioned on one side, in over 70% of cases rigidity developed later than on the contalateral side.

Gendre (1885) and Aust (1886) confirmed this finding. Aust, in particular, obtained this result in 12 out of a total of 13 experiments. Having conducted in vivo sectioning of the left side of the spinal cord in rabbits (underneath the pyramidal crossing), Bierfreund (1888) made the following statement: "I was very surprised to find that after a few hours following death, the right half of the body became very rigid, while the left half remained almost normally mobilisable." Bierfreund thought that the "accelerating" effect of the central nervous system on the appearance of cadaveric rigidity was the result of a weak excitation of the muscular system, and if this excitation really did exist, it was too weak to cause a visible contraction. To prove this hypothesis, Bierfreund conducted animal experiments that involved weak irritation by the sciatic nerve. The results were the very opposite of what he had hoped for.

The experimental results described above and some others are partially contradictory. Therefore, it remains unclear what role the nervous system may play in the development of cadaveric rigidity.

Some years ago, a method to increase understanding of rigor mortis through the objective measurement of the intensity of cadaveric rigidity in rats was developed. The principle of the method is to determine the force required to cause a movement of small amplitude (4 mm) in the limb under examination. Since the movement doesn't break rigor mortis, serial measurements can be conducted. The apparatus used measures the resistance caused by rigor mortis in the knee and hip joints of rats. This method has been used in the past to evaluate the influence of several pre-mortem and postmotrem factors (i.e., body weight, muscular mass, age, physical exercise, ambient temperature, various causes of death, electrocution) on the development of rigor mortis.

In present investigations, experiments are performed that at least partially clarifies the influence of the central nervous system on the development of rigor mortis.

Experimentation: Animals: male albino rats, weighing approx. 300 g.

Measurement time points: 10 min, 1h, 2h, 3h, 4h, 5h, 6h, 8h, 12h, 16h, and 24h postmotrem.

Measurements were made on the hind limbs of the animals.

Group N°1: control

Group N°2: medulla oblongata section

Group N°3: destruction of spinal chord with a needle introduced in the spinal canal

Group N°4: sciatic nerve section

Results: No significant difference was found in the development of the intensity of rigor mortis among the four groups.

Conclusion: In "normal" conditions, the central nervous system has no significant influence on the intensity or on the time course of the rigor mortis. These experiments do not exclude the possibility of the influence of the CNS on the development of cadaveric rigidity in some pathological conditions.

Rigor Mortis, Central Nervous System, Rats

G70 β—Phenylethylamine as a Biomarker in Mechanical Asphyxia-Related Fatalities

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The goal of this presentation is to establish β—Phenylethylamine (PEA) as a biomarker of asphyxia during medicolegal investigation by characterizing the rate-limited step of oxygen-dependent monoamine oxidase B (MAOB).

This presentation will impact the forensic community and/or humanity by showing how the elevation of PEA concentration in blood may play a crucial role in asphyxia-related fatalities. A PEA blood level higher than 2.7 £gg/ml can play a diagnostic role in the determination of asphyxia during the medicolegal investigation. An endogenous substance, PEA allows forensic scientists to develop a state-of-the-art biomarker using the rate-limiting step of MAOB to specify the cause of death in asphyxia.

Identification of asphyxia depends on various non-specific parameters in forensic medicine, such as signs of petechial hemorrhages, cyanosis, engorgement of right heart chambers, lung congestion, and a variety of signs in mechanical asphyxia. The cause of death in asphyxia depends on the history and the exclusion of other causes. It is imperative to develop a quantitative and specific biomarker to interpret the scientific evidence and to ensure a precise diagnosis of asphyxia during the medicolegal investigation. PEA, a specific substrate of MAOB, is a biogenic amine and acts as a sympathomimetic amine through its release of dopamine. The rate-limiting step of the MAOB activity of monoamine deamination is a highly oxygen-dependent phenomenon. The hypothesis is that reduction of the activity of MAOB during the hypoxic status could cause an accumulation of PEA in human body fluids.

A retrospective study consisted of forty-one cases of mechanical asphyxia and thirty-seven cases unrelated to asphyxia that were collected from the Institute of Forensic Medicine, Ministry of Justice, during medicolegal investigation in Taiwan. There were sixteen strangulation fatalities where the causes of death were by manual strangulation (hand or ligature) or hanging. In twenty-five cases of suffocation with mostly choking on food, fixing a pad or gag over the face, and drowning were concluded to be the causes of death. The control group of fatalities unrelated to asphyxia included sudden death by cardiac failure, gunshot injury, violence, and traffic and falling accidents. *In vitro* study in human platelets and *in vivo* animal models in rats were used to monitor the PEA alternation during the hypoxic status. Gas chromatography/mass spectrometry was performed to determine the PEA concentrations of each forensic fatality's body fluids and of each animal specimen.

The PEA blood concentrations of strangulation, suffocation and control cases were 34.2 ± 7.7 µg/ml (mean ± SEM, n=16), 33.0 ± 6.7 µg/ml (n=25) and 0.16 ± 0.03 µg/ml (n=37), respectively. The PEA blood levels of asphyxia-related fatalities were significantly higher than those of control cases (p<0.005). There was no difference in PEA blood levels between suffocation and strangulation cases. The PEA urine concentrations of strangulation, suffocation and control cases were 1.5 ± 1.1 µg/ml (n=8), 0.3 ± 0.2 µg/ml (n=9) and 0.2 ± 0.1 µg/ml (n=12), respectively. The PEA gastric content concentrations in strangulation, suffocation and control cases ranged from 0.03 to 124.1µg/ml with no statistical difference between asphyxia and control group. The postmortem interval for the asphyxia and control groups was 4.3 ± 0.8 days and 5.0 ± 1.0 days, respectively.The PEA profile was not affected by postmortem alteration up to 13 days. Decreasing oxidative activity of MAOB and accumulation of PEA are observed during a hypoxic status in human platelets. An animal model to induce a hypoxic status in rats resulted in elevation of PEA blood levels up to two to four times the control value.

In conclusion, elevation of PEA concentration in blood may play a crucial role in asphyxia-related fatalities. The PEA blood level higher than 2.7 µg/ml can play a diagnostic role in determining asphyxia during the medicolegal investigation. An endogenous substance, PEA allows forensic scientists to develop a state-of-the-art biomarker using the rate-limiting step of MAOB to specify the cause of death in asphyxia.

β—Phenylethylamine, Asphyxia, Strangulation

G71 Forensic Pathologists and the NICHD Brain and Tissue Bank for Developmental Disorders

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After attending this presentation, attendees will be able to recognize the significant contribution of forensic pathologists to medical research by support of the activities of the NICHD Brain and Tissue Bank for Developmental Disorders.

This presentation will impact the forensic community and/or humanity by showing the significant contribution of forensic pathologists to medical research involving the use of postmortem human tissues.

Medical developments have increased the use of human tissues, especially for research purposes. The National Institute of Child Health and Human Development (NICHD), in 1991, established a Brain and Tissue Bank at the University of Maryland with a collaborating retrieval site at the University of Miami. Establishment of the Bank was in response to requests by family support groups for increased research on developmental disorders affecting children and young adults.

The Bank obtains donors through efforts by support groups and forensic pathologists. Through a coordinated outreach effort to support groups the Bank has registered over 2400 potential donors. The efforts have resulted in donation of autopsy tissue from nearly 1000 donors with over 100 different developmental disorders.

The legal and ethical issues regarding the use of human tissues donated for medical research have received great public attention. To protect the deceased's body from being used for postmortem research that is incompatible with the deceased or their families' wishes and values, informed consent is obtained for all tissue donations. The Bank provides the means for tissue donors to leave a legacy that will benefit future generations. A partial list of disorders includes adrenoleukodystrophy, autism, chromosomal disorders, metabolic disorders, Prader-Willi syndrome, sudden infant death syndrome, and tuberous sclerosis. Tissue from an additional 2000 donors has been obtained from local hospitals and the Office of the Chief Medical Examiner in Maryland. Tissue is stored formalin fixed and frozen at –80ºC. The Bank has collected over 55,000 tissue samples.

The availability of normal control tissue is critical to studying developmental disorders. The ONLY source of control tissue is from accident victims who come under the jurisdiction of medical examiners. Support by the Office of the Chief Medical Examiner of Maryland has enabled donation of tissue from normal individuals as well as individuals with autism, chromosomal disorders, PraderWilli syndrome, etc. In fact, disorders that are not inherently life threatening, such as autism, rarely come to autopsy unless death is accidental. The participation of medical examiners throughout the United States has enhanced the collection of tissues from normal donors (especially under 17 years of age) and donors with rare disorders.

The Bank serves an additional role: making the tissue available to qualified researchers. To date the Bank has distributed 12,000 tissue samples to 360 researchers in 11 countries. These researchers have published 150 full-length publications and an equal number of abstracts based on studies utilizing tissue from the Bank.

This report focuses on the role of forensic pathologists in medical research by support of activities of the Brain and Tissue Bank for developmental disorders. The mechanisms of how to obtain informed consent from the families of the newly dead is also addressed.

Forensic Pathologists, Tissue Donation, Medical Research

G72 Causes of Death Among People in the Prison of Loos (Northern France), 1997-2003

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People in prison are more likely to die prematurely, especially of violent causes, than people who are not in custody. Some of these deaths could be avoided. The goal of this presentation is to study the causes of death (violent and natural) among people in the prison of Loos.

This presentation will impact the forensic community and/or humanity by explaining what problems are present in French jails.

Methods: The authors examined the causes of death in both prisons of Loos for detainees in custody and sentenced detainees, from 1997 to 2003. The collected data included age, sex, work, cause of the death, location of the death, and history of addiction. The causes of death were categorized as violent (accidental intoxication, suicide, or homicide) or natural (cancer, cardiovascular disease).

Results: Forty-nine persons died in prison during the studied period: 47 male and 2 females ranging in age from 17 to 54 years. The average age was 30 years. There were 34 suicides, 4 natural deaths, and 11 deaths involving the presence of drugs or alcohol. In France, all deaths in prison (natural, homicide, accident, suicide, toxic) are autopsied and findings are described.

In this study the cases of suicides are described more precisely. Among the people who committed suicide, 30% were jailed after conviction for a sexual assault (34 of the 49 cases). Among them, 17 had already been sentenced and the others were waiting for a judgment. The position of the body and the presence of another detainee in the cell was studied. The method of suicide was mainly hanging with a large tie (29/34).

Discussion: The high number of deaths in custody resulting from self-harmful behavior has important implications for the criminal justice system and the penitentiary administration. The authorities have a high responsibility to prevent deaths in jail. It is important to develop a preventive health systems inside the jails to prevent suicides. Psychiatric treatments and therapy must be introduced to reduce the risks. An awareness of these causes might be of assistance in developing mechanisms to further reduce fatalities in this setting.

Prison, Death, Suicide

G73 Rathke's Cleft Cyst: Alleged "Brain Tumor" in a Middle-Aged Cocaine Abuser

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This presentation, will show the histology of a congenital anomaly that may present in a forensic case as a history of "brain tumor."

A 47-year-old female complained of chest pains at home, but failed to seek medical treatment. She collapsed at home later that day in the presence of a family member. She had a history of chronic cocaine use, and relatives were concerned that she might have used the drug on the day of her death. Her only other condition was an unclear history, according to the family, of a "brain tumor." The tumor had reportedly been present for some time, but she had received no recent medical care or treatment for it.

At autopsy, gross inspection of the uncal region revealed an enlarged tan-brown mass beneath the pituitary stalk. The stalk itself was fluctuant to pressure, but did not appear to be enlarged. Sectioning of the brain revealed a focal 0.4 cm diameter mass, with an apparent necrotic or caseous center, abutting the optic chiasm on one side, and the mammillary bodies on the other. Microscopic evaluation revealed the mass to be cystic, with a true wall of squamous epithelium, surrounding a center of amorphous fluid and squames. This is believed to be a Rathke's cleft cyst.

Rathke's cleft cysts are found in all age groups, but mean occurrence is 40-50 years. They are typically asymptomatic and found incidentally at autopsy. During embryologic development, Rathke's pouch is formed from an evagination of oral ectoderm that grows toward the midbrain. When the anterior lobe of the pituitary gland is formed from this ectoderm, the pouch is reduced to a residual cleft. Cysts are formed when the cleft persists, becomes enlarged, and its secretions accumulate. The cyst fluid can be yellow and thin, or green or brown thick mucus. It is lined with columnar or cuboidal epithelium in most cases, but mixed cell epithelium or pseudostratified squamous epithelium has been found. Ciliated columnar cells and goblet cells are also present in a majority of the cases. Most Rathke's cleft cysts are asymptomatic, but they can produce a mass effect causing headaches, visual changes, and pituitary dysfunction. Pituitary histology in this case appeared normal. Rathke's cleft cysts are usually located within the sella turcica. Rarely, they are found in a suprasellar location, as in this case.

Death was due to the complications of chronic cocaine abuse, with hypertensive and atherosclerotic cardiovascular disease. The family could be assured that the "brain tumor" had been located at autopsy, but had nothing to do with her death.

Rathke's Cleft Cyst, Rathke's Pouch, Forensic Pathology

G74 Microscopic Soft Tissue Decomposition and Time Since Death

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After attending this presentation, attendees will understand the histological soft tissue demise associated with long-term understanding of rigor mortis.

This presentation will impact the forensic community and/or humanity by qualifying the changes that occur at a histological level as a body decomposes; specifically, the temperatures at which each of the layers of tissue lyse during this process.

Introduction: The stages of human soft tissue decomposition are universally accepted as autolysis and putrefaction with subsequent macroscopic disfigurement. While the visual signals have been long recognized and appreciated by pathology, the schedule and precise histological deterioration of epidermal, dermal, fat, and muscle tissue have never been quantified let alone qualified. And, even though biochemistry characterizes these events, this study focuses only on structure. This study provides a longitudinal histological validation of the process in order to more accurately design future research regarding soft tissue decomposition.

Materials and Methods: At the outdoor decomposition research facility at The University of Tennessee, eight identical landmarks on six cadavers were biopsied for two weeks following death, and examined with light and electron microscopy for temporal patterning. These sites were the ventral chest (pectoral region), shoulder (deltoid region), ventral upper arm (biceps), ventral forearm (flexors), lateral hip (gluteal), ventral upper leg (rectus femoris), dorsal lower leg (gastrocnemius/soleus), and sole of foot (plantar aponeurosis/flexor digitorum brevis). Each site was biopsied once each day for the 14 day period. Biopsy sites were paraffin sealed, and adjacent puncture sites selected during the decomposition process. Biopsies were prepared by routine formalin-fixed histological methods at The University of Tennessee Medical Center and examined using a Leica ZX900 light microscope and an Olympus XNC environmental scanning electron microscope.

Results: The cell death associated with decomposition more closely resembles the characteristics of clinically documented cell necrosis as opposed to the apoptotic events of programmed cell death. That is, the cells of decomposing tissue go through an expansion and explosion process, which causes a breakdown of the cell membrane resulting in the expulsion of their cytoplasmic contents into the extracellular matrix rather than simply shriveling into a condensed mass and breaking apart as in apoptosis. Each of the layers (epidermis, dermis, lipid and muscle fibre) experience the same type of cell death, although they do not occur in the same temporal period. The loss of muscle fibre structure was observed at 270 degree days.

The epidermis structure was lost at 150 degree days. The dermis cell structure was maintained until 230 degree days. Fat cell structure was last to fail at 450 degree days.

As part of a recent endeavor to understand the cellular aspect of soft tissue decomposition, this study provides validation of the cellular death process that is the hallmark of initial decomposition. Thus, this research provides a baseline for future experimental design.

Time Since Death, Soft Tissue Decomposition, Histology

G75 An Atypical Gunshot Wound With Absence of a Weapon? The Value of a Thorough Scene Investigation

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The goal of this presentation is to increase awareness of zip guns when investigating scenes in which a weapon is not apparent, and to aid in the recognition of the atypical wounds they produce.

This presentation will impact the forensic community and/or humanity by alerting the forensic community to the possible use of a zip gun in likely cases of suicidal gunshot wounds where a weapon is not initially apparent at scene investigation, and an atypical gunshot wound of entrance is present at autopsy.

This presentation will describe the case of a 43-year-old male auto mechanic with depression found dead at work. The body was found on the floor of a washroom stall at the auto body shop where he worked. The deceased had sustained a contact gunshot wound of the forehead, and no weapon was found at the scene during initial investigation. A claw hammer was present in a pool of blood beneath the victim's right arm, and blood spatter was present on the hand and arm.

The deceased's social history strongly suggested that the wound was self-inflicted. Two possibilities were considered; firstly, that the gun had been removed from the scene prior to the investigator's arrival, and secondly, that the case actually represented a homicide.

Autopsy revealed an atypical lacerated contact gunshot wound of the forehead, with a retained medium caliber lead bullet within the posterior scalp. The case was pended for police investigation.

Subsequently, a simple zip-gun fashioned from a piece of pipe, a connector and an air-hose nozzle, along with a pin, was found on the floor at the scene by a co-worker who was cleaning the stall, and the police were notified. On closer examination, a .38 caliber cartridge case was found embedded in the pipe. The conclusion reached was that the deceased had committed suicide using a zip gun constructed from available auto shop parts, and fired the weapon using the hammer found adjacent to him. Due to the nature of the scene and the innocuous appearance of the weapon, the mechanism of the injury and the manner of death were not immediately obvious.

In the United States, zip guns were popular in poor, inner city areas during the 1950s, since they were easy to manufacture from cheap, commonly available materials. Frequently, they were constructed from a piece of wood, a metal barrel such as a car antenna, and a firing pin made from a nail. The simplest zip guns consisted of a piece of metal pipe with a cartridge inserted at one end. To fire the weapon, the protruding cartridge base was struck with a hammer. Because the diameter of the bullet was frequently smaller than that of the unrifled barrel, the bullet would be unstable and tumble upon leaving the barrel. The resulting low velocity and instability of the bullet made zip guns only suitable for short-range use. Today, conventional firearms are less costly and simple to acquire, making zip guns almost obsolete.

Because zip guns are rarely seen, investigators and pathologists may be unfamiliar with their construction and appearance, and the type of wounds they produce.

This case will serve to alert pathologists and investigators to the possible use of a zip gun in likely cases of suicidal gunshot wounds where a weapon is not apparent upon initial inspection of the scene, and an atypical gunshot wound of entrance is present at autopsy.

Zip Guns, Atypical Wounds, Scene Investigation

G76 Suicide or Homicide - The Importance of Forensic Evidence: A Case Study

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Participants will develop a better understanding of the role and the importance of correlating autopsy findings and evidence from scene examination defining the manner of death.

This presentation will impact the forensic community and/or humanity by demonstrating the difficulties in defining a suicide case that may be considered unusual with respect to evidence recovered from the death scene, the background of the deceased, and the connection of the suicide to an earlier murder.

Traditionally, the most common method of committing suicide by women is via drug overdose. Some statistical reports indicate that since the mid 1980s there has been a significant increase in the number of female suicides involving the use of a firearm. The most common wound site reported in such suicides is the head, and the handgun is the most common weapon utilized by women to commit suicide. Investigation of suicides in most instances tends to be straightforward, however there are some suicides which are very problematic. The determination of the cause and manner of death requires proper evaluation of the autopsy findings, in addition to various findings relating to the scene examination. In suicides, the type of weapon used and the existence of a motive or intent are crucial in the reconstruction of events leading to death. The following report describes a suicide case that may be considered unusual with respect to evidence recovered from the death scene, the background of the deceased, and the connection of the suicide to an earlier murder. In the early morning of January 17, 2004, the local police in Bari, Italy were alerted to the death of a 24-year-old female, by a young man who was fully clothed, with the exception of his pants. The young man informed police that he had witnessed a suicide of a woman whose body was located under a local bridge, a short distance from the police station. Inspection of the death scene by police revealed the young woman to be lying on the ground next to the open door of her automobile. The deceased, who was wearing a very broad rimmed hat, exhibited a single gunshot wound to the front of the head. A small handgun was recovered next to the deceased by the police. While being interviewed at the scene, the informant told police that young woman was his secret mistress, and that he had received numerous calls the previous evening from the woman. During the telephone conversations the male informant noted that the young woman was very distraught, and insisted that they meet beneath the bridge. Upon arriving beneath the bridge, the informant approached the woman as she was ranting about their past, at which point she placed a handgun against the top of her head and pulled the trigger. The informant at this point ran to the woman, then held her in a desperate attempt to revive her.

Examination of the car of the deceased by police led to the recovery of a short note which had been written by the woman, and which stated that she wished she could have prevented the murder of her mother. After a short examination of the scene, the police became very suspicious of the informant and arrested him in connection with the death of the woman. Further investigation of the suspect revealed that he had recently received several very expensive gifts from the father of the deceased, who was unaware that the suspect was married. Unknown to the Italian authorities at the time of the suspect's arrest, the German Police had an arrest warrant

out for the young woman and her boyfriend. Two years prior, the deceased and her boyfriend murdered her mother in Germany. The mother had been bludgeoned, then run over with a motor vehicle to make it appear as if the death was an automobile accident.

The crime scene investigation reported that the body of the deceased was located next to the open door of her BMW. She was in a seated position on the pavement, with legs flexed, and her head and shoulders positioned back in the space between the opened door and the driver's seat. Her clothes exhibited no evidence of tears or rearrangement, with the exception of her hat which exhibited a circular defect in the front with traces of blood. Located next to the right hand of the deceased was a Baby – Browning .25 caliber handgun, model 1932. An empty shell casing of the same caliber was recovered from beneath the body of the deceased. The postmotrem condition of the deceased as reported by the medical examiner at the scene noted a core body temperature of approximately 28° Celsius, minimal lividity changes and relatively little evidence of rigor. Inspection of the car revealed many items of value including jewellery, cash, and an airline ticket for a flight to Paris that was scheduled the same day as the death. The autopsy confirmed that the muzzle of the handgun was against the brim of the hat worn by the deceased when it was discharged. Soot, primer residue, and spent gunpowder particles were observed in and around the circular defect site on the hat. Analysis for primer residues were found to be positive on each hand of the victim, in particular on the external metacarpal surface between the first and second digits. A metal jacketed .25 caliber bullet was recovered from within the skull. Considering the cerebral lesions, it was evident that the bullet had passed through the frontal bone and the right frontal lobe, before crossing the midbrain and ending up in the left cerebellar lobe. Toxicological analysis was negative; however, sperm was identified from the anus of the deceased. DNA analysis of the sperm found it not to match the DNA profile of the suspect. Ballistic examination of the recovered bullet and cartridge revealed them to have been fired by the .25 caliber Baby – Browning recovered next to the deceased. One point of debate in the investigation was the possibility of positioning of the handgun by the deceased to commit suicide. The Baby – Browning, model 1932, possesses a three-stage safety system to avoid accidental discharge: it cannot be discharged with the magazine removed, even if a cartridge has been loaded. A manual safety is located on the left side of the weapon, along with a secondary safety which is located on the grip which blocks the trigger except when the pistol is held firmly in the hand, ready for shooting. Latent fingerprints on the handgun were identified as belonging the deceased. The autopsy and ballistic findings strongly supported the notion that the deceased had fired the weapon. A reconstruction of the incident revealed that the woman held the handgun with both hands, with her finger wrapped around the back of the butt, and that she utilized her thumb to depress the trigger. The small amount of gunshot residue detected on the clothing of the suspect boyfriend was attributed to contamination while holding the deceased after the discharge of the weapon. The combined findings of the forensic investigation convinced prosecutors and police to reconsider the manner of death as a suicide. The complete details of this investigation will be presented.

Criminalistics, Handguns, Suicide

G77 Determination of Range of Fire in Skeletal Remains

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After attending this presentation, attendees will better understand a technique that can aid in the determination of range of fire in skeletal remains found with firearm injuries.

This presentation will impact the forensic community and/or humanity by providing a relatively quick and easy method for evaluation of firearm injuries in skeletal remains.

The goal of this presentation is to introduce forensic scientists to a technique that can aid in the determination of range of fire in skeletal remains found with firearm injuries.

Introduction: The scenario is not an uncommon one: a person goes off into a secluded area with the purpose of commiting suicide by shooting themself, and is later found in a decomposed or skeletal state. The presence of a weapon would certainly indicate a suicide; however, circumstances are not always as they appear. Remains can also be scattered and separated from the weapon, and weapons can be separated from the remains due to theft. When remains are decomposed or skeletal, the usual clues to range of fire, soot, and stippling are often lost or obscured. The authors present a technique that can aid in the determination of range of fire in the absence of visible soot.

The sodium rhodizonate staining technique is widely employed in crime laboratories to detect lead residue on clothing. The staining pattern obtained can then be compared to the implicated weapon and ammunition utilized to determine the possible range of fire. This technique employs spraying the garment with sodium rhodizonate, then sequentially over-spraying with buffer and then hydrochloric acid. A pink color with buffer and then blue-purple color with acid is indicative of the presence of lead. This test has been employed on skin; however the authors demonstrate the technique on human and animal skulls.

Materials and Methods: Amputated heads from six previously slaughtered pigs were purchased for this experiment. Three different weapons and ammunition were utilized: a revolver with a non-jacketed bullet, a 9mm semi-automatic pistol with a copper-jacketed bullet, and a shotgun with 00 buckshot. Hard contact shots were fired with the weapon placed between the eyes on the upper portion of the snout. Distant shots were fired from 3 feet with the handguns and approximately 28 feet with the shotgun. The skin from the head was then removed and tested for traces of lead. The skulls were then boiled in water to aid in the removal of the remainder of the soft tissue. Once the soft tissues were removed, the skulls were re-assembled, if necessary, and tested for lead residue. All skulls were examined for visible lead prior to testing with sodium rhodizonate. Color changes were documented and photographed. A test was determined to be positive for lead if the color changed from pink with the buffer to purple-violet with the acid.

Results: The distant gunshot wound from the revolver with the unjacketed bullet showed faint positive staining of the bone around the outer surface of the defect, with no staining on the inside of the skull. Evaluation of the skin revealed a ¼ inch x ¼ inch area of positive staining with a few positive spots 6 inches from the wound. The distant gunshot wound from the semi-automatic weapon revealed no visible residue prior to testing. After testing, a small rim of lead partially encircled the skin wound and there were a few positive spots 4, 5, and 6 inches from the wound edges. There were no traces of lead on the skull. The shotgun inflicted multiple buck shot wounds which tested positive for traces of lead on the skin, but not the skull. All contact range wounds had visible residue on the skin prior to testing, and subsequently had brightly positive staining after testing with sodium rhodizonate. The outer surfaces of the skulls also showed positive staining, however the inner surfaces of the skulls also stained positively. Of note, the brains of the pigs were present at the time of the shooting. This finding was reproduced on two human skulls, one of known contact range and the other of presumed contact range.

Conclusion: Sodium rhodizonate may help determine range of fire in skeletal remains. Lead residue was detected inside the skulls with inflicted contact range firearm injuries, whereas it was only on the surface of the entrance wound, and in small amounts, of the distant wounds. More studies are currently underway to further explore these findings.

Sodium Rhodizonate, Skeletal Remains, Range of Fire

G78 A Modern "Martyr's Crown": A Fatal Case of Multiple Self-Inflicted Nail Gun Shots

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After attending this presentation, attendees will understand an atypical case of multiple nail gun shots in a 62-year-old man. The peculiarity of the case is represented from the surprising sequence of radiological images.

This presentation will impact the forensic community by underlying the role of a correct and complete radiological store in cases of foreign bodies injuries.

The case of a 62-year-old man, who was taken to the emergency room with multiple head wounds, is presented. He complained only of headache, and spontaneously declared that he had shot himself in the head with multiple nails from a nail gun, which he handed over to the physicians. He was conscious, oriented to place and time, and had no focal neurological or cognitive defects. Only the finding of a foreign metallic body on the surface of the scalp in the right temporal region alarmed the physicians, who immediately hospitalized the patient. Radiographs of the head demonstrated seven injuries with foreign metallic bodies inside. This reproduced the typical appearance of the "Martyr's Crown." A CT scan confirmed the presence of multiple nails penetrating the skull in the right (5) and left (2) temporal regions. A subarachnoid hemorrhage was also detected; the ventricular system was unremarkable. Four days after admission, a surgical approach was attempted to pull out nails, six of which were pulled out by cutting the scalp and temporal muscles; the last one, not on the surface, required a craniotomy. The patient awoke one hour after surgery, but his clinical condition rapidly worsened. He became comatose, and died after 10 days of hospitalization.

Few cases of unsuccessful attempted nail gun suicides are reported in literature, fewer cases of successful suicides are described most frequently the head and the left side of chest represent the preferred targets of the body.

Nail guns have been used since the 1950s, designed as a powerful industrial tool to drive nails into various hard surfaces with ease. Recent years have seen an increased diffusion in the domestic environment, too. The ease of use and speed of these tools enhance productivity at the cost of increased potential for traumatic injury. The nail gun fires a single nail or bolt, as projectiles, into wooden or metal surfaces. It could be compared to conventional firearms, being capable of firing projectiles of up to 10 cm into fully stressed concrete at a velocity up to 424 m/sec.

International literature records nail gun related injuries, sometimes lethal, with two categories of forensic interest: industrial accidents and suicide attempts

In conclusion, the case report represents an atypical case of nail gun suicide; highlights the rarity of the event in the literature, and points out the absence of any clinical sign until surgery.

Nail Gun, Successful Suicide, Cerebral Ischaemia

G79 .17 HMR – It's Not Your Father's .22

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The goal of this presentation is to present a case study of a suicide employing a .17 HMR to familiarize the forensics community with this round and potential resulting injuries resultant there from.

Familiarity of the various forensic disciplines with new rounds should impact the forensic community and/or humanity by allowing recognition of same when encountered in a case, a potential significant benefit in cases where o weapon is recovered at the scene.

This case study involves the death of a 27-year-old male who had been involved in a physical altercation with his wife on the morning of his death. The wife exited the residence and, on hearing a gunshot, re-entered to find the decedent with a fatal intra-oral gunshot wound. Recovered from the scene were a box of .17 HMR rounds.

At autopsy, the subject had a ¾ inch stellate contact midline intra-oral gunshot wound with a surrounding 1½ inch area of soot on the roof of the mouth. The shot fractured the floor of the skull and continued to the left parietal brain where the projectile was recovered at the brain surface. Typical subarachnoid hemorrhages and cortical contusions were associated with the wound. Externally, the decedent had an impression on his chest corresponding to a spent .17 HMR casing.

The .17 HMR TNT cartridge is marketed by CCI as a small varmint round with a hollow point tip for "explosive performance." A follow-up, the .17 HMR GamePoint round was introduced in 2004, marketed as a "dimple-tip bullet [which] mushrooms like a big game bullet instead of fragmenting like a varmint bullet. This greatly reduces damage to edible meat!" A comparison of the .17 HMRs with the various CCI .22 cartridges (http://www.cci-ammunition.com/default.asp) shows velocities for the .17 (2375 & 2525 ft/sec) exceeding the .22 magnum (1875 ft/sec) and energy (250 & 241 ft-lbs) approaching the .22 magnum (312 ft-lbs) – see below.

Round	Weight (grains)	Velocity (ft/sec)	Energy (ft-lbs)
.22 short	29	1080	75
.22 long rifle	40	1235	135
.22 magnum	40	1875	312
.17 HMR GamePoint	20	2375	250
.17 HMR TNT	17	2525	241

A potential concern is an attempt (presumably by a novice) to fire such a .17 caliber from a .22 weapon. The .22 magnum may be able to chamber the .17 HMR, however, the 0.05 inch step-down from the casing to the bullet would provide for release of much of the propulsive gases. In theory, this might create problems for the shooter.

In summary, the .17 HMR round has significant velocity and energy. While causing far more damage than a typical .22 caliber round, the tissue destruction is markedly less than that seen with larger calibers.

Conclusion: Familiarity of the various forensic disciplines with new rounds should allow recognition of same when encountered in a case–a potential significant benefit in cases where a weapon is recovered at the scene.

Gunshot Wounds, Suicide, Firearms

G80 A Shot In the Dark? Investigating Accidental Gunshot Wounds

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The goal of this presentation is to provide a general review, using a case study, of proper investigation of lethal gunshot wounds and, in particular, recognition of the importance of scene investigation and firearms function testing in gunshot wound deaths. In addition, attendees will learn that a particular weapon (Tokarev CZ52) has a tendency, when dropped, to accidentally discharge due to a defective hammer drop safety.

This presentation will impact the forensic community and/or humanity by reviewing the overall investigation of a gunshot wound fatality with special attention to scene investigation, firearms examination, and reconstruction to allow for better recognition of manner of death in fatal cases. Proper death classification's societal benefits are obvious, allowing insurance payments to be made or withheld where appropriate, and criminal prosecutions to proceed if indicated.

Most lethal gunshot wounds are suicides or homicides. True accidental gunshot fatalities are rare, particularly when the misnomer of

"hunting accidents" with firearms is excluded. With such a paucity of actual deaths due to accidental gunshot wounds, an almost imperceptible bias against recognition of such cases may develop.

Using the case study of the death of a 39-year-old male National Guardsman, the steps of a thorough case investigation, including scene investigation and reconstruction, are reviewed. Through processing of the scene in the case study, a gouge was recognized on the floor, near the body. This represented the impact point of the hammer mechanism on the floor, indicating that an accidental discharge was a real possibility.

The weapon employed should be examined, if possible, in all firearms deaths, particularly for function testing. In the presented fatality, the weapon employed was a Czech 7.62 mm caliber Tokarev (CZ52) pistol. The manufacturer of the pistol, Century International Arms, has issued a recall warning due to a defective hammer drop safety. Inspected weapons, recognized by a "Z" mark on the left side of the trigger guard, indicate the weapon has been "inspected to ensure proper operation in order to avoid grave bodily injury and/or property damage."

On function testing, the decedent's weapon was found to be functional with a trigger pull of 7 +/- ¼ pounds in single action mode. The holster was soiled with scattered gunpowder particles. Comparison of the flooring from the scene and the gun showed the slide and hammer had indeed caused the gouge. Video recorded re-enactment showed the gun would regularly discharge when dropped in a similar manner.

Using the location of the decedent's wounds in combination with the gouge in the floor at the scene, a reconstruction of the decedent's death proved consistent with the history of the victim having accidentally dropped the gun, resulting in his death.

Forensic pathology is not limited to the physical examination of a body. Utilizing available resources, including firearms examination and scene investigation, the medical examiner's analysis of a fatality is enhanced, hopefully ensuring proper classification of deaths.

Gunshot Wounds, Accident, Safety

G81 Utilization of Automated Fingerprint Identification System (AFIS) to Aid in the Identification of Unknown Perpetrators to Close Unsolved Cases

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The goal of this presentation is to describe the processes and outcomes involved with the implementation and utilization of a fingerprint comparison system between the central district medical examiner's office and the local law enforcement offices.

This presentation will impact the forensic community and/or humanity by helping law enforcement to close out "cold" case files and find persons involved in identity theft. The law enforcement and forensic communities will benefit from matching latent and ten print files to the deceased individuals, knowing that the case files can be closed and the offenders are permanently off the streets.

Hypothesis: Matching the fingerprints of deceased individuals from a specific profile with those in the Automated Fingerprint Identification System (AFIS) database could identify perpetrators who are deceased that may have committed unsolved crimes or have been involved with identity theft.

Introduction: The highest incidence group of perpetrators of violent crime is males aged 15-45. These individuals are also the highest group to undergo medicolegal autopsy. By submission of routine fingerprints of deceased males aged 15-45 into AFIS, two questions may be answered (1) identification of perpetrators in ten print file should be identified as deceased, so that case files can be closed involving these individuals, and (2) some of these individuals have not been previously arrested and do not have a ten print fingerprint file but may be identified in the latent fingerprint files as suspects or perpetrators of crimes. The identification may also potentially uncover perpetrators of identity theft.

Methods and Materials: As a preliminary study, 50 consecutive males aged 15-45 are being fingerprinted as part of the medicolegal autopsy at the Office of the Chief Medical Examiner (OCME) Central District, Richmond, Virginia. The fingerprinting method utilizes fingerprint strips and ink pads. The fingers are cleaned and dried prior to printing. Four fingerprint strips are labeled with the individual's personal identification. Two sets of fingerprints are taken. The fingerprints are then entered into the AFIS database by the fingerprint examiners of the Division of Forensic Sciences (DFS) for a search of the ten print and latent files. The results of the search are reported back to the OCME, and if a match does occur these results will be issued to the submitting law enforcement agency. Fingerprints that are not a match will be archived.

The number of decedents that match with the ten print and latent print files are calculated and assessed for statistical significance with regards to the cost/benefit based on the number of cases closed or solved based on the results of this information. The positive predictive value will be calculated to further define the value of this study.

Fingerprints, Perpetrators, AFIS

G82 Dead Hits: Matching Decedents' DNA to Unsolved Crime Scenes

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The goal of this presentation is to determine the value of comparing DNA samples from decedents to DNA evidence left at unsolved crime scenes.

This presentation will impact the forensic community and/or humanity by providing closure to cold cases, ultimately impacting the family and friends of those who were victims of unsolved crimes. The forensic and law enforcement community would benefit from determining DNA matches or hits from unsolved crime scenes and knowing that the perpetrators of these violent acts are now deceased.

Hypothesis: Submission of DNA samples from cases performed at Office of the Chief Medical Examiner (OCME) Central District, Richmond, Virginia, that meet the demographic profile of persons at risk for societal maladjustment for comparison with biological evidence left at scenes of unsolved crimes will result in the solving and closing of outstanding cases.

Introduction: A large percentage of medical examiner cases represent a high-risk group for societal maladjustment (crime) and for encounters with the legal system as felons. The felon data bank archives the DNA profiles of felons. The Division of Forensic Science (DFS) in Richmond, Virginia, also archives profiles of biologic evidence left at scenes of crimes by unknown perpetrators who are not in the data bank. Some perpetrators of crimes who have left biologic evidence profiled by DFS may die without ever being caught, convicted and entered into the felon data bank or compared with DNA evidence profiles.

A pilot study to establish identities among the three groups would assist law enforcement by: (1) solving and closing some outstanding cases upon identification of a decedent as the perpetrator of a crime where the decedent was not in the data bank but had left biological evidence, and (2) determining whether, in the future, continued comparison of the designated group of decedents would assist the law enforcement community by saving time, money, and record keeping in a futile search for presently unidentified, but now deceased, perpetrators of crime.

Materials and Methods: OCME Central pathologists collect and archive blood spots of all medicolegal cases. From these cases, a subset of 50 consecutive males aged 15 to 45 will be the focus of the pilot study. Prior to submitting samples to the data bank, a list of the individuals will be submitted to the data bank. Data bank staff will check the samples against the listed individuals that already exist in the data bank, and exclude from the study those who match by name. The remaining samples will then be submitted on a specially designed data bank Request for Examination (RFE) form, and will be assigned a unique sample number. The data bank profiles those samples utilizing standard DNA-STR profiling kits and enters the results in a specially created database (index), where they remain for an indefinite period of time for comparison purposes.

DNA profiles from these samples are compared against unidentified profiles obtained from crime scenes. If a match occurs, a certificate of analysis is issued to the submitting law enforcement agency, with a copy to the OCME Central. No certificate of analysis is issued for a search not resulting in a match. Matches or hits are presented to the police to correlate with the investigative information.

Results: The percentage of hits are calculated and assessed statistically for cost/benefit for law enforcement based on the number of cases actually closed/solved as the result of this information. Additionally, the predictive value positive will be calculated to further describe the efficacy of this study.

Conclusion: The major observation would be the establishment of identities or hits in cold cases.

DNA, Decedents, Cold Cases

G83 To Dye or Not to Dye: A Tale of the Blues

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After attending this presentation, attendees will be able to evaluate the reliability of toluidine blue dye application as part of the postmortem genital examination; be able to compare the results from photo-colposcopy at various magnifications vs. photo-colposcopy plus toluidine blue dye application; and be able to better understand the nature and appearance of postmortem anogenital anatomy at various intervals.

This presentation will impact the forensic community and/or humanity by helping to promote consistency and reliability among examiners; improving diagnostic acumen of examiners; and enhancing both antemortem and postmortem investigations and genital examinations.

Living with the Blues: **Richart** (1963) reported the use of 1% toluidine blue in more than 200 women as an in vivo staining method to delineate areas of neoplastic epithelium on the cervix. The intensity of the stain was closely related to the number of nuclei per unit area. **Collins *et al***. (1966) studied 242 patients to determine the efficacy of the dye for outlining neoplastic areas on the vulva. **Lauber and Souma** (1982) utilized the dye as an adjunct in the evaluation of traumatic intercourse. Results were compared between a group of 22 rape victims and 22 controls that had engaged in consensual coitus. Both groups were examined $\leq$ 48 hours. Further investigation of toluidine blue by **McCauley** *et al*. (1987) evaluated the influence of race, parity, age, and other factors in 24 rape victims and 48 controls, all examined within 48 hours.

***Dying with the Blues*:** In 1992, Bays and Lewman described 4 case studies of children, ages 3 months to 4 years, where toluidine blue was used at autopsy to aid in the detection of genital and anal injuries due to child sexual abuse. In 3 of the cases, the dye uptake revealed previously undetected lacerations and a patterned injury due to a foreign object. Use of colposcopy was documented in only one case; magnification was not specified. This autopsy was done 3 days after the disappearance of the child.

When DNA does the Blues: One study, by Hochmeister, Whelan, *et al*. (1997), studied vaginal swabs from women after consensual intercourse. The postcoital swabs were directly exposed to toluidine blue and other destaining agents in order to determine if the dye had an adverse effect on recovery of DNA. Although there was no effect on either PCR or RFLP recovery, the sample size consisted of only 5 women and the collection time was only 6 hours post-coitus.

Rhythm of the Blues: As a general nuclear stain, toluidine blue, when used in vivo, depends on the presence or absence of a nucleated cell population at the exposed surface. Because many current protocols stem from the earlier studies, salient recommendations from those **methodologies** should be considered:

- Richart (1963), described proper decolorization as the most important part of the method. In very mild dysplasia with very small lesions, application of the acetic acid destaining agent in *too liberal* or *too vigorous* a manner might rapidly remove all the stain, even from areas of dysplasia.
- Lauber and Souma (1982) used lubricating jelly to decolorize. Like Richart, they stressed that it was essential to ensure that the tested area was wiped repeatedly with cotton balls until completely dry. They also described the use of finer stroking with a dry cotton tip applicator to differentiate lacerations from dye trapped in crevices.
- In addition to cervical mucous, columnar epithelium, and areas of inflammation, the concomitant presence of 23 categories of benign diseases will cause a **false positive** dye uptake in living subjects (Collins, 1966).
- **Application interval**: a great deal of variability exists in the application of this nuclear stain for documentation of traumatic intercourse in the living. Original studies were done on subjects who were examined within 48 hours. The effects of wound healing on dye application have not been studied. Programs that employ toluidine blue during extended intervals after reported sexual assault must consider the possibility of false positive dye uptake in areas of granulation tissue.
- Lauber and Souma recommended application of the dye **before** speculum insertion to avoid the possibility of findings due to iatrogenic trauma and to circumvent the known spermicidal effect of the dye in vitro. However, they also recommended procuring a *hanging drop vaginal specimen*, prior to application of the dye, in order to compare with a subsequent sample. Recent protocols do not recommend this step.
- Programs that use this nuclear stain vary significantly in their methodology, i.e., **timing** of dye application *before* or *after* speculum insertion. The Office of Criminal Justice Planning (OCJP) protocol in California recommends dye application at the *conclusion* of biological evidence collection.
- Early studies were done before colposcopy with magnified photographs was incorporated into sexual assault examinations**. Slaughter, Brown, Crowley, and Peck** (1997) saw no injuries with toluidine blue that were not already seen via colposcopy. However, 15X magnification was routinely used for inspection and photographs. Visualization at lesser magnifications may not allow the same level of scrutiny of the anogenital tissues. Photos taken *prior* to speculum insertion can establish the presence or absence of pre-existing injury. Likewise, when and if iatrogenic injury occurs, it can be documented as such.
- Subtle findings are an examiner issue. Follow-up exams are needed to understand those findings that may mimic trauma *and* to appreciate changes that occur with healing (Slaughter, personal communication).
- Antemortem use of the **victim as his/her own control**: when patients who present with acute genital injury are brought back for a follow-up examination, the resolution of injury and course of healing can be documented. For the rape-homicide victim, comparisons are best drawn from a baseline group of cases where the cause of death has a non-sexual etiology.

- **Postmortem artifact**: in addition to all of the conditions that affect dye uptake in the living, factors such as skin slip, mucosal autolysis, blood, and other secretions, may cause a false positive uptake during the postmortem interval.

Further study is needed to assess the efficacy and reliability of this nuclear stain as an adjunct to the postmortem genital examination. A prospective study of postmortem cases drawn from various causes of death will allow a comparison of toluidine blue and colposcopy. This subgroup will be part of a larger baseline study on the nature and appearance of the anogenital tissues at various postmortem intervals. When the understanding of what is normal and what is not in the postmortem interval is improved, the application of any staining adjuncts may then enhance, for pictorial purposes, what is already known to be present.

Colposcopy, Toluidine Blue Dye, Postmortem Genital Examinations

G84 Postmortem Monocular Indirect Ophthalmoscopy

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After attending this presentation, attendees will become aware of how to perform postmortem indirect ophthalmoscopy and how it differs from direct ophthalmoscopy.

This presentation will impact the forensic community and/or humanity by describing an efficient, low cost method to examine the posterior retina following death that permits a wide field of view compared with direct ophthalmoscopy.

Postmortem fundal examination can be conducted with a hand held direct ophthalmoscope, head mounted binocular indirect ophthalmoscope or by monocular indirect ophthalmoscopy. The direct ophthalmoscope provides a detailed monocular retinal inspection with high magnification (15x for an emmetrope, less in hyperopia and more in myopia), but a small field of view (6.5 - 10?). Unfortunately, postmortem corneal changes can make fundal examination less than optimal with the direct ophthalmoscope. Binocular indirect ophthalmoscopy, a technique for evaluating the entire ocular fundus, provides a stereoscopic, low magnification, wide-angle, moderate to high resolution view of the retina. However, the binocular indirect ophthalmoscope is moderately expensive and requires some training to properly use.

Monocular indirect ophthalmoscopy is performed using a bright focal light source (penlight, Finhoff transilluminator, headlamp, otorhinolaryngology headlight or light source from direct ophthalmoscope) and a high plus condensing lens. The decedent's eyelid is held open with an eyelid speculum while glycerin or an ophthalmic irrigating solution is used to keep the cornea moist during the examination. After dimming the room lights, the light source is positioned against the examiner's lateral canthus/cheek or between the examiner's eyes. The light source must be directed through the pupil to illuminate the fundus. The image of the retina is then projected out of the eye, and in an emmetropic eye with no refractive error the image of the fundus will be formed at infinity. An aspheric condensing lens is held between the thumb and index finger then placed in front of the eye, thus focusing the retinal image in front of the observer. Initially the condensing lens is held to one side of the decedent's eye until the pupillary red reflex is established and moved between the eye and the examiner (initially about 1-2 cm from the decedent's eye) and then slowly pulled towards the examiner and away from the decedent's eye until the image of the fundus fills the lens, usually about 3–5 cm or equivalent to the focal distance of the lens. Alignment of the condensing lens is critical. It must be held parallel with the plane of the iris, with the flat surface of the lens facing the decedent's eye (position the surface rim of the lens with a silver ring towards the decedent's eye). The condensing lens must be centered in-line and perpendicular to the axis from the examiner's pupil to the decedent's pupil. Resting the examiner's little finger on the decedent's forehead is helpful as it helps stabilize the lens. The real inverted, laterally reversed image is less magnified than that of a direct ophthalmoscope, but the field of view is much larger.

Indirect ophthalmoscopy permits viewing of the posterior fundus and equator even if there is less than perfect anterior segment media; however, postmortem corneal clouding may cause the fundus to appear hazy. A disadvantage of the technique, as with conventional direct ophthalmoscopy, is the lack of a stereoscopic view; however, stereopsis can be achieved but this depends on the condensing lens, viewing distance, and interpupillary distance of the examiner. This technique is about as difficult as direct ophthalmoscopy to learn. Presently available aspheric lenses range from +14 to +40 diopters and come in different diameters. Lower power lenses provide higher magnification but offer a smaller field of view and must be held farther from the decedent's eye, making positioning of the lens less steady. Further investigation is needed to identify techniques that mitigate postmortem corneal clouding.

Postmortem Indirect Ophthalmoscopy, Direct Ophthalmoscopy, Ocular Fundus

G85 Multislice Computed Tomography In Forensic Pathology

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Imaging in forensic pathology has been known for more than one hundred years, but used very little and only in selected cases such as shootings and battered child syndrome, in which cases traditional x-ray technique has been applied. The goal of this presentation is to introduce routine multislice computed tomography (CT) in forensic pathology.

This presentation will impact the forensic community and/or humanity by demonstrating how computed tomography can be a useful tool as a standard examination before autopsies.

The material consists of more than 1,000 consecutive cases which, before traditional postmortem examinations, were scanned in a CT-scanner (Siemens Somatom Plus4Exp). The results were compared with the results of the autopsies. The examiner records the results of the scanning and provides the description and the pictures to the autopsy pathologist, who then records his results.

All data are stored in optical discs or CD-ROM, and relevant expositions are developed and generated in 3-D images. The scanning procedure is very short – a few minutes – but the generation of the pictures takes approximately 20-40 minutes per case.

The preliminary evaluation shows that the method is especially valuable to demonstrate foreign bodies such as bullets and artificial joints etc., fractures of the skeleton and larynx, and also intracranial hemorrhages and hemorrhages from rupture of large vessels such ruptured aneurysms of the aorta. In some cases, radiographic calcification of the coronaries is so marked that it suggests the cause of death to be coronary insufficiency.

In the authors' opinion, the new method has come to stay in forensic pathology – in the future combined with MR-scanning which covers the soft tissue examination better. Since the method is non-invasive it is more in accordance with the increasing resistance to classic postmortem examinations.

The new non-invasive technique may also appeal to the hospital pathologist, due to the fact that when it has become routine the technique can replace many postmortem examinations in hospitals.

Computed Tomography, Virtopsy, CT-Scanning

G86 Murder in the Ancient Castle: A XIV Century Warrior Virtual Autopsy

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The goal of this presentation is to present a unique case of the discovery of human skeleton remains of a XIV century "warrior"murdered by a crossbow arrow found in the cervical spine. A virtual autopsy ("virtopsy") was conducted with multislice Computed Tomography (MSCT) and X ray. The results of radiocarbon dating are also presented.

"There was a time, in a Tuscan castle, a brave knight valiantly died fighting a battle to defend the fortress: This is his story." Thus could begin this exceptional report concerning a discovery in a medieval castle. A medieval murder by a crossbow is presented. In February of 2004, during restructuring of a medieval castle in a Tuscan country, a burial was discovered. The burial was found at the base of an ancient keep in the highest side of the hill where the castle was built within a rectangular room. This room was more recently used for animal shelter.

The burial was placed in a pit dug in barren clay, and contained easily recognizable human skeletal remains in supine position with the arms bent on the chest and the head protected by two larges stones.

These skeletal remains constituted a primary sepulture in full space. The skeleton appeared completely preserved in each part. Anthropological examination confirmed that the remains belonged to a 30-40-year-old male with a stature of about 170 cm. The anterior surface of the left maxilla had a round bone defect with clean-cut outline, 22.10 x 14.65 mm. The alveolar processes of the left maxilla had a round bone defect with an irregular outline involving the second incisor, canine and first premolar, 17.88 x 10.64 mm galley dart stile was thrust between the second and the third cervical vertebrae. A complete x–ray study of the skeleton and an image - guided virtual autopsy with multislice computed tomography (MSCT) were made to analyse the correlation between radiologic images, anthropologic data and macroscopic findings

The x-ray study has confirmed the presence of the dart, classified as a "verrettone," a kind of XIV century dart.

The 3-D reconstruction analysis of the maxillary alveolar wound demonstrated the traumatic origin due to the dart entrance wound. The MSCT was able to analyze and reconstruct the internal dart trajectory. The dart penetrated the spinal cord causing an instantaneous death due to a complete section of medulla oblongata.

No other traumatic lesions were found.

The radiocarbon test (database used: INTC AL 98) was performed to date the remains. It confirmed them as being from the XIV century.

In conclusion, the case reported represents a unique case of human skeletal remains from a XIV century homicide, killed by a crossbow arrow in the cervical spine. A complete study with modern techniques has been performed, using CT scan and x-ray imaging, DNA analysis and Carbon 14 examination to date remains.

Crossbow Homicide, Radiocarbon Test, Multi-slice Computed Tomography (MSCT)

G87 19th Century Autopsy Techniques: Failing to Meet 21st Century Forensic Science Needs

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After attending this presentation, attendees will be familiar with diagnostic medical procedures applicable to death investigation in lieu of an autopsy.

This presentation will impact the forensic community and/or humanity by refining the autopsy selection criteria, which will allow greater opportunity for use of advanced clinical techniques and achieve a higher quality of report for use in adjudicated cases.

The autopsy hit its heyday in the 1880s due to the European masters like Rene Laennec, Rudolf Virchow, and Ambroise August Tardieu to name a few. Subsequent improvements to the autopsy include use of Roentgen's x-ray device, photography replacing artwork, and increased utilization of laboratory studies including microbiology and immunology. In contrast, some technologies, notably histology, have fallen into decline at many forensic facilities. Currently, Jurgen Ludwig's multiple editions on autopsy practices are the most modern compendium of pathology techniques derived purely for the purposes of demonstration and diagnosis. Yet the traditional autopsy still relies upon narrative styles little changed over the years, with the exception that comparing lesions to articles of food has been replaced by standard nomenclature and metrics. The pictorial style of autopsy reporting has been very difficult to incorporate, despite the truth of a picture being worth a thousand words. Pre-printed diagrams marked with short annotations are used by some and in this digital age, many photographs are still made using film technology, despite the instant feedback and proven advantages of digital imaging.

A wide variety of disciplines are incorporated at the autopsy table [anthropology, bloodstain pattern interpretation, trace evidence, and clinicians] to provide focal expertise ensuring no stone goes unturned. Expectations of the pathologists include being a physician with clinical skills. Pathologists should be adept at crime scenes, and clinical physical exams including the ability to read a 12-lead ECG, x-rays and other diagnostic images. They also need to be conversant with surgeons regarding resuscitation and surgical decision making. It is beneficial to remain current with the latest pharmaceuticals. The majority of continuing education, journals read and textbooks procured are of a clinical nature, from family practice to the surgicalandmedical specialties, pediatrics and OB/GYN. Significant additions to autopsy protocols include the following:

- Invasive angiographic studies
- Advanced x-ray protocols for child deaths following AAP guidelines
- Bronchoscopy and endoscopy
- Intra-peritoneal lavage
- Epiluminescence
- Supra-vital staining
- Cardiac conduction dissections
- Cytology of fluids, fine needle aspirates and touch preps
- Needle biopsy for tissue culture
- Needle biopsy for gross and/or histologic diagnosis
- *In situ* retinal evaluation
- Retinal recovery and histologic evaluation
- Histologic dating of wounds
- Histologic evaluation of wounds for foreign materials
- Evaluation/interpretation of bloodstain patterns on victims and clothing

- Excision and retention of bone fractures for fractural analysis and toolmarks
- Soft tissue and osseous burn pattern interpretation
- Digital narrative/pictorial public record autopsy protocol
- Privileged pictorial autopsy protocol
- Review by cultural anthropology

In the practice of pathology, the traditional autopsy tis a quaint expression of the best technology the 1880s had to offer. As with today's medicine, the practice of forensics has far more tools in its toolbox now than in the 19th century, mainly borrowed from clinical brethren. By using those tools and refining examinations with diagnostic procedures adopted from clinical colleagues, the percentage of persons needing autopsy to attain diagnosis has paralleled hospital autopsy experience and fallen to 14%. Because the new procedures with fewer autopsies save time, those most in need of autopsy; primarily homicides, child deaths and those too young to die, receive an Engineering Investigation quality autopsy averaging 12 hours of physician time per case. Thus, those cases requiring the highest standards of proof receive the greatest effort with the latest technology and the best reporting format.

Autopsy, Forensics, Pathology

G88 Diesel Fumes Do Kill: A Case of Fatal Carbon Monoxide Poisoning Directly Attributed to Diesel Fuel Exhaust

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The goal of this presentation is to present a novel case of fatal carbon monoxide (CO) poisoning directly attributable to diesel fuel exhaust, a previously unreported and perhaps under-recognized source of CO.

This presentation will impact the forensic community and/or humanity by reporting to the forensic community an under-recognized and potentially fatal source of CO poisoning. Exhausts emitted from diesel fuel, although possessing lower levels of CO than exhaust from gasoline fuel, are nevertheless a conceivably dangerous source of CO. Through this three-part research project prompted by this single case, the authors aim to promote further awareness that CO intoxication can occur from inhalation of diesel exhausts, similar to open-air intoxication and, most importantly, to emphasize that it is preventable.

This presentation will fully examine a case of CO poisoning brought to autopsy as a possible work-related natural death in Louisville, Kentucky. The death was initially considered to be caused from complications of ischemic heart disease (IHD), pending toxicological analysis that included a CO level. The CO was ordered at the time of autopsy because the victim was found in the secure cab of a running diesel engine semi-trailer truck at a rest stop. When the toxicology results showed high levels of blood carboxyhemoglobin, the death was recertified as CO intoxication secondary to inhalation of [diesel] vehicular exhaust fumes. This case will illustrate how diesel fuel can potentially serve as a source of CO in fatal and nonfatal poisonings.

Often called the "*silent killer*," CO is the most common fatal poisoning in the United States, claiming 1,000 - 3,500 lives every year. Although suicides constitute the majority of fatalities in CO poisoning, accidents account for approximately 30% of annual deaths. CO is produced by the incomplete combustion of organic material, and high concentrations can rapidly accumulate under many different scenarios. The most common sources of fatal CO intoxication are from inhaled fumes in fires or motor vehicle emissions. Typical accidental poisonings usually involve unsuspected increased CO levels in enclosed environments, which can include secured motor vehicles, closed residential or parking garages, car washes, homes, and even tents. Open air CO intoxication is a well-known potential hazard in boating-related activities. CO poisoning has been notoriously attributed to the inhalation of fumes emitted from the gasoline powered motor vehicular exhaust when personal-use automobiles were involved, even when the engine possessed a catalytic converter. In the U.S., a very small fraction of personal automobiles have a diesel engine. While it is known that diesel fuel combustion engines produce much lower levels of CO than gasoline engines, these CO emissions could certainly rise to lethal levels given a sufficient amount of time in an enclosed space and under suitable environmental conditions.

The case involves a moderately decomposed 52-year-old male truck driver found prone between the sleeper and driver compartments of a secure tractor trailer truck. The initial cause of death attributed to IHD was amended after the toxicology results from the Kentucky Office of Forensic Toxicology (OFT) showed a blood carboxyhemoglobin saturation of 67% by differential spectrophotometry. The amended cause of death was attributed to CO intoxication sustained from inhalation of motor vehicular exhaust. IHD was considered a significant factor contributing to his death.

Because of the unique source of fatal CO intoxication in this case, the contributory IHD, and the possible contaminants in the putrefied blood, a 10 year retrospective review was conducted of all non-fire related CO deaths autopsied at the Office of the Chief Medical Examiner in Louisville, KY from 1994-2003. The review compared this case to gross autopsy and toxicological findings and scene investigation of 116 postmortem cases. Specifically examined were severity of heart disease, degree of postmortem decomposition, and evidence of cherry red skin discoloration present at autopsy and scene description. In addition, for confirmation of the validity of the carboxyhemoglobin detection method used by the Kentucky OFT, blood samples from cases representing varying degrees of decomposition along with controls were submitted to two different commercial laboratories and one federal laboratory. The carboxyhemoglobin concentrations were measured using three different laboratory methods. The results from the commercial and federal laboratories were compared to the Kentucky OFT results and were found to show no statistically significant differences in measured carboxyhemoglobin concentration. Lastly, an extensive literature search and personal communication yielded no reported cases of fatal CO poisoning, accidental or suicidal, attributed to diesel fuel exhaust.

Carbon Monoxide, Diesel Fuel, Poisoning

G89 Sublingual Tablet Thwarts Opioid Addiction

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The goal of this presentation is to offer information regarding a new tablet, buprenorphine, which when dissolved under the tongue (sublingual) prevents opiate/opioid withdrawal, craving and continued addiction, and reduces co-morbid diseases, crime, and healthcare costs.

This presentation will impact the medical, legal, and forensic community, and/or humanity by demonstrating a high degree of positive outcome results of maintained sobriety in its first year of use by motivated patients and private physicians utilizing buprenorphine.

The Center for Substance Abuse Treatment (CSAT) and The Substance Abuse and Mental Health Services Administration (SAMHSA), divisions of the U.S. Department of Health and Human Services (USHHS), have recognized that approximately 980,000 people in the U.S. are addicted to opioids while only 205%, 180,000, are treated. This innovative treatment allows the physician to prescribe this drug in the private office setting and is called Office Based Opioid Treatment (OBOT).

Opiates (morphine and codeine) and semi-synthetic and synthetic opioids (heroin, oxycodone, hydromorphone, hydrocodone, methadone, fentanyl) are abused by oral ingestion, nasal insufflation, transmucosal absorption (oral, nasal, rectal and vaginal) and injection. The amount of transmitted diseases from substance abuse, i.e., hepatitis, HIV and sexually transmitted diseases significantly elevate the cost of medical treatment and crime. The chemo-therapeutical drug for the past 32 years to detoxify from opioids and maintain sobriety has been methadone. Methadone itself is addicting, but enables the addict to live in society, maintain employment, and remain healthy and productive. However, the addicted patients with the primary, chronic, recurrent, neurobiological disorder of the brain (definition of addiction by the National Institute of Drug Abuse) must be treated daily by reporting to federal and state licensed narcotic treatment programs (NTP) each morning for their dose of methadone. This is time consuming and frequently reduces employability and disrupts the family homeostasis.

Buprenorphine is an agonist-antagonist opioid that is used as an analgesic in small doses by injection but stops opioid craving when given in high strengths as a sublingual tablet. The Drug Abuse Treatment Act of 2000 opened pathways for qualified physicians to prescribe a 30 day supply to patients from their offices and filled at pharmacies. This enables the addicted patient to receive treatment while making them more employable, able to leave welfare subsidies, provides social acceptability, enhances mentally and physical health, family acceptability and responsibility.

Two forms of the drug, manufactured under the names of Subutex® and Suboxone®, have been available since January 2003. The former, pure buprenorphine, induces the drug to a stable maintenance dose. The patient is then switched to the latter drug that is combined with a pure opioid antagonist, naloxone. If a patient tries to pulverize, solubilize, and inject it, the patient will experience rapid withdrawal symptoms.

The overall purpose is to educate and train physicians to treat addiction on the front line of medical practice by the family physician, internist or psychiatrist and thereby treat larger numbers of addicts not currently in treatment and involved in criminal events to support their addiction.

The physician must have a minimum of eight hours of training by government (CSAT) approved addiction specialty organizations.

To date, the reports of buprenorphine's use indicate it is well tolerated and well accepted. Patients can find certified physicians on a physician locator web-site. The benefits of these new drugs are to invite untreated addicts into a less formidable type healing program that eliminates the necessity of reporting to a NTP each morning and raises self-esteem. Since approximately 70% - 80% of inmates in the penal institutions are charged with committing a crime directly or indirectly related to drug abuse or the disease of addiction, it becomes more cost effective to build better lives rather than bigger prisons.

Subutex®, Suboxone®, OBOT

G90 An Analysis of 35 Ethylene Glycol Fatalities in Cook County, Illinois From 1993 Through 2003

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After attending this presentation the participant will understand that suicide is the most common manner of death from ethylene glycol intoxication in Cook County, Illinois, followed by accident, and rarely undetermined; understand the common death investigation circumstances surrounding death from ethylene glycol intoxication; and understand that toxicology values, although important in determining the cause of death, cannot replace a thorough death investigation when determining manner of death.

This presentation will impact the forensic community and/or humanity by providing realization that homicidal ethylene glycol intoxication is very rare, with suicidal ingestion by far the most common manner of death. Although homicidal poisoning is possible, the determination of the manner of death by the medical examiner or forensic pathologist should rely on the circumstances of the death after a thorough investigation, and not based on toxicology values alone, which overlap with accidental and intentional ingestions.

Introduction: A cluster of alleged and convicted homicidal ethylene glycol poisoning deaths has recently been reported in the media. In light of these reports, the authors sought to retrospectively review the experience of the Cook County Medical Examiner's Office investigating deaths occurring from ethylene glycol intoxication in an 11 year period from 1993 through 2003.

Background: Ethylene glycol is a relatively inexpensive and easily obtainable liquid used predominately as an antifreeze-antiboil additive in motor vehicles, but is also found in detergents, paints, cosmetics, and deicing products. It has a sweet taste, and is odorless and colorless, but commonly has fluorescent green or yellow dye added. It is an intoxicant with properties similar to ethanol when ingested, and is occasionally used as a substitute for ethanol when ethanol is not available. Several hours after ingestion, toxic effects of nausea, vomiting, convulsions, stupor, and coma can develop. Death usually occurs 24 to 48 hours later depending on the amount ingested, but can be delayed with medical intervention, as ethylene glycol causes metabolic acidosis, hyperosmolality, and tissue injury through its toxic metabolites.

Results and Analysis: During this 11 year period, 35 cases of fatal ethylene glycol intoxication were found in the Medical Examiner's Office computerized database. Retrospective analysis included review of the investigation and circumstances of the death; reports of follow-up investigations, including family interviews, autopsy reports, toxicology results; and any ancillary testing results. Temporally, one case occurred in 1993, no cases in 1994 or 1995, seven cases in 1996, eight cases in 1997, two in 1998, four in 1999, one in 2000, two in 2001, four in 2002, and six in 2003. Deaths were highest in October, April, and August, with only December having none. The average age was 43 years for both sexes, with a range of 25 to 73 years. There were 27 males and 8 females (ratio of 3.4 to 1). Twenty-eight were white and seven were black.

Manner of death was determined for the 35 deaths: 29 were suicides, 4 accidental, and 1 undetermined. There were no homicides. Of the suicidal determinations, ten left suicide notes or phone messages of intent. The four accidental determinations were related to chronic alcoholism and use of ethylene glycol as a substitute intoxicant. The one undetermined case could not be resolved between suicide and accident in a setting of chronic alcoholism and depression. Of the 29 suicide determinations, 14 had history of clinical depression, three had psychiatric diagnoses, and ten were going through a breakup in a long-standing relationship. Twenty-one had either commercial containers or cups of antifreeze at the scene. In examining where death or collapse from intoxication occurred, 28 were at their own home or apartment, 1 at work, 2 at their neighbor's home, 3 in motels, and one in a large department store. Of these 28 found at home, 11 were found in their bedroom, 4 in the basement, 1 in the kitchen, 1 inside a cabinet, 2 in the bathroom, and 7 had no specific location within the home noted.

Autopsy findings were nonspecific and consistent with drug ingestion with pulmonary and cerebral edema. Calcium oxalate crystals were found in renal tubules if death was not significantly delayed by treatment.

Ethylene glycol toxicology analysis was divided into three study groups: (1) those pronounced dead at the scene with postmortem analysis; (2) those found still alive and admitted to the hospital for a short period of time with postmortem toxicology; (3) those found still alive and admitted to the hospital, but subsequently died with antemortem hospital toxicology analysis only. There were 15 victims in the first group dead at the scene. The average blood ethylene glycol concentration on postmortem toxicology testing was 264 mg/dl (range 0 to 849 mg/dl). Average urine concentration was 1028 mg/dl (range 151 to 2193 mg/dl). The average ratio of blood to urine compared in individual cases was 0.31 (range 0.12

to 0.50). The manner of death for all members of this first group dead at the scene was suicide.

The second group was found alive and admitted to the hospital, but died after a short period of time, usually in the emergency room, and underwent autopsy with postmortem toxicology testing. All had metabolic acidosis and hyperosmolality while alive. Examples include two victims who both lived nine hours in the ER after a prior ingestion at unknown time. One had ethylene glycol in the blood of 626 mg/dl, bile 529 mg/dl, and vitreous 716 mg/dl. The second victim had ethylene glycol in the blood of 1141 mg/dl, bile 1134 mg/dl, and urine 561 mg/dl. In these two cases, bile seemed to parallel blood levels.

The third group was found alive and admitted to the hospital, but subsequently died, some after a long hospital course. This group tended to have large variable antemortem blood levels depending when testing was performed during the hospital course. The range of initial ethylene glycol in the blood was 143 to 864 mg/dl. All had documented metabolic acidosis and hyperosmolality, and all progressed to coma and death. Serial determinations of ethylene glycol blood levels were performed in many of the patients in this group and showed variable ethylene glycol metabolism rates. The half-life of ethylene glycol appeared to be less than 12 hours in this group where serial hospital blood measurements were taken.

Conclusion: In spite of the recent cluster of alleged and convicted ethylene glycol homicides reported in the media, none have been found in Cook County, Illinois, within the past 11 years. The majority of the Cook County deaths were from suicidal ingestion, with a few accidents in people using it as a substitute for alcohol. The results are similar to a prior reported cluster of non-fatal intentional ethylene glycol intoxications in Northeastern Illinois in 1996.[1] Toxicology values of ethylene glycol should not be used as a substitute for a thorough death investigation in determining manner of death.

[1] Leikin JB, Toerne T, Burda A, *et al*. Summertime cluster of intentional ethylene glycol ingestions. *JAMA*, Nov 5, 1997-vol 278, No. 17, p 1406.

Ethylene Glycol, Manner of Death, Toxicology

G91 Patterns of Illicit Drug Use of Prisoners in Police Custody in London, United Kingdom

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After attending this presentation, attendees will gain an understanding of the types of illicit drug use seen in prisoners in police custody in the U.K., and the characteristics of such drugs users.

This presentation will impact the forensic community and/or humanity by allowing understanding of the needs of the drug users and the need for forensic physicians to have a broad general medical background, and thus assisting in determining the type of training needed by forensic physicians to manage such patients in the police setting.

Various national and local strategies have been formulated and implemented directed at reducing illicit drug use, and crime associated with such drug use, in England & Wales. A number of these strategies directly involve police (including drug arrest referral workers in all police stations, drug testing for trigger offenses, needle exchange schemes), and thus directly or indirectly, forensic physicians.

Aims and Methods: Studies undertaken in 1992 identified the proportion of drugs users seen as part of the forensic physician workload and explored the characteristics of such drug users seen in police custody. The aim of the current study was to identify changes that have taken place in the last decade comparing the number and characteristics of drug users seen in police custody. A prospective, anonymised, structured questionnaire survey was undertaken of consecutive, self-admitted illicit drug users seen by forensic physicians in police custody within the Metropolitan Police Service in London, U.K.

Results: In a separate study 30% of detainees seen had dependence on heroin or crack cocaine (1992 – 11%). 113 drug users were studied in 2003. 95.4% gave their consent to participate in the study and complete the questionnaire. Of those consenting, 82% were male, 18% female. Mean age was 28.5y (range 18-49). 80% were unemployed; 29% had no fixed address (1992 – 10%); 65% were Caucasian (1992 – 85%); 18% were Bangladeshi (1992 – 4%). Significant mental health issues (e.g., schizophrenia) were present in 18%; 15% had significant alcohol use; 23% were married or had long term partners; 56% of partners/spouses used drugs. Heroin remains the most frequently used drug – in 93% of cases (1992 – 77%); crack cocaine was used by 87% (1992 –30%); mean daily cost – heroin GBP 76 (range 20-240), crack GBP 81 (range 20-300). More than 50% of users inject crack and heroin simultaneously. 56% used the intravenous route (1992 – 72%); 25% had shared needles at least once (1992- 41.6%); 100% had accessible sources of clean needles; 6.4% were hepatitis B positive (1992 – 25.7%); 42% were aware of hepatitis prophylaxis (1992 – 9.7%); hepatis C positive – 20.2% (not recorded in 1992); 3.6% were HIV positive. The mean total length of time of drug use was 7.5y (range 1 month – 20 years); 82% had served a previous prison sentence; 73% of prison sentences were drug-related (drug-defined – 21%, drug-inspired – 74%); 54% had used drugs in prison (1992- 82%); 11% had used needles in prison (1992- 30%); 3% of users stated they had started using in prison. 38% had been on some form of rehabilitation programs previously; 11% had been on Drug Treatment & Testing Orders (DTTO); 5.5% were currently on DTTOs at assessment; 32% had used the services of Drug Arrest Referral Teams in police stations; 10% were in contact with Drug Teams at the time of assessment.

Summary and Conclusions: National drug reduction strategies appear to have had little beneficial influence on patterns of drug use of the population seen in police custody. In the last decade there appears to be a substantial increase in the prevalence of drug use – particularly of crack cocaine. Treatment interventions are either not available, not followed through or not needed. In very general terms, the illicit drug use problem appears to have significantly worsened in the population seen in police custody, although there is evidence that suggests that within this population health education and harm reduction messages appear to have had some positive effects.

Drugs, Police Custody, Forensic Physicians

G92 Child Homicides in Hong Kong: A Retrospective Review of a Ten-Year Period From 1989-1998

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After attending this presentation, attendees will understand the characteristics of child homicide in a predominantly Chinese population and thus be able to compare and contrast with characteristics in their own population.

This presentation will impact the forensic community and/or humanity by providing rare data on child homicide in a predominantly Chinese culture. It also represents a systematic review of all child homicides for all of Hong Kong in a ten year period. It shows similarities with other published material but will also highlight differences which may be cultural in nature.

This paper presents the findings of a retrospective review of all child homicide cases seen in Hong Kong in a ten-year period between 1989 and 1998. In this period there were a total of 799 homicide incidents, with 948 victims and 1666 offenders. Children younger than 4 accounted for 7.3% of victims (n = 69) and between ages 10-15, 8.8% of victims (n = 83). However, there was a much lower homicide rate between ages 5 and 10, accounting for only 2% (n = 19) of all homicide victims. These results are consistent with previous statistics that child homicide had a bimodal pattern, peaking in 'very early childhood' and 'late adolescence' (Christoffel)[1]

Victim-offender relationships, causes of death and manner of death will also be discussed.

[i] Christoffel, K.K. (1984). Homicide in childhood: A public health problem in need of attention. *American Journal of Public Health*, 74(1), 68-70.

Child Homicide, Hong Kong, Retrospective Review

G93 Evolution of the Intentional Injury Infant Syndrome in Northern France

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In northern France, child abuse represents a daily preoccupation in forensic medicine. The goal of this presentation is to retrospectively study infants hospitalized for subdural hematoma and examined in the forensic department for suspicion of child abuse.

This presentation will impact the forensic community and/or humanity by showing the importance of child abuse and Intentional Injury Infant Syndrome (IIIS) in northern France.

Patients and Methods: During a 36 month period (January, 1999, to December, 2001), 39 infants aged 1 month to 2 years, hospitalized for subdural hematoma, were examined or autopsied (eight cases). Clinical and paraclinical information was collected.

Results: Intracranial hematoma: 22 subdural hematomas were bilateral, 5 were interhemispheric and 12 were unilateral. Five infants had evidence of different ages of intracranial hematomas and 7 had chronic subdural hematomas. Some infants had associated skull fractures. Severe cerebral edema was present in 8 cases.

Ophtalmoscopic findings: 33/39 cases had abnormal ophtalmoscopic findings. Eighteen cases had retinal hemorrages. Some cases were associated with retinoschisis (3), with other ocular haemorrages (2), and/or with papilledema (3). Retinal haemorrages were absent in six cases.

General examination: 25/39 had evidence of child abuse including bruises (12 cases), soft-tissues injuries (5 cases), rib fractures (6 cases), long bone fractures (2 cases), burns (1 case), bilateral testis injury (1 case), severe denutrition with growth and psychomotor retardation (6 cases).

Risk factors: 19 cases had antecedent evidence of child abuse or neglect in their family. Eighteen were first born and the only child. Thirteen infants had previously been abused; in 1 case, the mother was young (less than 18) and in another one she was psychotic.

Facts: In 11 cases, related facts were a history of shaken baby syndrome; in 8 other cases, the history was not correlated with the observed injuries. In 18 cases, injury mechanism was not explained by the caregivers. In two cases, the caregivers have affirmed that they played with their children.

Neuroimaging: In 27 cases, MRI was performed and was abnormal in all cases. They were compared with results obtained in CT imaging, and standard radiography.

Discussion and Conclusion: Only 33/39 subdural hematomas were associated with retinal hemorrages and determined the classical description of "the shaken baby syndrome." The absence of a traumatic history or a history not correlated with the clinical signs is a major element for the diagnosis and is highly suggestive of child abuse. Associated injuries observed in 50% cases are also pertinent arguments. The use and the utility of neuroimaging to determine the time of the lesions and their origin is very important and discussed. A specific prevention of the IIIS should be developed in France.

IIIS, Child Abue, Clinical Forensics

G94 Breath Holding Spells Associated With Unexpected Sudden Childhood Death

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After attending this presentation, attendees will be able to recognize a medical condition that may account for sudden death in childhood (greater than 12 months old).

Breath holding spells (BHS) have traditionally been thought to be benign–"something that the patient will outgrow." However, clinical monitoring during some of these "spells" has resulted in the documentation of both severe bradycardia and dispersed QT intervals. A recent study reported ten patients with significant bradycardia that required permanent pacemaker placement.

The authors report the case of a 20-month-old Caucasian male, born by induction via membrane rupture and the use of pitocin at the gestational age of 38 weeks with APGAR scores of 7/8. He was noted to be a "slow starter," requiring vigorous sternal rubs to facilitate normal vital signs. In addition to this he had temperature instability that required his transfer to the Special Care Nursery for monitoring and isolette placement to maintain his temperature. He remained in the hospital for six days after his birth. After discharge he had what his parents described, and his doctor related, as "breath holding spells," occurring two to three times a week. These did not alarm his parents because his older sister also suffered from them. His spells were provoked by crying or coughing, and after those activities he occasionally had a quiet period with apparent apnea. These spells were associated with both pallor or cyanosis that could last for five to ten seconds. Multiple 911 calls were made when the apneic spells progressed into seizure activity lasting more than 30 seconds. At the age of seven weeks, following a coughing episode with an emergency room evaluation, he was found to have oxygen saturation of 88 to 89 percent. While the phlebotomist was drawing his blood he became apneic. He was given supplemental oxygen and became more alert. A follow up chest x-ray revealed a slightly enlarged cardiac silhouette. A subsequent echocardiogram was normal. He was worked up for gastroesophageal reflux disease and placed on omeprazole. In the last four months of his life he had a marked decrease in these episodes.

On the day of his death, while under the care of his aunt, he was placed in his crib after his lunch meal. No articles of potential respiratory compromise were in the crib. He awoke with a cry after his nap, and when his caregiver checked on him 20 minutes later, he was found unresponsive and a 911 was called. Attempts at resuscitation were unsuccessful.

Postmortem exam revealed no anatomic cause of death. Toxicology, blood cultures, histology, postmortem radiographs, and vitreous electrolytes were unremarkable. Detailed cardiac pathology was normal.

Breath holding spells are a frequently observed event in infancy and early childhood. Their association with sudden and unexpected death is rare. Typical cases begin between six and twelve months of age, and rarely last past age four. Breath holding spells have been associated with pallor and/or cyanosis, and severe cases involving convulsions have been described. Several causes and explanations have been proposed, but proof of etiology is not found in most cases. Autonomic dysfunction and paroxysmal vagal overactivity have been felt to play a significant role.

The death of this child represents a case of paroxysmal vagal overactivity with a fatal outcome. While rare, when the history is consistent with this premorbid diagnosis, and no alternative explanation is found, this cause of death should be a consideration.

Breath Holding Spells, Paroxysmal Vagal Overactivity, Sudden Unexpected Death in Childhood

G95 An Interdisciplinary Approach for Diagnosis and Age Estimation of Infants' Fractures in the Course of the Autopsy

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After attending this presentation, attendees will understand a scheme for diagnosis and age estimation of infants' fractures during autopsy.

This presentation will impact the forensic community and/or humanity by diagnosing and estimating the age of infants' fracture as an important contribution to the diagnosis of the battered child syndrome. Fractures of different ages are suspicious, and dating the fractures allows some scrutiny in assessing whether the ages are in accordance with the details given by the accused. Moreover, the implementation of an interdisciplinary approach involving forensic pathologists, osteopathologists, and radiologists allows use all resources and enhances cooperation with other disciplines.

Age assessment of infants' fractures plays an important role in the diagnosis of the battered child syndrome. In postmotrem cases an interdisciplinary scheme involving careful external investigation, skeletal survey, autopsy, radiography, and osteo-histology has proven useful for dating infants' fractures. Four postmortem cases of infants with multiple fractures of different ages due to child abuse (a total of 48 osseous lesions) were evaluated. Early stages of fracture healing processes were dated histologically by the extent of periosteal thickening, osteoid production and calcification of soft callus. In advanced healing processes the osseous apposition rate defined by the width of the newly formed trabeculae was measured for age estimation of the fractures. Multiple influencing variables must be considered. Hence, dating the osseous lesions leads not to one single day, but to a time-interval when the fracture has occured. The results of the cases presented indicate the forensic relevance of defining a time interval of the injury, which often allows some scrutiny in assessing whether the ages are in accordance with the details given by the accused. Also, fractures of different ages are a strong indicator of child abuse. Further work in this field will lead to more precise dating of infants' fractures.

Battered Child Syndrom, Infants' Fractures, Osteo-Histology

G96 Are Retinal Hemorrhages Diagnostic of Shaken Baby Syndrome? What Really Killed Baby Cooper

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The goal of this presentation is to discuss the inherent limitations of the current state of medical knowledge regarding the specificity and causal connection of retinal hemorrhages and Shaken Baby Syndrome.

Bilateral extensive retinal hemorrhages accompanying evidence of childhood head trauma (subdural or subarachnoid hemorrhage) are considered virtually diagnostic (pathognomonic) of Shaken Baby Syndrome by most pediatricians and ophthalmologists. The association of retinal hemorrhages and Shaken Baby Syndrome, with or without impact, is a subject of increasing debate in the forensic medicolegal community. The purpose of this presentation is to describe the diagnostic dilemma presented by the suspected child abuse death case of 3 month 24 day old Baby Cooper, who was alleged to be the victim of Shaken Baby Syndrome (SBS) while in the care of his state licensed daycare provider.

On December 18th, 2002, Baby Cooper's daycare provider reported that he didn't look right as he lay sleeping 45 minutes after being placed down for his afternoon nap. Baby Cooper's "little cheeks were purple." He was picked up and it was described that "his little arms went limp." 911 was immediately called. Pending emergency personnel arrival, rescue breathing was started as the daycare provider talked to the 911 operator. The paramedics arrived within five minutes. By that time Baby Cooper was breathing again but had an irregular heart rhythm (bradycardia). Paramedic assessment in the field revealed no evidence of trauma. The daycare provider denied any intentional or accidental traumatic injury. Baby Cooper was quickly transported to San Diego Children's Hospital. Upon arrival, Emergency Department medical staff noted that Baby Cooper's pupils were fixed and dilated, he had no pulse, and could not breathe on his own. He was intubated and after 45 minutes of resuscitation, including CPR, Baby Cooper's heart began to beat on its own but his respirations had to be maintained on a ventilator. A CT scan two hours after hospital admission revealed brain swelling consistent with global hypoxic-ischemic injury, including complete obliteration of the sulci and basilar cisterns. The admitting pediatrician believed he saw a frontal lobe contusion on the CT scan. Abdominal and pelvic CT scans were negative. Possible blood was noted in the posterior chamber of baby Cooper's eyes. A neurological examination concluded that Baby Cooper was probably brain dead. A trauma surgeon examination concluded there was no external evidence of trauma except for a bruise on Baby Cooper's chest caused by the CPR done in the Emergency Department of the hospital. Baby Cooper's initial blood studies, done within one hour of hospital arrival, revealed that his blood sugar was 372, his blood gas had a pH of 7.02, his sodium level was elevated to160 and his potassium was elevated to 11.5. Baby Cooper's initial coagulation studies revealed a severe coagulopathy (a PT of 17, a PPT of greater than >130, and a low fibrinogen level of 44). Three hours post hospital admission an ophthalmology examination revealed bilateral retinal hemorrhages extending out to the periphery. Chest x-ray noted the child's lungs to be hyperinflated. A complete skeletal survey the following day was negative. One hour before a blood culture draw, Baby Cooper received several IV injections of an antibiotic. Brain death was declared 48 hours after admission. Organ donation took place 64 hours after admission, preceded by anticoagulant therapy.

Baby Cooper's prior medical history included normal birth weight, a prolonged vaginal delivery, mild jaundice and significant head molding. At two weeks Baby Cooper underwent an unremarkable circumcision. At six weeks Baby Cooper was diagnosed with microcephaly (head circumference below the 5th percentile). Baby Cooper's diet consisted of maternal breast milk either via nursing or via bottle. In the month before hospital admission Baby Cooper had sporadic episodes of constipation (up to four days) and days when he would not eat well.

At autopsy, anoxic cerebral changes ("respirator brain") with some lymphocytic infiltration, questionable "Traumatic Axonal Injury" ("focal retraction balls") and superficial hemorrhagic injury of the upper spinal cord and cerebrum were noted. No frontal lobe contusion, subdural hematoma, subarachnoid hemorrhage, or other traumatic brain injury was present. Baby Cooper had extensive bilateral retinal hemorrhages, and unexplained subdural bleeding in the lower thoracic spinal column. Toxicology was negative. After two months, the medical examiner signed an amended death certificate and concluded that Baby Cooper was the victim of Shaken Baby Syndrome and ruled the manner of death as homicide.

The trial of the day care provider was a battle of conflicting medical experts. The prosecution contended that Baby Cooper died of Shaken Baby Syndrome because of the rapid onset of brain swelling, the superficial spinal cord and cerebral hemorrhagic injury and the bilateral retinal hemorrhages. Defense medical experts concluded that Baby Cooper stopped breathing because of a Sudden Infant Death Syndrome event (SIDS) that was resuscitated (known as " a near-miss SIDS" or a "resuscitated SIDS" case). All the findings at autopsy were the result of Baby Cooper being kept alive on a ventilator for more than two days days before he was formally declared dead. The retinal hemorrhages were caused by

the child being given vigorous CPR while the lungs were hyperinflated. The severe anoxic changes with swelling caused the superficial hemorrhagic and cerebral injury due to crushing against the skull, together with a patient having a severe clotting disorder upon admission to the hospital.

At trial, based solely upon the medical findings, the prosecution claimed that the daycare provider became increasingly irritated with Baby Cooper's crying, and in a moment of frustration shook him to death. In her defense the daycare provider testified she did nothing to injure the child and called numerous character witnesses who testified that, over a fifteen year period, they had children in her daycare or were frequent visitors to the daycare. They testified to her love, understanding, and abilities to care for the needs of children. Character witnesses also testified that children were always well cared for, and that the daycare provider never lost her temper or became frustrated with a child. After two six-week jury trials (the first jury trial ended in a deadlock), the daycare provider was acquitted of all charges. The controversial medical evidence along with the character evidence convinced the jury that the daycare provider was not the type of person who would be capable of harming an infant child.

In reviewing a case of suspected Shaken Baby Syndrome death, all aspects of the case must be integrated before drawing any conclusion regarding cause and manner of death. Attention should be paid to post hospital admission medical treatment and diagnostic tests, along with a careful evaluation of secondary effects of medical care. Extensive peripheral retinal hemorrhages are part of a constellation of findings helpful to diagnose some cases of Shaken Baby Syndrome. Retinal hemorrhages in the absence of specific brain injury (subdural hemorrhage, subarachnoid hemorrhage, or contusions) present a diagnostic dilemma.

Shaken Baby Syndrome, Retinal Hemorrhages, SIDS

G97 Fatal Craniocerebral Trauma With Hemorrhagic Retinopathy in an Infant: Abuse or Accident?

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After attending this presentation, attendees will be aware of the limitations of certain ocular findings that are considered diagnostic for inflicted childhood neurotrauma and remember the importance of a thorough investiation before determining if a fatal pediatric head injury is intentional or unintentional.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of a thorough investigation for all cases of fatal pediatric head injury.

Severe hemorrhagic retinopathy, retinoschisis and perimacular folds have been considered characteristic of inflicted childhood neurotrauma (Shaken Baby Syndrome), rarely occurring in children with intracranial hemorrhage from other causes. Observational reports and evidence-based inquiries have begun to question those assumptions. This is a report of a case of a 7-month-old infant who was left in the care of his 11-year-old brother and 10-year-old cousin for about two hours. When his mother returned from the store she found the infant unresponsive. He was transported to the local hospital where a cranial CT scan showed a non-displaced skull fracture adjacent to the coronal suture with widening of the sagital suture, an extensive scalp hematoma, and a mixed density left subdural hematoma. Cerebral edema was noted, with diffuse effacement of the sulci over the left cerebral hemisphere and a suggestion of transtenorial herniation. After the infant was transferred to a tertiary medical center, a pediatric ophthalmology consult reported extensive bilateral retinal hemorrhages with premacular subhyaloid hemorrhage in the right eye and macular edema of the left eye consistent with a non-accidental head injury. A skeletal survey revealed no fractures other than the parietal skull fracture described on the initial cranial CT examination. A repeat cranial CT scan showed poor gray-white differentiation consistent with severe anoxic brain injury. Clinical brain death was determined about 20 hours after admission.

Major findings at the autopsy included multiple (6) contemporaneous acute skull fractures (consistent with a crush injury from quasi-static loading), subscalpular extravasated blood, subgaleal and epidural hemorrhage, subdural hematoma, diffuse subarachnoid hemorrhage, severe anoxic brain injury and a right cortical cerebral contusion. Postmortem ophthalmologic findings consisted of extensive bilateral retinal hemorrhages; intrascleral hemorrhages; retinoschisis and a perimacular retinal fold in the right eye; macular edema of the left eye; and intradural, subdural, and subarachnoid hemorrhage of the optic nerves.

Subsequent investigation revealed that the 10-year-old cousin had placed the infant in a baby carriage and taken him and his sister outside while the 11-year-old brother played basketball with friends. Investigators doubted her story that when she came back inside she lifted the infant out of the stroller with one hand and put the stroller away with her other hand. Subsequent investigation and examination of the stroller showed that if the frame latch was not secure, releasing the latch on the handle would permit the stroller to collapse and lurch forward into the legs of the young babysitter, causing her to fall onto the stroller. Recent evidence-based reports have questioned the diagnostic specificity of certain ocular findings in infants/young children with brain injuries. Statements in the medical literature that retinoschisis and perimacular circular folds are diagnostic of shaken baby syndrome are not supported by objective scientific evidence. It is imperative that ocular findings are not viewed out of context and a thorough investigation is conducted before determining whether a fatal pediatric head injury is intentional or unintentional.

Shaken Baby Syndrome, Inflicted Childhood Neurotrauma, Retinal Hemorrhages

G98 The Evidence-Based Medicine Paradigm Shift and Forensic Pathology

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Attendees will learn that the concepts of Evidence-Based Medicine are not being used in forensic pathology writings, although some of the terminology is being applied in polemics about the Shaken Baby Syndrome.

This presentation will impact the forensic community and/or humanity by assisting forensic pathologists in being better able to judge the validity of assertions about Abusive Head Injury and/or Shaken Baby Syndrome couched in terms of Evidence Based Medicine.

Hypothesis: The term Evidence-Based Medicine (EBM) has, so far, been utilized in the Forensic Pathology context to gain entry to the current literature for an editorial, an opinion paper, and a single case report, all attempting to discredit the concept of Shaken Baby Syndrome. Such papers might not be given as much consideration without the appearance of fluency with the issues raised by EBM.

Synopsis: Evidence-Based Medicine (EBM) is an approach to scientific decision-making in selecting treatments for well-defined diseases. Prospective, double-blinded, randomized controlled trials (RCTs) of therapies are given the highest weight, while other forms of comparing health interventions are ranked lower in the EBM hierarchy. The term Evidence-Based as used in the forensic pathology literature to date asserts that no evidence exists, or only weak evidence exists, for what is called Shaken Baby Syndrome. EBM nomenclature has not been used in other contexts to establish or refute other diagnoses in health-related papers, whether in medicine, respiratory care, or dentistry.

Evidence-Based Medicine (EBM) concepts were introduced to a broad readership in a publication in the Journal of the American Medical Association in 1992. The then editor of the JAMA, George Lundberg, referred to the JAMA itself as "The Journal of Physician Behavior

Change." He was describing his vision for the impact of the articles presented in the Journal. EBM has rapidly achieved widespread acceptance and is achieving "Physician Behavior Change." Print and electronic journals have sprung up to publish articles using the term, and at times even applying the concepts.

Use of the term "Evidence-Based Medicine" has not been uniformly associated with appropriate appreciation of EBM's goals nor application of its techniques. Reviewing the actual EBM literature reveals multiple articles complaining that others use their terminology but not their concepts. Still other articles discuss the phenomenon of EBM and urge further study of the validity of its assumptions. Much of the literature dealing with the results from applying EBM describe large studies (called mega-studies) and substitutes for mega-studies by literature analyses (called meta-analyses), both seeking to achieve more "Statistical Power" (statistical significance) by comparisons of treatment in similar, large groups. Additionally, other articles call for Evidence-Based comparisons of various forms of intervention from toilet-training to cancer treatments.

A review of the literature accessed through PubMed (http://www.ncbi.nlm.nih.gov/PubMed) searching for the terms "Evidence-Based Medicine" and "Shaken Baby" reveals only three papers: one is a literature review, the second is a single case report with a brief literature review, and the third is a comment published in the same issue as the case report. Both of the literature reviews fail to provide a citation to describe the classifications used to assert the weakness(es) of existing "Evidence."

Determining whether the terminology from EBM is used accurately or not requires the reader to review the goals and techniques of EBM. Such a review leads one to realize that the terms and techniques of EBM are misapplied in these three publications. Abusive Head Injury is not a "treatment" applied prospectively and randomly with case-controls (RCTs) in a mega-study.

The published reports of cases, case series, or studies involving Abusive Head Injuries or Shaken Babies are not legitimate subjects for meta-analyses: Those studies which support statistical inference (have sufficient "Statistical Power" on their own) gain no benefit from having their populations and selection criteria diluted. Those studies which do not support statistical inference are too dissimilar both in their populations and selection criteria to be legitimately combined. When such heterogeneous populations are combined for analysis, the result is at best an admixture, not the blend meta-analysis seeks. It is a priori apparent that every attempted meta-analyses of such disparate groupings must lack all true "Statistical Power," whether for or against any given hypothesis.

Evidence-Based Medicine, Abusive Head Injury, Shaken Baby Syndrome

G99 Sequential SIDS or Double Homicide? Challenges of Delayed Investigation of Potential "Subtle" Child Homicides

Stacy A. Drake, MSN, RN, Teresa Royer, MSN, RN, Stephen K. Wilson, MD, Dwayne A. Wolf, MD, PhD, Ashraf Mozayani, PharmD, PhD, and Luis A. Sanchez, MD, Harris County Medical Examiner Office, 1885 Old Spanish Trail, Houston, TX 77054*

After attending this presentation, attendees will understand the challenges of delayed investigation in sequential infant deaths.

This presentation will impact the forensic community and/or humanity by demonstrating successful coordination of investigation of sequential childhood deaths. Experience illustrates a truism that needs to be remembered in all death investigation; namely, that all autopsy, biochemical and toxicologic data must be considered in the context of a coordinated investigation.

A stepfather placed his five-month old white female child on a living room love seat for a nap at 9:00 a.m.. According to police records, the stepfather went to sleep across the room on a couch. He awoke a few hours later to find the infant unresponsive. The infant was transported to the regional hospital where she was pulseless and apneic with a rectal temperature of 93.0° F. The initial police investigative report made no mention of syringes or insulin at the scene of death. Little information regarding the stepfather's medical history or background was obtained at that time.

At autopsy, the infant was normally developed and well nourished, with a length and weight appropriate for age. No contusions, abrasions, scars, or other signs of old or recent trauma were noted. Evidence of medical intervention included an intraosseous catheter in the right tibia, a single needle puncture wound in the left antecubital fossa, three needle puncture wounds in the right antecubital fossa, and a single needle puncture wound on the anterior right lower leg. No additional puncture wounds were seen. Postmortem x-rays revealed no acute or old skeletal lesions. There were no petechial hemorrhages in any of the internal thoracic organs, and no congenital organ anomalies were identified. Abundant hemosiderin-laden pulmonary macrophages were detected. Additional postmortem microscopic, microbiologic, and toxicologic studies were unrevealing. Vitreous glucose levels were not obtained due to insufficient sample quantity. The cause of death was classified as sudden infant death syndrome (SIDS).

Two years after the first child's death, the couple had moved to a different location, in a different police jurisdiction. A two-month-old male sibling was discovered by the father not breathing. Emergency medical personnel arrived to find the child unresponsive and pulseless on the sofa, with the father, again the sole caregiver, pointing toward the child without attempting resuscitation. The local hospital documented a rectal temperature of 92.6° F approximately one-hour and ten minutes after the father claimed the child was last known to be alive. Autopsy revealed a developmentally normal child, with no injuries. Gross and microscopic examination did not reveal evidence of natural disease, although abundant hemosiderin-laden macrophages were detected in the lungs. Resuscitative attempts had been aggressive and puncture marks were in the bilateral femoral areas; however, no other sites suspicious for injection were noted at autopsy. Postmortem microbiology and metabolic screening were noncontributory. Toxicology for standard drugs of abuse, salicylate and acetaminophen was negative. Vitreous fluid was not obtained. Because of additional investigative information, a postmortem blood test for insulin and C-peptide was done. Although the ratio of insulin to C-peptide was suspicious for exogenous insulin injection, the relative postmortem stability of these compounds is not known.

After the second case was reported to the medical examiner office, a coordinated investigation into both of these cases was initiated, with re-evaluation of the first death. Following a comprehensive investigation, utilizing both correlative interpretations and essential interagency cooperation, the cause and manner of death in the initial case was changed to undetermined, while the second case was similarly left as undetermined. These cases illustrate several points to be considered in sequential child death investigations. First, multijurisdictional and multiagency coordination was crucial because the family moved into another police jurisdiction before the second death. Secondly, no suspicious circumstances came to light during initial investigation of the first child death. In retrospect, some red flags were evident and should have been detected with current investigative protocols. Third, interpretation and differential diagnostic implications of hemosiderin-laden pulmonary macrophages in infants will be briefly described. Finally, the difficulty of interpretation of postmortem insulin and C-peptide levels will be described. Limited experimental data obtained during attempted validation of this postmortem biochemical test will be presented.

SIDS, Insulin, Sequential Deaths

G100 Case Presentation: Infant Death Due to Epidermolysis Bullosa

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The goal of this presentation is to acquaint the forensic community with the manifestations of epidermolysis bullosa, so that they might include this disease process in their differential when confronted with similar infant deaths.

When confronted with an infant death, this presentation will impact the forensic community and/or humanity by demonstrating the importance for the forensic staff to consider the possibility of a natural disease process with manifestations that could mimic traumatic injuries. The skin lesions of epidermolysis could be mistaken for thermal injuries if a thorough history is not available, and if the possibility of a disease is not considered.

This presentation reviews a case of death caused by complications of epidermolysis bullosa in a 17-month-old Asian infant.This child began to form skin bullae in the diaper area days after birth; these soon spread to include the extremities and face. A biopsy-proven diagnosis of epidermolysis bullosa simplex (Dowling-Meara subtype) was given at age 2 months. Mucosal involvement became apparent when white plaques were noticed in the oral cavity. Recurrent reflux hindered feeding, and resulted in a lack of adequate weight gain. Persistent respiratory difficulties necessitated tracheostomy tube placement at the age of 4 months. The tracheostomy site soon became infected; although treated, a mucoid discharge, on occasion culture-positive for *Staphylococcus aureus* and *Pseudomonas aeruginosa*, continued to drain from the tracheostomy site. A gastrostomy tube was placed at the age of 5 months, due to the child's difficulty swallowing. By his seventeenth month of life, the child's condition had seemed to stabilize and even slightly improve, when, one afternoon, he was found gasping for air; when the father attempted to suction the tracheostomy site, the child stopped breathing. An ambulance transported the child to a nearby hospital, where he was pronounced dead.

An autopsy was performed by the medical examiner's office. The small-for-age body had numerous scattered skin lesions, ranging from unruptured, thin-roofed bullae containing clear fluid, to superficial, red, weeping erosions, to red-brown, dried erosions with a crusted base. The teeth were dysplastic. The fingernails and toenails were absent; the nailbeds had erosions. The oropharyngeal and laryngeal mucosae were markedly edematous, with multifocal ulceration, scarring, and stenosis. The trachea and mainstem bronchi had superficial mucosal erosions as well. Hematoxylin-eosin stained sections of these mucosal erosions had extensive chronic inflammation and submucosal fibrosis. Sections of lung parenchyma had mucus plugs in scattered bronchioles. There was no evidence of trauma. The cause of death was listed as: "Complications of epidermolysis bullosa."

Epidermolysis bullosa is a group of rare genetic disorders that result in fragile epithelium that splits and blisters when subjected to minor trauma. Subtypes are classified by the level of the disrupted epithelium or by genetic basis in newer classifications. Epidermolysis bullosa simplex, due to mutations in genes forming keratins, results in splitting within the superficial layers of the epidermis. Junctional epidermolysis bullosa is due to mutations in genes forming hemidesmosomes or anchoring filaments, and results in separation of the basal cell layer from the basement membrane. Dystrophic epidermolysis bullosa is a result of mutation of the gene forming type VII collagen, and causes separation of the epidermis from the underlying dermis. These disorders range from mild to lethal, and can present at birth or later in life.

When presented with an infant death, it is important for the forensic staff to consider the possibility of a natural disease process with manifestations that could mimic traumatic injuries. The skin lesions of epidermolysis bullosa could be mistaken for thermal injuries if a thorough history is not available, and if the possibility of a disease process is not considered.

Epidermolysis Bullosa, EB, Epidermolysis Bullosa Simplex

G101 Child Abuse by Another Child: Can it Happen?

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The goal of this presentation is to recognize and appreciate child abuse by another child as a special entity with far reaching professional, ethical, and social consequences.

This presentation will impact the forensic community and/or humanity by demonstrating how child abuse by another child is an extremely rare occurrence; however, when it happens it should be promptly recognized. To assure proper handling of these distressing cases in an efficient and sensible manner, team work of all involved investigators, pathologists, clinicians, and social workers appears to be of paramount importance.

In this presentation the authors describe a rare and unusual variant of child abuse in which the investigation focused on ruling out a preschool child as the perpetrator. The first part of the presentation outlines the investigative process, highlighting the importance of the alternative approach to examination and specific methods during the inquiry of the suspects. Following that the authors discuss autopsy findings such as the complex nature of the injuries and particularly the peculiar ocular involvement. Correlation between the pathology and proposed mechanism(s) of injury is emphasized.

Secondly, ethical, social, and professional issues concerning all involved parties in this daunting and disturbing case are analyzed. Differing opinions and crucial disagreements among child abuse experts regarding workup and findings in this case are disconcerting. These fundamental differences might reflect to a certain extent doubts and emerging crises that are becoming increasingly apparent in the child abuse field. In the end the authors analyze these issues in terms of outcome and follow-up of this tragic event.

Blunt Force Injuries, Retinal Hemorrhage, Social Services

G102 Acute Pancreatitis in a 2½-Year-Old Child: A Fatal Therapeutic Complication of Polyethylene Glycol (PEG)-L-Asparaginase

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The goal of this presentation is to present to the forensic community a case report and review of an unusual cause of acute pancreatitis. The authors discuss therapeutic effects and complications of the administration of PEG-asparaginase as a chemotherapeutic agent.

This presentation will impact the forensic community and/or humanity by heightening awareness in the forensic community of an unusual cause of acute pancreatitis, stressing the importance of gathering health history in a patient diagnosed with acute pancreatitis, and informing the medical community of this possible complication of the use of PEG-asparaginase and to raise the index of suspicion so that preventative measures may be applied.

This presentation consists of a case study of a female toddler who died suddenly from acute pancreatitis, a complication of chemotherapeutic intervention for Acute Lymphoblastic Leukemia (ALL). The authors review the pathogenesis, incidence, and diagnostic workup of PEG-L-asparaginase-induced acute pancreatitis.

A 2 ½-year-old white female was diagnosed with ALL after the onset of easy bruising, nosebleeds, and lower leg (shin) pain. Induction therapy consisted of an antineoplastic and palliative regimen of vincristine, dexamethasone, pegaspargase (PEG), cytarabine, and methotrexate. Remission was induced as the blast counts, which initially ranged from 10 to 14% on peripheral smear, became essentially absent. The therapy was complicated by hypertension and sinus bradycardia, which prompted treatment with enalapril, an angiotensin-converting enzyme inhibitor. The symptoms resolved by discharge. For approximately one week thereafter, the patient's blood count remained free of leukemic cells. Approximately two weeks post induction chemotherapy, the patient developed abdominal pain without fever. The patient's mother attributed two episodes of vomiting to dexamethasone prescribed to the patient. On the morning of death her mother administered an over-the-counter oral stomach remedy and reported that the toddler had difficulty breathing. The emergency medical service was notified and transported the patient to the hospital where, despite aggressive resuscitation attempts she was pronounced dead in the emergency department.

Due to the sudden and clinically unexpected nature of the patient's death while in apparent remission, an autopsy was requested by the local coroner. At autopsy the body was that of a normal but pale female child with no congenital anomalies. Internal examination exhibited hemorrhagic ascites with petechiae of the small bowel mesentery and omentum. The pancreatic tail was enlarged and violaceous. Microscopical examination revealed multifocal necrosis, hemorrhage, and acute inflammatory cellular infiltrates in the pancreatic parenchyma. Inflammation extended to the peripancreatic fat, small intestine and appendiceal wall. Other findings included hepatic steatosis and a focal intraluminal thrombus in a pulmonary artery of the right lower lobe. Histopathological examination of the post-mortem bone marrow confirmed the presence of all three hematopoietic cell lines, but severe autolytic change precluded unequivocal recognition of blasts. No gallstones, structural anomalies of the gastrointestinal tract, or other risk factors for pancreatitis were noted. The cause of death was ascribed to acute hemorrhagic pancreatitis with the contributing factor of ALL, status post chemotherapeutic intervention (PEG-aspargase).

Asparaginase is an enzyme manufactured by certain bacteria, plants and animals. *Escherichia coli* bacteria supply asparaginase used for medical purposes. Asparaginase catalyzes the hydrolysis of the amino acid, asparagine, to aspartic acid. Neoplastic cells, especially those of ALL, have low levels of asparagine synthetase. For this reason they fail to produce sufficient asparagine to survive and require an exogenous source of the amino acid. Asparaginase, a chemotherapeutic agent for ALL, eliminates exogenous asparagine by hydrolyzing serum asparagine into nonfunctional aspartic acid and ammonia. Asparagine is needed by ALL cells to build proteins for cellular structure and enzymes. Documented complications of asparaginase include allergic reactions, chemical hepatotoxicity, thrombogenic coagulopathies, hyperglycemia, and acute pancreatitis. Clinical acute pancreatitis is noted in about 1% of patients receiving asparaginase, and rarely results in death.

Asparaginase is used in several forms in conjunction with other chemotherapeutic agents to combat ALL. The L-asparaginase form produced by *E. coli* has been reported to have a lower rate of acute pancreatitis than that of asparaginase alone. In an effort to reduce the incidence of immunogenicity, polyethylene glycol (PEG) is added to L-asparaginase.

PEG-asparaginase therapy is a known cause of acute pancreatitis in the absence of other risk factors. The implications for the patient can be serious: in rare instances significant morbidity and, as this case study demonstrates, even mortality may occur. Acute pancreatitis must be considered in the differential diagnosis of gastrointestinal symptoms in the leukemic patient treated with PEG-asparaginase.

Fatal Acute Pancreatitis, PEG-asparaginase, Acute Lymphoblastic Leukemia

G103 Increased Risk of Sudden Infant Death Syndrome (SIDS) Among Infants Harboring the Apolipoprotein E-4 Allele: Genetic and Pathologic Similarities to Alzheimer's Disease (AD)

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After attending this presentation, attendees will learn that there is increased apoptotic neurodegeneration in SIDS, which may constitute the proximate cause of death, and that similar to AD, the risk of SIDS may be enhanced among those individuals harboring the Apolipoprotein E-4 allele.

Because of the 96% incidence of increased numbers of Alz-50 immunoreactive neurons in SIDS, this microscopic feature may be useful in establishing the criteria for an objective diagnosis, if convincingly confirmed. This presentation will impact the forensic community and/or humanity by providing direction for future investigation, along the lines of altered cholesterol metabolism in SIDS, and the relationship between the severity of Alz-50 pathology and dose of the ApoE-4 allele.

Introduction: A number of studies suggest a neuropathologic overlap between Sudden Infant Death Syndrome (SIDS) and the dementing disorder Alzheimer's disease (AD). AD is a neurodegenerative disease characterized by the pathologic presence of neurofibrillary tangles and accumulation of the peptide β-amyloid, predominantly in the temporal cortex and hippocampus. Pre-tangles (early form of the neurofibrillary tangle) and degenerating neurons in AD and increased numbers of neurons in SIDS medulla and temporal cortex are reactive with Alz-50 antibody compared to respective control populations. Likewise, increased levels of the neurotoxin β-amyloid are uniformly present in AD brain and have been observed in the temporal lobe of many SIDS infants. Studies of non-demented individuals with coronary artery disease (CAD) suggest that Alz-50 immunoreactive neurons occur in advance of AD-like β-amyloid accumulation. An increased risk of developing AD is associated with increased frequency of the Apolipoprotein E-4 (ApoE-4) genotype. Three ApoE alleles taken two at a time are possible (2/2, 2/3, 3/3, 2/4, 3/4 and 4/4). Likewise, there is an increased risk of CAD if an individual retains the ApoE-4 genotype, reportedly because of associated elevations in circulating cholesterol levels. Elevated circulating cholesterol is prevalent in AD and cholesterol is emerging as a factor promoting production of β-amyloid in the disorder. Furthermore, CAD in early life increases the risk of developing AD.

Scientific Objectives: (1) Determine if there is increased prevalence of the ApoE-4 genotype among infants dying of SIDS compared to age-matched infants dying of known causes; (2) Provide previously published data indicating that Alz-50 antibody highlights neurons undergoing apoptosis; (3) Demonstrate that there are significantly increased numbers of Alz-50 immunoreactive neurons throughout the length of the respiratory nuclei in the medulla of SIDS infants, thus suggesting that neurodegeneration may underlie the cause of SIDS.

Methods: The authors investigated 115 infants > 4 weeks of age and < 12 months of age (81 SIDS and 34 non-SIDS) for ApoE genotype. The cause of death was diagnosed using 1991 NICHD criteria for SIDS and standard protocols for known causes (non-SIDS). ApoE-4 genotype was evaluated in brain tissue using real-time PCR methods. Temporal cortex and medulla from a subset of these infants were evaluated for Alz-50 immunoreactive neurons in 50 µm vibratome sections. Some sections were

counterstained for condensed DNA (apoptotic bodies) with propidium iodide subsequent to Alz-50 immunohistochemistry and RNAase treatment (to degrade all RNA).

Results: The mean age at death was 94.5 $\pm$ 7.8 days among infants with the E-4 allele and 93.2 $\pm$ 12.4 days among infants without the E-4 allele. The ApoE-4 allele occurred in 29.95% of the infant population and was absent in 70.15% of the infants. The ApoE-4 allele frequency was increased in SIDS (16.75%) compared to infants dying of known causes (7.6%); this difference was significant using the Armitage's trend test ($P < 0.05$) and marginally significant ($P = 0.086$) using a linear-by-linear chi square assessment. There was a 2.2-fold increased risk of SIDS (OR, 0.76 – 6.46) if an infant harbored the ApoE-4 allele.

Ninety-six percent of SIDS infants exhibit significantly greater numbers of Alz-50 immunoreactive neurons in temporal lobe and throughout the extent of, and exclusively in the dorsal and ventral respiratory nuclei and the reticular activating nuclei of, the dorsal medulla. Essentially all Alz-50 immunoreactive neurons in SIDS brain exhibit condensed bodies of DNA stained by propidium iodide (apoptotic bodies). Such apoptotic bodies were confined to the nuclear envelope and did not occur in the absence of an Alz-50 immunoreactive neuron.

Discussion: There is a greater than 2-fold increase in the ApoE-4 allele frequency among infants dying of SIDS compared to age-matched infants dying of known causes. This is similar to the just over 2-fold increase in the ApoE-4 genotype among individuals with AD compared to age-matched non-demented non-heart disease controls. This genetic difference in SIDS is concomitant with a marked increase in features suggestive of early AD neuropathology. Because of the anatomic link between the location of enhanced apoptosis in the medulla and control of involuntary respiration and arousal from sleep, SIDS may be a neurodegenerative disorder of infancy. Future multi-site studies will be required to confirm this possibility. Due to the link between ApoE genotype and cholesterol metabolism, investigation of cholesterol levels in SIDS brains and circulation may be fruitful.

Conclusions: SIDS may be the AD of infancy, and as in AD, the influence of ApoE genotype may contribute to the severity of neuropathology in SIDS.

SIDS, Alzheimers-Like Neuropathology, Apolipoprotein E Genotype

G104 Ano-Genital Findings in Sexually Abused Children in Cases With a Conviction

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After attending this presentation, attendees will understand that ano-genital findings at colposcopic examination are not major determinants for conviction at court.

This presentation will impact the forensic community and/or humanity by assisting professionals in understanding that specific physical findings of the ano-genital area are seldom found in sexually abused children; the history told by the child remains paramount in cases of sexual abuse.

The department of Forensic Medicine, Aarhus, Jutland, Denmark, performs, at the request of the police, colposcopic examinations of children suspected to be sexually abused. Included in the research during the period from January 1, 1996 to September 1, 2002, were 482 children, giving an incidence of 1,48/ 10,000 children from birth to 16 years of age in Jutland, Denmark. This study includes those cases in which the perpetrators were convicted at court because of substantial evidence of sexual abuse of the child.

Results: One Hundred sixty-five perpetrators were convicted at court, involving 149 girls and 11 boys, with a median victim age of 13.5 years for boys and 10.6 years for girls (range 0-15 years of age). Forty-one children reported touching of genitals; 22 attempts of vaginal, anal, or oral penetration, 21 vaginal penetration; 5 anal penetration; 10 fellatio; and 33 a combination of the above (the rest were other or unknown). Twelve children were examined within 24 hours after the last sexual assault, 36 within a week and the rest more than a week later.

Colposcopic findings: Sixty-one girls had normal internal genital findings (vagina, hymen, vestibulum, labia minor). Ninety-one had abnormal findings, all non-specific findings except for 10 who had lesions. One hundred thirty-three had normal external genital findings (labia majora, perineum, perianal area). Fifteen girls had abnormal external genitals, of which six were lesions of the labia majora or/and perineum. Two boys had abnormal but non-specific findings of the penis and four of the anus. Abnormal findings of the anus were found in 22 girls; of the abnormal anal findings, seven were lesions. Thirty girls had an incomplete cleft of the hymen, but only eight were complete posterior clefts.

Abnormal ano-genital findings were not significantly correlated to conviction at court; however, the age of the child was.

Conclusion: The history from the child, not physical findings, remains the single most important feature in cases of sexual abuse.

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Child Sexual Abuse, Colposcopic Examination, Conviction at Court

G105 The Contribution of Computerized Image Analysis to the Diagnosis of Munchausen Syndrome by Proxy

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After attending this presentation, attendees will understand the difficulty in diagnosing child abuse, in particular Munchausen syndrome by proxy, and understand the advantages of computerized image analysis for child abuse diagnosis.

This presentation will impact the forensic community and/or humanity by demonstrating the use of new technologies, such as computerized image analysis, when child abuse is suspected

Munchausen syndrome by proxy cannot be diagnosed by objective means unless the perpetrator is caught in flagrante delicto (such as when using video surveillance). A psychiatric report on its own does note constitute sufficient proof for such a diagnosis. The authors present a case that shows how new diagnostic means may be useful in the practice of clinical forensic medicine in general, and in the case of the Munchausen syndrome by proxy in particular.

The case concerns a female infant with a past history of hematomas described as "spontaneous" by the pediatricians. The investigation started when the infant, aged three months, was admitted to the hospital for a fracture of the skull, thought to be accidental on the basis of the initial findings. A clinical forensic examination and forensic diaphanoscopy casted serious doubt on the accidental version of the fracture of the skull. Multiple hematomas, invisible to the naked eye, were also revealed, leading to complementary medical imaging analyses. As investigations proceeded, evidence supporting the hypothesis of infant abuse was mounting. In spite of the authors' negative recommendation, the hospital physicians allowed the mother to take the child home for the weekend. On Sunday night, the mother brought the child back for emergency hospitalization. The infant

presented with numerous petechiae on her head, with the exception of two areas: a digitiform zone on the scalp and a triangular zone in the nasobuccal region. Petechiae were also present on the upper part of the thorax and at the basis of the upper limbs. A number of hematomas, invisible to the naked eye, were revealed by forensic diaphanoscopy on the anterior side of the thorax. The lesional picture was consistent with a thoracic compression leading to the obstruction of the respiratory tract, in the context of an attempted asphyxia.

A key issue remained: who was the perpetrator of this child abuse?

The answer was provided using computerized analysis of the images obtained from the digitiform lesion on the infant's scalp and the mother's and father's fingers. The mother was identified as the perpetrator of the acts using objective criteria, in the particular context of Munchausen syndrome by proxy.

Child Abuse, Computerized Image Analysis, Munchausen Syndrome by Proxy

Physical Anthropology

H1 Rodent Modification of Human Skeletal Remains: Brown Rat (*Rattus norvegicus*) vs. Gray Squirrel (*Sciurus carolinensis*)

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The goal of this presentation is to demonstrate that members of the taxonomic order Rodentia have different incentives for gnawing bone, and that tooth marks on bones reflect species-specific motivations.

Postmortem scavenging by brown rats and gray squirrels appear to vary in time sequence due to different motivations for modifying bone. These observations will impact the forensic community and/or humanity by allowing for more informed estimates of time-since-death when accompanied by species-specific modifications to bone.

The most frequently reported scavengers of human skeletal remains are carnivores and rodents. Research detailing carnivore modification has established the scavenging sequence, sites of bone destruction, and the tooth marks most characteristic of this taxon. Canid behavior, in particular, has been well illustrated and sufficient evidence exists to show that modifications to long bone ends occur secondary to extracting grease and marrow from spongy portions of the bone. Attributes of rodent gnawing are often described as paired, broad, flat-bottomed grooves: a reflection of their chisel-shaped incisors. 'Rodents' are stated to modify the densest parts of the skeleton as they attempt to sharpen their teeth or extract calcium and other minerals from bone. The apparent motivations and gnawing attributes for any one species of this order has been presumed diagnostic of all members based on shared taxon and similar dental morphology. It is not uncommon, however, to read seemingly contradictory reports that claim rodents prefer fresh, spongy bone. In addition, published illustrations can be found that cite textbook motivations yet display rodent gnawing along regions deficit in compact bone.

Extended observations at the University of Tennessee's Anthropological Research Facility - a 2 ½ acre plot of land set aside for human decomposition research - demonstrates multiple case studies of rodent modification across the spectra of fresh ('greasy') bone to weathered ('dry') bone. Two cohabitants of the research facility will be used to illustrate this point: the brown rat (*Rattus norvegicus*) - a species responsible for bone modification that bares slight resemblance to conventional descriptions and illustrations of rodent damage to bone, and the gray squirrel (*Sciurus carolinensis*) - a species that manifests 'typical' rodent modification.

The brown rat is a commensal rodent that is heavily dependent on humans for food and protection; it feeds predominantly on cereal grains, but has developed a taste for nearly anything consumed by humans - including meat and fat. Cohabitation and dependency on humans has resulted in commensal species developing food preferences unlike most other rodents: yet even among 'commensal rodents' food preferences appear to vary - a fact well recognized by the food science industry.

To demonstrate the relationship between food predilection and site and type of bone modification, a singular experiment was conducted. Two unprovenienced human clavicles were obtained from the UTK Forensic Anthropology Center. The first clavicle was ivory in appearance and texture and had been previously snatched by 'rodents' during a bone scatter training simulation at the facility. This bone was later discovered wedged in the side of a tree stump with multiple, parallel flat-bottomed grooves traversing the compact bone at midshaft. The second clavicle was selected from an autopsy collection known to have been processed by hand-dipping in household chlorine bleach but was still sticky to the touch, manifested a dark golden-orange hue, and considered representative of a 'grease'-laden, or fresh clavicle. The two clavicles were individually secured to the top of a fallen tree trunk with approximately four feet separating the two specimens. This site was selected due to gray squirrels having been spotted in the area and its distant location from any known brown rat territories. It was hypothesized that gray squirrels would only show interest in the 'dry' bone. The clavicles were monitored periodically over several months for signs of disturbance. In conjunction, donated individuals placed at the facility near brown rat burrows and nesting locations were monitored for bone modification.

Photographic documentation of scavenging activity was obtained using passive infrared receivers to trigger camcorders and wildlife cameras. Tooth marks were documented by field notes and digital images acquired during site visits. To date, gray squirrels have only been photographed gnawing on the 'dry' clavicle and brown rats have only been captured modifying 'greasy' bone.

Rodents, Bone Modification, Postmortem Scavenging

H2 Postmortem Interval Field Research at Three High Elevation Biogeoclimatic Zones in Southwest Colorado

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The goal of this presentation is to present the result for each decomposition stage and the arthropod taxa associated with pig carrion from three high elevation biogeoclimatic zones in southwest Colorado.

This presentation will impact the forensic community and/or humanity by presenting research, which describes an interdisciplinary animal model, involving the fields of anthropology and entomology, from high elevation sites in the southwest Colorado region.

This project is a result of master's thesis research while working toward an MA in anthropology at Louisiana State University. Postmortem interval field research was conducted during the summer of 2002 from June through August, in La Plata County and San Juan County, Colorado. Prior to this initial research, no previous postmortem interval research had been conducted in southwest Colorado. Subadult pig (*Sus scrofa*) carcasses were placed on the ground (within a specifically designed bottomless cage) in three biogeoclimatic zones and sun exposure scenarios. Daily collection and recording of carrion associated arthropods; decomposition stage, and meteorological data were conducted through fly emergence. After emergence, site monitoring occurred every other day until the designated research end date.

Results of the research are: 1) as elevation increased, the rate of decomposition lengthened due to a prolongation of the bloat stage; 2) of the 63 taxa collected, an overlapping of 30 species occurred in two of the biogeoclimatic zones; 3) there is a strong indication of elevational preference for the Sarcophagidae species due to no overlapping; and 4) a previously undescribed hybrid cross of Boettcheria was collected.

The three biogeoclimatic zones, sun exposure scenarios, and research lengths are as follows: 1) pinyon-juniper, mesa top at 6,700 feet, full sun for 40 days; 2) aspen grove, east facing slope at 8,700 feet, shade for 40 days, and 3) timberline pine, west facing slope at 11,100 feet, partial sun/shade for 30 days.

At the 6,700 feet sun exposed scenario, the lengths of decomposition were: less than 24 hours for the fresh stage; two days in the bloat stage; two days in the active decomposition stage, and one day in the advanced decomposition stage. Dry remains stage was reached on the seventh day since time of death. Emergence occurred during the 12th - 14th days since time of death. The maximum temperatures ranged from 94ºF to 106ºF with a mean temperature of 100ºF. The minimum temperatures ranged from 48ºF to 61ºF with a mean temperature of 55ºF. Relative humidity levels

ranged from 8 to 45 percent with a mean of 20 percent. No measurable precipitation occurred during this 14 day period.

At the 8,700 feet shaded scenario, the lengths of decomposition were: three days for the fresh stage; five days in the bloat stage; two days in the active decomposition stage, and two days in the advanced decomposition stage. Dry remains stage was reached on the 13th day since time of death. Emergence occurred for seven days between the 20th and 28th days since time of death. The maximum temperatures ranged from 69ºF to 89ºF with a mean temperature of 82ºF. The minimum temperatures ranged from 50ºF to 60ºF with a mean temperature of 54ºF. Relative humidity levels ranged from 6 to 65 percent with a mean of 23 percent. Precipitation of 15mm was recorded during this 28 day period.

At the 11,100 feet partial sun/shade scenario, the lengths of decomposition were: five days for the fresh stage; 14 days for the bloat stage, and 11 days in the active decomposition stage. The maximum temperatures ranged from 43ºF to 73ºF with a mean temperature of 63ºF. The minimum temperatures ranged from 32ºF to 48ºF with a mean temperature of 42ºF. Relative humidity levels ranged from 10 to 93 percent with a mean of 38 percent. Precipitation of 72mm was recorded during this 30 day period.

Of the 28 Diptera taxa collected, *Phormia regina* was the sole Calliphorid that overlapped all three biogeoclimatic zones. *Cochliomyia macellaria*, *P. sericata*, *B. plinthopyga*, and *T. sulculata* were collected only at the 6700 feet site. *Sarcophaga nearctica* and *T. montanensis* were collected only at the 8,700 feet site. *Calliphora alaskensis*, *C. cadaverina* and a previously undescribed hybrid cross of *Boettcheria latisterna and Boettcheria litorosa* were collected solely at the 11,100 feet site.

Of the 28 Coleoptera taxa collected, *Thanatophilus lapponicus* overlapped all three biogeoclimatic zones. *Dermestes marmoratus*, *Nicrophorus marginatus*, *Nitidula ziczac*, *Cynaeus angustus*, and *Trox sonorae* were collected only at the 6,700 feet site. *Dermestes lardarius*, *Ontholestes cingulatus,* and *Omosita discoidea* were collected solely at the 8,700 feet site. *Aphodius fimetarius* was collected only at the 11,100 feet site.

Southwest Colorado consists of multiple biogeoclimatic zones; therefore, additional research has been ongoing in order to determine the decomposition rates and carrion associated arthropods in the various ogeoclimatic zones and elevations.

Postmortem Interval, High Elevation Biogeoclimatic Zones, Hybrid Boettcheria

H3 Decomposition in the Santa Monica Mountains: A Seasonal Taphonomic Analysis of Buried and Exposed Remains

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This poster represents many of the taphonomic processes at work in the Santa Monica Mountains. This ecosystem is representative of a specific type of climatological area found in Los Angeles County as well as southern Africa, southwestern Chile, southwestern Australia, and the Mediterranean. Aattendees will gain insight into the seasonal differences in decay rates of both buried and exposed remains.

As the first study of its kind in the greater Los Angeles area, this presentation will impact the forensic community and/or humanity by providing much needed data to law enforcement and coroner agencies in Los Angeles. Inaccurate assessment of the postmortem interval is counterproductive to the expeditious manner in which these agencies attempt to identify decedents who are found in Los Angeles County, particularly in the mountainous environment of the Santa Monica region.

Taphonomic studies allow scientists to more accurately estimate postmortem interval, making identification and investigation proceed more smoothly. The process of decomposition may be categorized into five stages: fresh, early decomposition, advanced decomposition, skeletonization, and extreme decomposition [2]. The duration of each stage is greatly influenced by many factors including: temperature, humidity, burial, soil type, trauma, and clothing [4].

Several studies have been done on postmortem interval in specific areas of North America including Galloway 1997; Galloway *et al*. 1989; Komar 1999; Mann *et al*. 1990; Rhine and Dawson 1998; Rodriguez and Bass 1983; Schoenly *et al*. 1991; Shalaby *et al*., 2000; Shean *et al*., 1993. However, due to the variation in local rates of decay, these studies are of limited utility outside the local geographic and climatic regions in which they are conducted. This study involved collection of data of decomposition rates in one climatic and geographic region of Los Angeles County, in order to more accurately determine postmortem interval in this area.

A 16-month field study was conducted on decomposition and scavenging rates in the Santa Monica Mountains (located in Los Angeles County, California). This area has a Mediterranean microclimate, involving relatively high daily temperatures, little rainfall, and both large and small scavenging animals. This microclimate is found only in the Santa Monica Mountains, southern Africa, southwestern Chile, and southwestern Australia. Due to their approximate human body size, their skin texture, and relative hairlessness, domestic pigs (*Sus scrofa*) were used as human models in this decomposition study. A total of eight pigs were used, two placed during each season; one pig was left on the surface, secured inside a chain link cage to prevent removal from the site by animal scavengers. The second pig was buried in a shallow grave 2 feet below the surface. This was done to document decomposition differences between seasons as well as between buried and exposed remains.

Significant differences were noted in decomposition rates between the spring and summer surface pigs. The two sets of pigs took approximately the same time to reach the advanced decomposition stage, but the spring pig reached skeletonization far more quickly than the summer pig despite the greater heat during the summer. The fall pig remained in the early stages of decomposition four times longer than either the spring or summer pig, and carnivores ended this experiment when they extracted the pig from the cage and removed it from the site.

The buried pigs fell victim to carnivore activity as well, although the timing of their excavations varied significantly. The spring pig spent 10 weeks underground, the summer pig a mere four days, and the fall pig two weeks. Differences in extraction times are possibly due to the soil porosity during the time of interment, with the pigs buried in moister, and hence denser, soil, remaining buried for longer periods of time. These specimens experienced adipocere formation as well, although it is unclear whether the adipocere development was due to moisture content or duration of interment. Data collection for the winter pigs is still underway, although winter decomposition rates appear similar to those of spring and summer (possibly due to a lack of rainfall this year).

The unexpected tenacity of the coyote population proved problematic, although the placement of the pigs does not appear to have attracted additional scavengers into the area, as the fall pig remained in the ground for two weeks, and the winter pig showed no signs of carnivore activity for more than five months.

As well as providing pertinent data to Los Angeles County decomposition rates and how they compare with rates documented in other areas of North America, this study also demonstrate the significant differences in decomposition rates seasonally within one microclimate. Additional studies are suggested to address this issue.

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Forensic Anthropology, Taphonomy, Decomposition

H4 Escaping Tennessee: Regions for Taphonomy Research Beyond Eastern Tennessee

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After attending this presentation, attendees will understand where taphonomically relevant regions are located in the continental United States and the possibilities for furthering the work begun at the Anthropology Research Facility in Tennessee.

By providing locations of taphonomically relevant regions, researchers can investigate climatic variables affecting the rate of decomposition further than is possible in eastern Tennessee, allowing for more accurate time since death estimates.

Since 1981, groundbreaking research on the processes, the results, and the factors affecting decomposition has come out of the Anthropology Research Facility at the University of Tennessee. The results of this research have revealed several factors affecting the speed of decomposition and thus the time-since-death estimate. These factors can be lumped into two groups: intrinsic variables specific to the body, like clothing and trauma, and extrinsic variables, such as climate and environment. Though extrinsic variables are known to affect intrinsic variables, the magnitude of that effect is unknown. Many researchers examining any of these variables express the need for further work to be done, in different climates and environments. Even the investigators at the ARF, however inventive, are constrained by climate. Though they recognize their findings may be applicable only to one specific region, what defines different taphonomically-relevant climate zones is not known. By using variables known to have a large affect on decomposition rates, regions can be mapped defining where these variables differ.

Several things need to be thought out when undertaking this kind of mapping. The distribution of cases, what variables, and the length of time they are being studied all need to be taken into consideration. The cases should cover the whole area being mapped and should be as evenly spaced as possible. When mapping, it is important to keep in mind three very influential climatic variables which can divide a region into taphonomically-relevant climates: temperature, humidity, and precipitation. Beyond the regions created by these factors, microclimates can further subdivide regions to account for the unique features of a particular area. As all the climate factors that affect taphonomy are unknown and the full effects of the known ones are uncertain, these microclimates hold a great deal of potential. Analyzing any of these variables for only a month or a season is unlikely to provide an accurate assessment of a region's climatic variability. A year's worth of data is required to account for the differences between seasons; more than one year is better to allow for anomalous weather conditions. By considering time, variation, and distribution, accurate regions can be mapped displaying the differences in climate.

In this study, 129 cities across the United States were used. For each of these cities, data for three variables were downloaded from the National Climatic Data Center's website run by the National Oceanic and Atmospheric Administration. For average temperature, daily data were downloaded for five years (1999-2003). Daily precipitation data only for 2003 were downloaded. Only one year was used due to extensive missing data for the previous four years and only those cases with 95% of the data available were used to map regions. All daily data were converted to monthly averages for more efficient analysis. The available humidity data came as monthly averages. All the data were analyzed by variable using a hierarchical analysis in SPSS 12.0. The resulting groups were plotted on a map of the U.S. and regions drawn. Each of the three variables was mapped independently, producing three maps. The maps were then overlaid on top of each other and composite regions drawn, creating a fourth map of overall climatic differences.

Temperature divided the country into five regions. Most of the country split into rows becoming progressively warmer with lower latitudes. Along the west coast is a band of a more moderate climate without the large difference between highs and lows seen in the rest of the country.

Humidity creates five regions as well. The most humidity is seen in the northwest corner with a thin band of humidity down the west coast. The remainder of the country splits into a checkerboard. First, a line through the central plains divides the rest of the country into an arid region in the west and a humid one in the east. These are further subdivided into a northern more humid area and a southern more arid one.

Similar to humidity, precipitation splits the majority of the U.S. into two regions with a line down the central plains. To the west of this line are three drier regions with two wet regions to the east. The exception to this pattern is a small area of extremely wet weather along Oregon's pacific coast. The southern regions tend to have higher precipitation levels than the northern ones.

Using temperature, humidity, and precipitation maps, a composite map was drawn showing 11 regions. These regions do not follow state lines, though most states fit decidedly in one region. The North East is characterized as cold, humid, and wet and involves Maine, New Hampshire, Vermont, Massachusetts, New York, Michigan, and Wisconsin. Just to the south is the Central East, a temperate, humid, and wet section including Rhode Island, Connecticut, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Kentucky, eastern Tennessee, Ohio, Indiana, Illinois, Missouri, and Iowa. The hot, humid, and wet zone of the South East contains North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Louisiana, and western Tennessee. The North Central is characterized as cold, humid, and dry includes Minnesota, North Dakota, and South Dakota. The temperate, humid, and dry region of the Central Plains contains Nebraska and Kansas. To the south is the South Central area, a hot, humid, and dry area involving most of Oklahoma and Texas. The cold, arid, and dry territory of the North West contains Montana, Wyoming, and Colorado. The Central West is characterized as temperate, arid, and dry and involves Idaho, eastern Oregon, Utah, and Nevada. To the south is the South West region of New Mexico and Arizona characterized as hot, arid, and dry. The west coast is divided into two regions with Washington and western Oregon in the moderate, humid, and wet north area and California in the moderate, humid, and dry south.

In a country that goes from the Atlantic to the Pacific and encompasses nearly every possible climate from the Arctic Circle to the Tropics, the potential for extensive and groundbreaking forensic taphonomic research is astounding. By using the three known influential climate variables, eleven regions in the U.S. were created. Each differs from its neighbor by temperature, humidity, or precipitation. Climate is the result of the interaction between these factors. In order to study how this interaction affects decomposition rates, at least one facility should be created in each region with the same goals as the ARF at UT. Though ideal, this is

not likely to be feasible. However, each region is home to at least one forensic science program. Studies done through these programs could offer the same necessary information required to validate and fine-tune existing theories and methods and discover new ones that could not be found in the temperate, wet region of eastern Tennessee. Dr. Bill Bass and the faculty and staff at the Anthropology Research Facility have taken the first steps with sporadic efforts across the country to take the next ones. There is justification for further studies and facilities outside of Tennessee, both climatic and environmental. New facilities need to be created to contend with all the possibilities offered by the many different climates available in the U.S.

Taphonomy, Decomposition, Body Farm

H5 Insect Colonization of Child-Sized Remains: Behavioral Analysis of Pig Carcasses via 24 Hour, High Resolution Video Surveillance

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The goal of this presentation is to document the behavioral patterns and activities of arthropods colonizing child-sized remains as observed via 24-hour high-resolution video surveillance.

This presentation will impact the forensic community and/or humanity by reinforcing the need for careful review of all factors when considering postmortem interval estimations.

The purpose of this research was to test the relationship between delays in arthropod colonization of child-sized remains and climatic conditions. The effects of weather conditions, particularly temperature, on insect colonization are well documented in the research literature. Most studies relied upon on-site observations, conducted several times a day. The traditional sampling methodology provides a limited view of arthropod colonization by framing the number of field observations in snippets of time. The restrictions of limited observations fail to account for unobserved arthropod species and activity, as well as the affect of the micro-climate.

The FBI's National Center for the Analysis of Violent Crime (NCAVC) is routinely consulted by federal, state, and local authorities in a variety of cases of bizarre and repetitive violent crimes, including child homicides. The NCAVC has previously conducted research on the taphonomy of child-sized remains. This study provided observations on a 24-hour basis, via high-resolution video camera, and collected weather data from the microenvironment at the disposal sites, as well as macro-environment data from a national weather collection site located nearby.

During the time period March 2004 through June 2004, the remains of two child-sized pigs (approximately 25 pounds) were deposited in an isolated wooded area in a suburban area of Virginia. The sites were secluded, approximately 250 feet from any dwellings. The pigs were placed on the surface, one was clothed, the other nude. Wire cages were placed over the two specimens to prevent larger scavengers from consuming the corpses. Pig carcasses were initially placed at study sites on days characterized by inclement weather conditions to assess the effects of such climatic conditions on arthropod colonization and succession. Two high-resolution video cameras were set up utilizing an infrared light source for night viewing. The cameras were set up to record on a 24-hour basis. Taping was conducted every day throughout the period. Remains were also physically monitored twice a day, arthropods collected, observations noted and temperature and humidity readings taken with a psychrometer. Data for the microenvironment was collected from the U.S. Marine Corps Meteorology and Oceanographic Division, which provided hourly data on wind speed and direction, temperature, humidity, sky cover, and weather observations. Two replicates of the study were conducted. Tapes were reviewed to document the number of arthropods visiting the sites, as well as genus and activity. Inter-rater reliability was performed to ensure genus documentation was accurate.

The results of this study demonstrate the relationship between weather and delays in arthropod colonization. For both replicates, rainy, overcast weather conditions delayed colonization even though temperatures were above established thresholds for activity. During initial spring replicate, such conditions contributed to a 17-day delay in carcass colonization by carrion frequenting insects. Similarly, a 3-day delay was observed in the late spring replicate. This study also showed the effect of seasonality on the succession of various arthropods and reinforced arthropod temporal predilections. Calliphorid activity was largely diurnal, beginning during midmorning and peaking in afternoon. Carrion beetle activity, however, was characterized by both diurnal and nocturnal activity patterns. Carrion beetle activity was not as dependent on temperature as fly activity. The study further highlighted the interspecific and intraspecific competition among insects for viable food sources and demonstrated exclusion and succession. Vertebrate scavenging was also a factor for decomposition, even though study carcasses were secured in wire mesh cages. The scavenging activities of small mammals and vultures clearly illustrated competitive interactions inherent between vertebrates and invertebrates competing for patchy carrion resources. Results of this study reinforce the need for careful review of all factors when considering postmortem interval estimations.

Postmortem Interval, Arthropod Colonization, Child-Sized Remains

H6 Human Decomposition in the Detroit River

Paula A. Perry, BA, Bournemouth University, Talbot Campus, Poole, Dorset BH12 5BF, United Kingdom*

After attending this presentation, attendees will understand how taphonomic variables specifically associated with the Detroit River affect decomposition. A decomposition model for this unique riverine environment will be established for the future application to similar environments.

This presentation will impact the forensic community and/or humanity by assisting in the understanding of decomposition rates in a unique riverine environment and identify factors that affect tissue breakdown in order to develop a model that will aid forensic personnel in establishing the postmortem interval.

The Detroit River is an international channel that links Lake St. Clair and the Upper Great Lakes to Lake Erie and is often the site of fatal accidents and suicides. The Detroit River contains dangerous levels of pollutants and organic waste products and as a result of industry, very little natural shore bank remains, preventing: fish spawning; vegetation growth; wildlife feeding, and natural sediment transfer. Because the environment surrounding the Detroit River and the waters themselves are extremely unique, it is necessary to identify the variables that influence decomposition rates in the Detroit River and study their affects on tissue breakdown in order to develop a model that will aid medical examiners in establishing the postmortem interval.

Sixty-nine case files of human remains recovered from the Detroit River from over the past nineteen years were studied. Cases included 55 males and 14 females ranging from aged six to eighty-five years. Submersion intervals were known in all cases and ranged from two hours to one hundred and twenty-nine days. Decomposition was recorded for each case in order to determine a progression of soft tissue loss in a fresh-water, riverine environment.

Of the sixty-nine cases examined; 30.4% (n= 21) were classified as stage 1 decay, 11.6% (n= 8) as stage 2 decay, 31.9% (n= 22) as stage 3 decay, 23.2% (n= 16) as stage 4 decay and 2.9% (n= 2) as stage 5 decay.

In the Detroit River, stage 1 remains lack discoloration or bloating, rigor or livor mortis may be present and are recovered between zero to two days. Stage 2 decomposition is observed between two to nine days and

consists of early discoloration, bloating and marbling, with minimal skin slippage. Stage 3 remains show advanced skin slippage and significant discoloration and bloating, and are found between nine to twenty-four days. Stage 4 is observed between twenty-four to fifty-eight days and displays tissue erosion and the purging of fluids. Stage 5 is characterized by the exposure of skeletal elements and is seen in remains that have been in the Detroit River for over fifty-eight days.

When compared to models of tissue decay developed by previous research, it was found that decomposition in the Detroit River follows a similar sequence, but the rate of decay is slower. Contributing factors are low water temperatures and the absence of postmortem feeding by aquatic organisms.

Further analysis showed that within the Detroit River, body weight and pollution affect decomposition with heavier individuals and higher levels of pollution in the water speed the rate of decay.

Detroit River, Decomposition, Postmortem Interval

H7 Observed Taphonomic Changes and Drift Trajectory of Bodies Recovered From the Tidal Thames, London England: A 15-Year Retrospective Study

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Attendees will gain a general understanding of the processes involved in marine/aquatic taphonomy and its application for the determination of postmortem submersion interval. It is hoped that after gaining an understanding of the basic principles of fluvial transportation, attendees can apply these in future casework within their own spheres to determine cadaver location and enhance recovery from aquatic environments.

With the discovery of human remains, one of the most important issues to be considered is the postmortem interval (PMI), as it is used to examine missing persons files in search for a likely match. It is imperative that accurate PMI determinations can be established as it can mean the difference between the positive identification of an individual or that individual remaining unidentified in the morgue. In forensic settings there is a growing need to understand aquatic decomposition in order to interpret decompostional changes as an aid to the determination of perimortem interval. The environmental context in rivers, lakes or oceans is different to that on land. Therefore, separate decomposition and preservation models need to be developed. This presentation will impact the forensic community and/or humanity by providing insight into the principles and forces that act upon a human cadaver in an aquatic environment. This data can potentially be applied to fluvial drift models that aid in not only the determination of search strategies for locating human remains, but to also the calculation of location at which they entered the river.

In 2002, River Thames lifeboat crews responded to approximately 400 cases of attempted suicides and suicide victim recovery. Many of their cases were recovered from the 62.14 km stretch of the tidal Thames, which runs through the Boroughs of Central and Greater London, particularly between Eel Pie Island and Barking Point. Bodies deposited in this area of the Thames are subject to diverse and ever changing conditions, as the river alters from fresh water to a marine environment; both of these settings have a unique and specific effect on the movement and decomposition of these bodies.

A retrospective study was carried out on 103 closed case files from the Marine Support Unit, Thames division of the Metropolitan Police. Each body used in the study had been positively identified; information such as demographic data, date last seen, and date recovered were present. The remains (84 males and 19 females) were recovered between December 1988 to June 2004 between Richmond and Barking Point. The aim of this study was to form a decompositonal table based on taphonomic changes related to the Postmortem Submersion Interval (PMSI), thereby creating a more accurate form of assessing PMSI to aid the process of identification. Another objective of the study was to evaluate the drift trajectory of the remains recovered in order to assess the viability of a predictive drift model. Such a model would provide insight into the fluvial transportation of human remains and, therefore, could be used to predict recovery locations as well as point of entry into the tidal Thames. The preliminary results are presented here.

PMSI was calculated from dates taken from missing person's reports or witness statements of sightings of the individual either in or entering the Thames. The PMSI ranged from 0 to 333 days, with a mean of 20.2787±4.74911 days and a mode of 3 days.

Using data from the 103 individuals recovered, taphonomic tables were developed focusing on a total of 13 variables for decomposition. Photographs exhibiting a minimum of 50% of the body, along with postmortem examination and police reports, were used to assess decompositional changes. As a result of a multivariance analysis test (MANOVA), which indicated a statistically significant relationship (Λ= 0.048, sig'. 0.000) between the decompositional variables and the season in which the remains were removed from the Thames, the taphonomic tables were further divided into two seasons, winter (November-April) and summer (May-October). Further analysis of variables that may account for the observed decomposition is presently underway.

Of the 103 cases, 47 had known points of entry into the Thames provided by witness statements and emergency calls. Drift distance both nautical miles and kilometers was analyzed in order to determine if a drift trajectory model could be developed for this stretch of the Thames, and also to determine if set variables could aid in determining the location of where a body may have either entered the river or would be expected to be recovered. Drift was calculated by using standard distances developed by the Port of London Authority, with London Bridge as the point of reference. Negative drift, moving upstream from the point of entry, was observed in 4 cases. The mean drift was 3689.8511 meters ±1000.389 meters (1.9836 ± 0.54119 nautical miles), with the PMSI ranging from 0 to 270 days. Preliminary analysis of variables affecting drift through the use of Pearson correlation ($P \leq 0.05$) indicates that demographic data such as sex, race, and physical build have no statistically significant correlation with drift distance. Analysis of PMSI indicates that there is also no statistically significant correlation between PMSI and drift ($r = -0.48$, $p = 0.747$). Investigation into tidal heights and upstream flow velocity is presently being conducted. Preliminary research has also led to the opinion that a predictive model is not applicable to this area of the tidal Thames due to complex micro and macro current systems, which can be altered through a multitude of environmental and industrial factors, such a sewage run off, upstream rain fall, or the presence of cargo, passenger, or pleasure boats.

Fluvial Transportation, Taphonomy, Aquatic Environment

H8 Analysis of Season at Death Using Cementum Increment Analysis

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The goal of this research project is to test the efficacy of using dental cementum to determine the time of year in which the death of an individual occurred (season-of-death). The biological basis of the project, materials and methods used, and the need for and benefits of the data produced are discussed.

This presentation will impact the forensic community and/or humanity by seeking to identify the timing of dental cementum increment formation in humans and thus provide a means by which season-of-death could be determined in forensic cases.

The forensic anthropologist's examination of skeletal material usually includes determination of the biological profile (age at death, sex, ancestry, and stature), estimation of postmortem interval, and detection of any trauma/pathology and its timing relative to the death. At present, estimates of postmortem interval, the amount of time that lapsed between death and discovery, are based on state of decomposition of the remains and their associated ecological conditions, and are generally given in broad ranges of months to years. Cementum increment analysis in humans has the potential to help narrow the estimate of postmortem interval to the actual calendar year and season during which the individual died. This project applies proven methods for determining season-of-death among mammals to the analysis of human teeth. Although age at death studies have been conducted, no known study has attempted to apply these methods to season of death. The theoretical underpinnings that make it possible to determine the time of year that an animal died simply from the microstructures in its teeth are the same for animals and human beings, and therefore a successful outcome is anticipated.

Dental increments are identified in the cementum deposits on the roots of human teeth and under microscopic examination appear as alternating dark and light bands, analogous to tree rings. Research with comparative samples of known-age and known date-of-death individuals has demonstrated a consistent relationship between annual seasons and the formation of distinct increment types. In general, the winter or arrested cementum increment appears as an opaque band while the summer or growth increment appears as a translucent band. Together these represent one year of an individual's life, providing an annual record of that person's life history. The total number of increments provides a means of determining the individual's age at death (Wittwer-Backofen 2004, Kagerer and Grupe 2001, Jankauskas *et al*. 2001, Geuser *et al*. 1999).

Methods of increment analysis are broadly similar. Increments are exposed by sectioning teeth and grinding or polishing the cut surfaces, which are then viewed under magnification. Research into the biology of cementum formation (Lieberman *et al*. 1992; Lieberman 1993) suggests that the petrographic method of sectioning is most appropriate for both archaeological samples and comparative samples because it takes advantage of changes in polarized light diffraction resulting from biological variation in the structure of cementum increments. With the petrographic method, teeth are embedded in either an epoxy or plastic matrix to help maintain the structural integrity of the tooth, thin sections are cut with a low speed saw fitted with a diamond blade, mounted on glass slides, and then ground and polished. Thin sections are viewed under 125X magnification with a transmitted, polarized light source. Cementum increments are counted and measured for thickness.

For this investigation, the authors have acquired extracted teeth, the individual's date of birth, and date of extraction from local dentists. Recent studies involving human teeth (Wittwer-Backofen 2004, Kagerer and Grupe 2001, Jankauskas *et al*. 2001, Geuser *et al*. 1999) have indicated that no statistical difference exists in cementum accumulation of different teeth within a single individual. For this reason a specific tooth was not required.

Precise interpretation of dental increments is predicated upon establishing seasonal formation times in the particular taxon under analysis. In the case of humans, no comparative study has recorded the specific timing of increment formation. The current project seeks to identify the timing of increment formation in humans and thus provide a means by which season-of-death could be determined in forensic cases. Results of the pilot study will be presented in this report.

Cementum Increment Analysis, Dental Anthropology, Season at Death

H9 The Meeting of Old and New: Luminol Application to a Suspected Ritualistic Heathen Stone From Viking Times

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The goal of this presentation is to introduce the audience to heathen worshipping ceremonies in Iceland in the Viking times as they relate to a recently discovered special stone that was, upon examination with Luminol, found to be focally positive.

This presentation will impact the forensic community and/or humanity by demonstrating the potential for Luminol to contribute to knowledge of this an ancient ceremonial stone in Iceland.

During the last year, the expansion of a summer home in the northwestern part of Iceland called Strandir, uncovered an unusually shaped stone, which some locals recognized to coincide with old descriptions of artifacts used during heathen worship. The stone had and external triangular shape with smooth and straight sides and on the base of the triangle was a deep cup-shaped depression in the surface. According to the stories blood was contained in this depressed area during the ceremonies. The local authorities in Strandir approached the forensic community and asked for possible aid in determining if blood had ever been contained in the cup-shaped part of the stone. Luminol application to the stone showed a very weak positive luminescence localized to the cup shaped area of the stone, with other areas of the stone being negative.

Luminol is known to detect old blood; however, it cannot determine when this presumptive blood was deposited. Geographical evaluation will be obtained to try to determine possible age of the chiseling of the stone.

Anthropology, Luminol, Heathen Ceremonies

H10 Lifestyles of the Unidentified: Challenges in Positive Identification

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The goal of this presentation is to illustrate skeletal features that may provide insight into an individual's lifestyle as well as aid in positive identification if antemortem records can be found.

This presentation will impact the forensic community and/or humanity by demonstrating that certain skeletal profiles can be linked to lifestyles such as homelessness. It is proposed that, despite the presence of distinguishing characteristics, many of these individuals remain unidentified due to their lifestyle.

The human skeleton exhibits many characteristics unique to an individual that can aid in positive identification. These include congenital and developmental variants as well as traits acquired during life, such as healed trauma, medical appliances, and dental restorations. The presence of rare or unique traits, however, is no guarantee of identification in cases of skeletal remains of unknown decedents. Certain lifestyles can, in fact, lead to a greater likelihood that a positive identification will not be achieved.

This poster will present skeletal profiles indicative of certain lifestyles that can impede the identification of an individual, leading to an increased probability of a case remaining unsolved. This will be illustrated by two cases of human remains recovered in 1996 and 1998 from Jefferson and St. Tammany Parishes in Louisiana. The first individual, a white male adult, is a partially skeletonized body recovered from an enclosed space in December 1998. The cause of death was determined to be compression asphyxia, due to a failed attempt to enter a building through an exhaust

shaft. Skeletal features indicated an age of 30-35 years, and a height of approximately 5'8". Also present was an amalgam on the upper molar, indicating dental work had been completed at some time in the past. Another feature that could aid in identification is a healed fracture of the left maxillary bone, as well as clothing and personal items recovered at the scene. Radiographs produced good visualization of the frontal sinuses, another trait unique to an individual that can aid in identification.

The second individual, found in an outdoor setting, was completely skeletonized, with the exception of the left hand and the feet. The left hand had preserved mummified tissue, while the feet were located within intact socks. However, no other clothing was found at the scene. Skeletal features were that of a black male, age 30-40 years, and a height of approximately 5'7". Although there was extensive tooth decay at time of death, the presence of multiple amalgams and an upper denture with a single false tooth (upper left lateral incisor), indicates that dental work with potential for x-rays had been completed at some time in the past. Also present are several developmental anomalies that would also appear in radiographs, including asymmetry at the distal end of the sternum, incomplete fusion of sacral units 4 and 5, and ossification defects of the patellae. Antemortem trauma includes a healed fracture of the right ulna, and a fracture of the proximal phalanx of the left great toe, both of which may have required medical attention in the past.

Despite the fact that both skeletons showed antemortem pathologies and unusual skeletal features that could lead to a positive identification, no potential matches with missing persons were made, and the two individuals remain unidentified. In the second case, facial reconstruction was also attempted. In both of the above cases, there were also indications of certain lifestyles that could hinder identification from being reached. Both individuals showed antemortem fractures that could be indicative of a violent lifestyle. The first individual suffered from a facial fracture that could have been sustained by a blow to the face below the left eye. The second individual suffered from a possible parry fracture of the lower right arm.

Secondly, although both individuals had received professional dental care sometime in the past, at the time of death tooth decay, extensive enough to cause antemortem loss and significant discomfort was present indicating that medical care had not been sought for some time. Finally, personal effects and circumstances of discovery are also indicative of certain lifestyles. The first individual was found to have hypodermic needles within the pockets of his clothing. Although no personal effects and very little clothing were recovered for the second individual, the location of discovery was a parking area used by a traveling carnival, indicating that the individual could have lacked a permanent address. Taken as a whole, the above evidence can be used to develop a profile of individuals who, despite possessing multiple skeletal and dental traits that could aid in identification, follow a lifestyle that in effect hinders such attempts, leading to greater likelihood of a "cold case."

Identification, Skeletal Remains, Cold Case

H11 Internal Cranial Fractures

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The goal of this presentation is to present the forensic anthropological community with examples of internal cranial fracturing and to emphasize the need to include internal examinations of the cranial bones in the protocol for forensic analysis of perimortem trauma.

This presentation will impact the forensic community and/or humanity by emphasizing the importance of examination of the internal cranial vault in assessing skeletal trauma.

The literature on cranial injuries focuses primarily on those visible on the external surface such as depressed fractures or those that transgress both inner and outer tables such as linear fractures. Experience with recent cases has highlighted the importance of internal examinations even in the absence of external indications of damage.

The anatomy of the skull is that of a sphere with a number of areas of weakness produced by foramina and areas of increased strength produced by buttresses. The outer table of dense bone provides a protective coat that, in many places of the cranial vault, covers a layer of trabecular bone known as diploe. The inner table provides direct protection for the brain and major blood drainage systems associated with the central nervous system.

Bone fracturing occurs when the abilities of bone tissue to withstand exceeds the bone's resilience. Being a combination of organic and inorganic materials, bone is capable of both elastic and plastic deformation prior to failure. Once bone is broken, however, the fracture will be transmitted through the bone until the energy is dissipated. Cranial fractures are usually depicted in the forensic literature as affecting primarily the outer table with secondary ramification on the inner table. In the two cases presented here, the outer table damage was minimal or absent while inner table or internal damage suggested more serious insults.

In the first case, the decomposed remains of an adult male were found in a field. Skeletal analysis for trauma was requested. The remains were cleaned and found to retain evidence of extensive sharp force trauma including multiple stab wounds to the back and lower side and cuts on the cervical vertebrae. External examination of the skull showed little evidence of damage however, internally, two points of impact were evident with extensive incomplete fracturing radiating from these points. Examination under low power magnification showed fine fracturing on the outer table but insufficient to give the impact points as clearly. Information gleaned about the crime suggested the victim was hit twice over the head with a flashlight, and was tortured with a knife before having his throat cut.

Similarly, in a case presented previously, compression fractures in the posterior portion of the supraorbital plates in the remains of an adult female in her mid-fifties suggested compression fracturing. External damage was limited to minor incomplete fracturing in the left lateral portion of the anterior vault and some in the orbits.

These cases suggest that internal examination either by craniotomy or illumination and visual examination are critical for a complete anthropological evaluation. The energy exerted on the outer table may be transmitted through these bones with little damage but passed through to the inner table in such a manner that fracture point is reached. Cranial vault injuries are more complex than is often appreciated and require more detailed analysis.

Trauma Analysis, Cranial Fractures, Protocol

H12 Perimortem Bone Fracture Distinguished From Postmortem Fire Trauma: A Case Study With Mixed Signals

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The goal of this presentation is to illustrate the use of burned bone biomechanics to distinguish perimortem trauma from postmortem trauma.

This presentation will impact the forensic community and/or humanity by using a case study to demonstrate the potential of burned bone examination.

Burned bone fractures have been a curiosity to anthropologists for decades. Thermal destruction to bone has a recent renewed interest with increased popularity of forensic science analyses of taphonomic influences and also because of human rights issues.

A recent case in the Buffalo, NY, area illustrates a situation where a body was discovered when a blaze was extinguished in an abandoned building. It was soon determined that the fire was act of arson used in an attempt to conceal a death. While the heat and flames damaged the remains of this adult female, the third author (JJW) discovered head trauma in autopsy, thus a homicide was officially identified.

Past research in the area of thermal destruction of bone by the first author and others (1) has shown predictable patterns of destruction of human remains when observing and assessing body position, soft tissue influence, alteration of bone color, and burn fracture patterns, where charted normal patterns enable researchers to recognize abnormal patterns.

Examination of the burned victim's right hand and wrist presented an unusual pattern of destruction. At and above the wrist, severe burning occurred where there was complete separation of the radius and ulna. While wrist destruction is common for early fire destruction[1], the hand demonstrated atypical damage. The fingers were not in pugilistic posture, and distal phalanges are heat damaged or missing. Since atypical post-cranium burning was diagnosed along with perimortem head trauma ruled as a homicide, the medical examiner (JJW) decided that all bones should be removed and examined in a dry state by anthropologists.

Re-examination of the right radius indicated heat damage and traumatic perimortem fracture at the distal end of the shaft. The radius indicates bending blunt force trauma of the shaft with the forearm shaft bending anterior (compression) to posterior (tension), the opposite direction of a typical Colles fracture that occurs when a person falls, and catches their weight on their wrist and hand.

Indications of pre-fire forearm trauma are confirmed by fracture and burn patters. There is a fracture pattern that is continuous and uniform through burned and unburned bone. The fact that the fracture did not alter in direction or form in the unburned and burned portions of the bone indicates that the bone fractured in a green state, unburned. A second feature indicating fresh bone fracture is an incomplete butterfly fracture. While only visible under microscopic examination, this fracture illustrates a typical green bone butterfly fracture. The fractures described above appear to be the product of perimortem trauma. This trauma likely compromised the forearm and restricted pugilistic posture formation in the right hand since the fulcrum for the powerful forearm wrist flexors is absent. The distal ulna burned beyond analytical capabilities.

When the hand of a fire victim was viewed as atypical after burning, close examination indicated fracture characteristics that could have occurred only before the fire. This case illustrates that knowledge of normal burn patterns assists in the examination of perimortem trauma in human remains. This combined with knowledge of biomechanical properties of green bone fracture aided in the diagnosis and interpretation of a homicide, even in an incident when criminal behavior has attempted to alter evidence with arson.

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Burned Bone, Pugilistic Pose, Bone Fracture

H13 Mandible and Cranial Base Fractures in Adults: Experimental Testing

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This goal of this presentation is to outline results from a recent study on fracture production and propagation in the human skull, and demonstrate the biomechanical forces behind blunt force trauma, cranial base fractures, and mandible fractures.

This presentation will impact the forensic community and/or humanity by showing the biomechanics behind the creation and propagation of cranial base and mandible fractures using experimental testing.

Fracture biomechanics can contribute a great deal to the field of physical anthropology, with trauma analysis aiding in determining cause and manner of death (1). Postmortem trauma assessment is an essential tool for identifying the type of trauma location of impact sites, sequencing blows, and establishing the characteristics of the object responsible for injury (1). In anthropological trauma analysis, one of the most complicated and confusing areas is blunt force trauma. Within the realm of blunt force trauma, cranial base fractures and mandible fractures are two areas that are extremely hard to interpret and have confused anthropologists for years.

Fractures that travel through the cranial base have been designated a wide range of terminology, and an even wider range of biomechanical explanations for their creation. They have been attributed to falls, blows to the top of the skull, and hinge fractures (1). However, the exact mechanisms behind the creation and propagation of cranial base fractures remain unclear. Mandible fractures are similarly confusing, due to the unique shape and biomechanical properties of the mandible which can produce abnormal fracture patterns. The curved shape of the mandible causes it to react to forces in a different manner than do more regular bones, such as the long bones leading to difficulty identifying point of impact.

To illuminate the creation and propagation of cranial base fractures and mandible fractures, a study design was developed that would utilize the cutting edge technology in the fields of industrial and biomedical engineering, while keeping with the needs of anthropology. Because of the unique biomechanical properties of the human skull, it was decided that a non-human substitute was not an option. Fifteen fully fleshed, unembalmed cadaver heads were used. A small portion of the cranial vault was removed from each head, as well as the brain to allow viewing of the creation of the cranial base fractures by high-speed film. An engineering drop tower system was constructed to delivered calibrated, fully monitored blows to each specimen.

Each specimen was impacted in several designated areas in a controlled experiment to produce cranial base fractures. In addition, each head was impacted in the mandible, with five heads impacted at the apex of the chin, five at the midline of the horizontal ramus, and five at the gonial angle. Five data acquisition load cells monitored the biomechanical response of the skulls for compressive and shear stress in the X, Y, and Z moments in millisecond intervals. With the data from the load cells, the forces throughout the impact and fracture propagation were charted and analyzed. After testing, each of the specimens was examined, with fractures charted and photographed. Each head was then processed and reconstructed to analyze the fracture patterns that resulted from each impact location. The experimental design allowed for complete monitoring throughout the impact event, and provided extensive data on how the cranium responds to blunt force trauma and how fractures occur.

Results from the testing showed that cranial base fractures can be created by a strong blow to the lower parietal region, and fracture propagation travels through the areas of least support with in the base. Radiating fractures were also observed around the external auditory meatus. The mandible was shown to have characteristic fracture patterns correlating to the location of impact and resulting stress. Each of the three test areas displayed different patterns, and characteristic areas of tension and compression. Results from testing may help forensic anthropologists to understand confusing fracture patterns in the cranial base and mandible, and provide better trauma analysis.

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Cranial Base Fractures, Mandible Fractures, Impact Biomechanics

H14 Unusual Cranial Base Trauma in Victims of the Khmer Rouge

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After attending this presentation, attendees will be familiarized with an unusual pattern of cranial trauma observed in skeletal remains of Khmer Rouge victims.

This presentation will impact the forensic community and/or humanity by disseminating information to the forensic community regarding a pattern of trauma stemming from extreme interpersonal violence. Hypothetical scenarios will be proposed concerning the specific origin of this trauma.

The skeletal remains described in this study represent victims of the Khmer Rouge; the remains are currently housed in a memorial stupa at Choeung Ek, near Phnom Penh, Cambodia. Between 1975 and 1979, approximately 15,000 men, women, and children were executed and buried in mass graves at Choeung Ek. It is likely that most of these individuals were originally detainees in Phnom Penh's Tuol Sleng prison. In the early 1980s, Vietnamese officials excavated roughly half of the mass graves at Choeung Ek. When the remains were disinterred, they were disarticulated, sorted by bone type, and later stored in a stupa built on the site. The Cambodian government now administers the site as a museum and it is popularly referred to as "the Killing Fields," although numerous such sites are scattered throughout Cambodia.

Witness accounts suggest that members of the Khmer Rouge generally avoided using up scarce ammunition on executions – gunshot was not necessarily the standard method of execution. Alternate means such as stabbing, strangulation, suffocation, and bludgeoning were often employed instead.

A random sample of 85 crania housed in the stupa was examined for morphological variation and trauma. Subadult crania were excluded and a sex estimate was recorded for each individual. Sex estimates were based solely on cranial morphology, as all crania were disassociated from their respective post-cranial portions. Since sex and age estimates were fairly generalized, patterns of differential execution treatment were difficult to assess.

Out of the 85 crania examined at Choeung Ek, ten individuals (12%) display blunt force trauma to the occipital. The trauma typically presents as a sizeable loss of the occipital bone from the middle of the foramen magnum to the external occipital protuberance (roughly between opisthion and opisthocranion). Half of the fractures are focused centrally on the squamous portion of the occipital, the other are oriented to the left or right. In several cases, the foramen magnum is fractured posterior to the occipital condyles; in many cases the entire occipital base is absent. The breakage pattern includes fractures that migrate across the spheno-occipito sutures and into the lesser wings of the sphenoid. Often, fractures run from the margins of the missing bone toward lambda and the mastoid processes. Some of these fractures even split large external occipital protuberances. Multiple blows are apparent on several crania. Radiating fractures are visible on nearly all crania; concentric fractures are associated with some as well. Beveling is present on the margins of the affected bones, typically on the inner table, though a few instances of external beveling occur, suggesting that differential forces were applied to the cranial base.

The cranial trauma appears to represent a unique and deliberate pattern of execution. While most interpersonal violence is directed at the face, forehead, and sides of the head, here it is directed at the cranial base. Two possible methods of producing the observed trauma are proposed. One hypothesis is that the individuals were struck while in a crouched "execution-style" position, much the same as would be appropriate for a beheading. A second possibility is that the executed individuals were struck with an upswing directed at the skull base, while standing. In either case, this trauma demonstrates an effort to maximize the effectiveness of the blow - this area of the skull is strongly supported, but potentially sensitive because of its connection with the spinal column.

Forensic Anthropology, Cranial Trauma, Execution

H15 Microscopic and Cross Section Analysis of Occult Intraosseous Fracture (Bone Bruise) of the Skull

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The goal of this presentation is to present a case report in which cross-section analysis of a so-called "bone bruise" of the skull revealed extensive microfracture of the bone.

This presentation will impact the forensic community and/or humanity by raising awareness of the forensic importance of bone cross-section analysis for occult intraosseous fracture, and show the possibility of using this pattern of microfracture in comparative tool mark analysis.

Occult intraosseous fracture of bone, otherwise known as a "bone bruise," is usually the result of compressive and/or impaction forces - including falls, car accidents, sports injuries, and other injuries including deliberate blows received at the hands of others. In the clinical setting, a bone bruise is often considered an area of trabecular bone microfracture with bony alterations similar to those seen in stress fractures, and there is little or no limitation of motion or function. In these clinical settings, bone bruises are poorly defined, and are not visible on plain film radiographs. Magnetic Resonance Imaging (MRI) often reveals subtle variations in signal intensity of the medullary bone, but this MRI modality is not readily available in most forensic autopsy settings. Gross examination of the bone at autopsy often demonstrates discoloration of the bone due to hemorrhage, but with a bone bruise there are no visible cracks in the bone, nor variation in the contour of the bone's surface. However, gross and microscopic *cross-section* examination of these areas can reveal evidence of impaction or compression forces sufficient to break the bone. This cross-section analysis of the bone can also be valuable for determining the precise area of bone which sustained the blow. Measuring the extent of discrete areas of microfracture has the potential to prove useful for tool mark comparison studies.

In this case study, the decomposing body of an adult female was found outdoors partially covered by forest debris. The skull was essentially skeletonized, although there was a considerable amount of soft tissue remaining on the lower trunk and extremities. The cause of death was determined to be sharp force trauma. The only area of apparent injury to the skull was a 1 X 3 inch teardrop - shaped area of discoloration in the frontal bone at the midline.

Gross examination of both the ectocranial and endocranial surfaces of the bone revealed no break in the contour of the bone. Plain film radiographs of the bone did not reveal the presence of any fractures. Within the darkened hemorrhagic area, however, there was a small semicircular line of darker discoloration on the ectocranial surface. A wedge-shaped section of frontal bone, including this line, was harvested with an oscillating bone saw. On cross-section, the gross appearance of the entire wedge of bone

revealed the hemorrhagic discoloration had seeped through the outer cortex to the diploë, and portions of the diploë were filled with blood. The bone exhibited fractures parallel to the ectocranial surface. Cross section examination also revealed other numerous tiny fractures, which extended into the diploë. These fractures could be seen by the naked eye. The fractures were essentially parallel, with separation of their margins being wider at the ectocranial surface of the bone, and becoming progressively narrower as they approached the diploë. None of the fractures crossed the diploë. The microfractures stopped abruptly at the outline of the semicircular line on the ectocranial surface of the bone.

Analysis of the semicircular line was done by the side-by-side comparative microscope technique usually reserved for ballistic comparative analysis.

Bone Bruise, Trauma, Tool Marks

H16 Disappearance, Torture, and Murder of Nine Individuals in a Community of Guatemala

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The goal of this presentation is to discuss a case in which fifteen individuals disappeared from the Ixil region of Guatemala between 1980 and 1982, and suggest the role that the Guatemalan Army played in the case.

This presentation will impact the forensic community and/or humanity by demonstrating that nine of these individuals were victims of systematic torture and murder during the Guatemalan Civil War.

The committee for Historical clarification of Guatemala (CEH) registers 32 massacres which took place between 1980 and 1982 in the Ixil ethnic region of Guatemala. Also occurring during this time was the total or partial destruction of 90 villages in the area, and the displacement of a major part of the rural population from its territory. The case presented here involving the nine recovered individuals is from one of these 32 massacres. The purpose of this investigation is to give this case exposure and provide scientific evidence to the justice system in order to start a trial.

The investigations carried out by the CEH revealed the existence of a clandestine cemetery in the hamlet ¨Batzcorral." This case appears twice in the report, with different dates. The first version relates that during February 1982 the bodies of five persons displaying signs of torture were found in the above-mentioned hamlet. The second version mentions that during the year 1985 a battle between the army and the guerillas occurred. This was the reason why army members, as revenge, tortured, and executed fifteen persons, whose bodies where dismembered.

The testimonies gathered by the Fundacion de Antropologia Forense de Guatemala, through interviews with members of the families of the disappeared, indicate that after a battle between the guerillas and the army of Guatemala, the soldiers started to search the outskirts of Nebaj for individuals who were allegedly involved in the conflict. On July 10, 1982, five men where captured. Five weeks later 10 more were reported missing. According to the testimonies, some of them were at their places of business. Neighbors say that they saw army members taking the missing persons to the military base. The wife of one of the missing related that she went to the base and asked for her husband. She was told that he was not there and that he might have gone to another place.

On September 15 of the same year, the owner of a nearby field informed family members that he found bodies being bitten by dogs, and that they presented signs of torture. Therefore, family members and neighbors decided to dig a grave to bury the bodies.

In the results obtained by the FAFG, two clandestine graves were found. In total, nine incomplete skeletons and eighteen limb bones (twelve arms and six legs) were recovered.

During the analysis of the bones, it was found that the nine skeletons were male (eight adults and one subadult). Each case presented trauma caused by sharp and blunt forces to the arms and legs, as well as blunt force trauma to the ribs. Cuts to the clothing were also observed. Seven bodies were mutilated, which was, according to the CEH, typical during the civil war in Guatemala. The trauma to these individuals is evidence of systematic torture. Therefore, according to the International right, the crimes of torture and murder were committed in these cases.

Torture, Mutilation, Massacre

H17 Morphoscopic Traits and the Statistical Determination of Ancestry

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This presentation will impact the forensic community and/or humanity by showing how they can utilize non-metric traits in a statistical approach and immediately start using these techniques to assess ancestry. Their opinions will be more reliable because they can state a probability of group membership and will know the samples and sample sizes their results and conclusions are based on.

The primary goal of the presentation is to provide statistical guidelines and results for using nonmetric traits in the determination of ancestry. It will be made clear that several statistical methods provide enhanced utilization of non-metric traits in the classification of unidentified human crania.

Hefner [1, 2] has shown empirically that the "typical" nonmetric traits of African-, Asian-, and European-derived groups are not found at frequencies suggested by forensic anthropologists such as Bass, Byers, Gill, and Rhine. These traits were highly valued by Earnest Hooton, and come predominantly from his "Harvard List" of traits. Hooton prepared illustrations of the "Harvard List" but apparently, neither he nor any of his students published group trait frequencies. While the extreme trait expressions are not as frequent as suggested and thus, not as reliable for estimating ancestry, the traits were nonetheless demonstrated to have value in discriminating between American Blacks and Whites. Hefner *et al.* [3] introduced a Binary Optimized Aggregate Score (BOAS) statistic that classified a sample of 165 American Blacks and 160 American Whites into ancestry 80% correctly. BOAS weighed each variable equally: it was simply the sum of binary trait scores (0 or 1) heuristically derived from the ordinal trait scores.

Discriminant functions (DF) optimize the weights of each variable to maximize group separation. However, Linear Discriminant Functions (LDFs) usually require multivariate normality and approximately the same level of variation in order to produce reliable results. LDFs are aided by the central limit theorum, which tends to increase the normality of data as more and more individuals are added. Some statisticians [4] have suggested that dichotomous or ordinal variables could be used in a LDF as if they were metric with certain caveats. One criterion of a valid two-way DF is that the DF scores of each group should be approximately normally distributed. This way, the sectioning point is guaranteed to be the optimum and should be valid for future samples, and posterior and typicality probabilities will represent the correct values. However, sectioning points can still be derived whether or not the DF scores are normally distributed. For example, if a measurement or function completely separated groups, it could be used no matter what the distribution was. One caveat is that the posterior and typicality probabilities may be misleading.

Logistic regression (LR) has been used to discriminate among groups and does not require assumptions of group variation and multivariate

normality. LR can incorporate categorical data as well as continuous data, and can utilize both in analyses. LR calculates a probability of group membership directly, rather than first calculating a composite score, then comparing group scores, and only then calculating a probability, as in LDFs. Similarly, two non-parametric DFs, Kernel DFs (KDFs) and Nearest Neighbor DFs (NNDFs), calculate probabilities directly, independent of group distributions.

For this study, the same ordinal data from Whites and Blacks were analyzed using LDF and a curious pattern emerged. The DF scores and probabilities for each group were skewed but in opposite directions in nearly every analysis, including LDF, KDF, NNDF, and LR of the original variables, as well as LDF of the principal components of the conventional and polychoric correlation matrices of scores. The principal component loadings of the polychoric and Pearson correlation matrices of the traits were remarkably similar (rho = 0.92). Transformations of scores did not appreciably affect the distributions. Cross-validated accuracies up to 90% were achieved using as few as three traits.

LR was the best method overall, in three-group analyses as well, but LR does not produce typicality probabilities. To substitute for typicality probabilities, nonparametric methods such as ranked probabilities and ranked interindividual similarity measures can be employed.

Analyses using KDFs and NNDFs also produced very good results, with crossvalidated accuracies approximately 88%. These results were better than using a basic Bayesian approach, which assumes independence of traits and weighs each trait equally. Problems with a simple Bayesian approach were illustrated by using a trait such as postbregmatic depression, which was present in 44% of the Blacks and 17% of the Whites. Postbregmatic depression was attenuated in LDF and LR through much lower function coefficients.

Our results show that the nonmetric traits examined can be analyzed in ordinal or binary scales (minimizing interobserver error) using DFs. LR produced slightly better results and provides a more robust and reliable prediction of ancestry using nonmetric traits. The results also empirically confirm the value of using nonmetric traits in a statistical framework, as Hooton had hoped. *Daubert* concerns can be addressed through using appropriate and large samples, recorded group frequencies and probabilities, graphs, and cross-validated results, rather than relying solely on the experience and intuition of the observer.

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Non-Metric Traits, Logistic Regression, Determination of Ancestry

H18 Forensic Identifications and the Complexity of Determining Biological Affinities of "Hispanic" Crania

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The attendees will be presented with results of a three-dimensional, geometric morphometric analysis of cranial shape illustrating variability in modern Latin American populations likely associated with differing migrational histories.

This presentation will impact the forensic community and/or humanity by raising appreciation of the biological diversity of "Hispanic" populations.

The use of "Hispanic" as a classification or category does not provide an adequate biological profile because it groups together populations of varied genetic backgrounds. In the U.S., the term "Hispanic" includes all persons of Spanish speaking countries. However, in the forensic setting the use of such an umbrella term is problematic because it ignores the distinct ethnohistories and migration patterns of each geographical region. According to the 2002 U.S. Census, more than one in eight people in the United States are of Hispanic origin and are more geographically concentrated in specific regions of the U.S. than non-Hispanic Whites. These statistics could have major implications in the medicolegal setting for the identification of unknown skeletal remains.

In recent studies, the authors demonstrated that modern Cubans show a strong African affinity followed by a Spanish component and lack an indigenous Amerindian biological affinity suggesting a complete replacement of the indigenous Cuban population. Contra, Mexicans show a different biological pattern entirely, lacking both the African and Spanish components, while having a strong indigenous Amerindian affinity.

This study presents ongoing research documenting the diversity of "Hispanic" populations. In order to further investigate the regional and geographic variation of Hispanic populations, the authors present the among-sample morphological variation of modern Panamanians (n=9), Afro-Antillean or West Indian Panamanians (n=6), modern Cubans (n=23), prehistoric Cubans (n=6), Prehistoric Ecuadorians (n=13), Spanish (n=30), Mexicans (n=31), American Whites (n=52), and Terry Blacks (n=18) using landmark-based Procrustes superimposition from the geometric morphometry. Twenty-three standard craniometric landmarks were used to reflect the among-group variation. A Microscribe G2X® digitizer was used to collect the coordinates using the software *Three Skull*, developed by Stephen D. Ousley.

A nonparametric MANOVA comparing the sum-of-squares accounted by group membership to that of 999 random permutations of group membership detected significant group differences. In addition, an Unweighted Pair Group Method with Arithmatic Mean (UPGMA) clustering analysis was performed from the generalized squared distance matrix to characterize relative shape similarities between the groups. Terry blacks, modern Cubans, Spanish, and American whites form a cluster distinct from the Ecuadorian, Mexican, Panamanian, and West Indian Panamanians samples. Interestingly, the West Indian Panamanians are more closely related to groups with strong Amerindian affinities rather than African affinities.

The majority of the Panamanian population is mestizo or admixed (Amerindian and Spanish or Amerindian, Spanish, West Indian, and Chinese). Panama's history has been shaped by its unique geography. First exploited by the Spanish as the crossroads and point of transfer for the gold, making its way from South America to Spain and, more recently, by the building of the Panama Canal. During the construction of the canal,

Panama saw a large influx of West Indians and Chinese immigrants brought as laborers, which had a lasting impact on the country's genetic make-up.

Notably, these results further support that populations broadly grouped together as "Hispanics" are not all the same and emphasize the importance of investigating regional or geographic morphological variations while taking into account the unique ethnohistorical origins of Hispanic populations. Incorporating these unique patterns of variation along with census/demographic data into forensic practice could substantially aid in the identification of unknown skeletal remains.

Forensic Anthropology, Hispanic Populations, Geometric Morphometrics

H19 Biological Variation Among Hispanic (Spanish-Speaking) Peoples of the Americas

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The goal of this presentation is to present the biological variation that exists among Hispanic (Spanish-speaking) peoples of the Americas and how this variation allows for the development of better standards in ancestry identification.

The purpose of this paper is to demonstrate the biological variation that exists among Hispanic (Spanish-speaking) peoples of the Americas. This paper will also attempt to show that craniometric data from different geographic areas in Latin America and Mexico could aid in the determination of the geographic origin of unknown individuals identified as Hispanic. Additionally, this paper will explore postcranial variation of Hispanic groups when compared to American Blacks and Whites. The impact of this research can aid in the development of better craniometric standards for use in ancestry identification on an international level. For example, FORDISC 3.0 will have more appropriate samples for use in Latin America and other parts of the world.

The determination of ancestry or group affiliation is one of the primary factors in a forensic anthropological analysis. Craniometric data is commonly used as a means of ancestry determination. However, sample specific standards may not always be readily available for a particular group. In the United States, "Hispanic" refers to individuals originating from Mexico, Puerto Rico, Cuba, South or Central America, or other Hispanic/Latino origin (U.S. Census Bureau 2003) and therefore does not have precise genetic meaning. In general, Hispanics are hybrid populations composed of various African, Native American and European genetic backgrounds. Caribbean Hispanics may have large African components, while Mexican Hispanics may have large Native American components. For example, Ross *et al*. 2004, using geometric morphometric methods, found Cuban Americans nearer to American Blacks, indicating the term Hispanic as too broad.

When analyzing biological variation from skeletal metrics, a commonly used method is biological distance or Mahalanobis D^2, a measure of population divergence based on polygenic traits (Buikstra *et al*. 1990). Samples used in this analysis are Guatemalans, Argentineans, American Hispanics and American Whites. All samples are modern and forensic in nature. The D^2 distances among all groups are all significant at the .001 level, indicating that group centroids are significantly different. The D^2 distance matrix indicates that the smallest distances, therefore the most similarities are found between American White and American Hispanic females, followed by males from the same groups. Argentinean males are more similar to American Hispanic males and furthest from Guatemalan males. Overall, Guatemalans are most differentiated from all other groups. When the first two canonical means are plotted they show, again, that Guatemalan males are furthest from the centroids and therefore more differentiated from the other groups. CAN 1 separates the sexes and indicates that American White males have taller, wider and longer cranial vaults. CAN 2 indicates that Guatemalan males have more facial forwardness, a wider face with wide nasal aperture, a wide palate and a wide interorbital breadth.

While all groups exhibit differences, Guatemalans appear to be most differentiated from all other groups. The most likely explanation for these results is that the Guatemalan sample is comprised of Indigenous individuals, i.e. more or less pure Native Americans, while Argentinean and American Hispanics have more European admixture. Additionally, craniometric data of known individuals from different groups could potentially aid in identifying more specific geographic origins of individuals who die in U.S. border crossings.

Biological Variation, Hispanic, Craniometric

H20 Classification and Evaluation of Unusual Individuals Using FORDISC

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After attending this presentation, attendees will have a greater appreciation of how to interpret FORDISC output, especially when using it with crania originating from populations different from FORDISC's reference samples. The importance of the use of an appropriate reference sample will be emphasized.

This presentation will impact the forensic community and/or humanity by increasing the forensic investigator's knowledge of the utility of the FORDISC program and other discriminant function analyses in identifying unknown remains.

FORDISC is an interactive computer program designed to classify an unknown adult cranium based on known samples from the Forensic Anthropology Data Bank and the Howells (1989) world sample. FORDISC uses discriminant functions to construct a classification matrix and assign group membership of the unknown cranium into one of the selected reference groups.

The utility of FORDISC for use in classifying worldwide populations has been criticized in the past for its "attempts to constrain worldwide human cranial variability into discrete biological groupings, or races" (1) and for classifying sex based on size (robust vs. gracile) rather than shape. These analyses are misleading for two reasons and demonstrate the two most common misapplications of FORDISC: use of inappropriate reference samples and failure to properly evaluate the typicality and posterior probabilities provided by the program.

FORDISC is designed to classify unknown crania based on the reference samples in its database. The researcher guides the analysis by choosing the populations against which to classify the unknown, choosing from eleven population samples from the Forensic Anthropology Data Bank or 28 population samples from Howells' worldwide database. Reference samples chosen for comparison should be those most likely to be the source population of the unknown cranium. The posterior and typicality probabilities together indicate the strength of the classification. The posterior probability evaluates the probability of group membership under the assumption that the unknown belongs to one of the groups in the function (3). Under the assumptions of the discriminant function analysis, the unknown cranium must be assigned to one of the groups chosen. The typicality probability, however, represents how likely the unknown belongs to any particular group, and includes the probability that the unknown may belong to several

or none of the groups selected. This value indicates how atypical the unknown skull would be in the populations chosen for comparison.

In this paper, classifications will be evaluated using data from the Forensic Anthropology Data Bank and Howells' worldwide data, using crania from populations known not to belong to any of the reference samples. Posterior and typicality probabilities usually indicate that a cranium is not similar to any reference sample. In order for FORDISC to perform effectively, it must be applied in regions or contexts where reference samples adequately represent cranial variation.

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FORDISC, Classification, Unusual Crania

H21 Ur-FORDISC, or Early Statistical Methods in Forensic Anthropology

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The goal of this presentation is to review the early extension of quantitative statistical methods in forensic anthropology that provided the impetus for the development of FORDISC for use in research and casework.

This presentation will impact the forensic community and/or humanity by providing help to forensic anthropologists and other forensic scientists in understanding the origins of the multivariate statistical techniques used in their field.

A statistical approach to skeletal identification and description developed in the nineteenth century with the use of indices to quantify observational characteristics of features such as skull shape, nose shape, relative long bone lengths, and the like. An index so used had the advantage of ostensibly removing size from consideration, and allowed its adherents to claim a quantitative group characterization of shape. The French anthropologist Paul Topinard wrote in 1894 that a cephalic index (100 X head breadth - head length) of 75 and under was "universally adopted" (but there were exceptions) as defining long-headedness or dolichocephaly. Topinard also combined several sets of skeletal measurements to form a database for determining stature by average long bone/stature ratios. For example, he found stature to be seven times maximum radius length, so stature (cm) = 7(radius length [cm]) plus 3.5 cm (a constant he employed only to move from skeletal to living stature).

Topinard's ratio approach seriously misrepresented both ends of the stature range. His remedy was to divide the sample into tall, short and medium sized people. A more adequate solution, which underpins today's FORDISC, was first used by the British biometrician Karl Pearson at the turn of the century. Pearson applied regression, said to be the most used and least understood type of statistical methodology, in its most elementary form, linear regression, to the calculation of stature. As Pearson (1899) put it, "The theory of regression shows that the most probable value of B [for example, stature] is expressible, so long as the correlation is normal, as a linear function of A [for example, femur length]."

A step of significance in the application of statistics to forensic anthropology came in the middle 1930s. Sometimes called the Fisherian stage of discriminatory analysis after its principal originator, R.A. Fisher, the linear discriminant function was initially applied by colleagues of Fisher's to problems familiar to forensic anthropologists. E.S. Martin in 1935 used Fisher's linear discriminant function to sex a collection of Egyptian mandibles, and M.M. Barnard in 1936 used discriminant function analysis to determine the secular variation in Egyptian skulls. Barnard used seven very familiar cranial measurements: maximum breadth and length, nasal width, and height, and the bregma-nasion-basion triangle. He stressed the applicability of the technique to supplement visual sexing of crania, particularly "to investigate further the minority of cases where the sex cannot be determined, without doubt, anatomically."

The next important mileposts, theoretically at least, on the road to FORDISC appeared in the Cambridge PhD thesis of the Indian statistician C.R. Rao in 1948. Fisher's discriminant function dealt with two categories; no doubt one reason that early applications involved human crania was that sexing conveniently offers two such categories. Rao, however, provided the theoretical basis for expanding discriminant function analysis to many categories, and, if that wasn't enough for one thesis, developed a test which answered his own question on the need to establish how many characters to use, "All right, given a set of measurements, is there further information in an additional set of measurements?"

Of the two preeminent physical anthropologists of the first half of the twentieth century, one, Ales Hrdlicka, suffered, as Alice Brues put it, from "math anxiety" and detested statistics. Fortunately the other, Earnest Hooton, did not, nor did his students, many of whom, well-placed academically, contributed to modern forensic anthropology such as Harry Shapiro, Bill Howells, Fred Hulse, Charles Snow, Alice Brues, and Larry Angel. In the late 1950s to early 1960s publications utilizing discriminant functions by Fred Thieme, Kazuo Hanihara, Jose Pons, Eugene Giles and Orville Elliot, and others began to appear. Giles and Elliot's papers in particular focused on forensic applications and their work was referenced in the first forensic anthropology text, W.M. Krogman's *The Human Skeleton in Forensic Medicine* (1962). Forensic anthropology statistics, although regarded suspiciously by some and grudgingly accepted by some others in the 1960s and later, and facilitated by the replacement of calculators by computers, led by the end of the twentieth century to the spectrum of aids to forensic anthropology incorporated in such now indispensable tools as FORDISC.

Discriminant Functions, History of Forensic Anthropology Statistics, Fordisc

H22 The Next FORDISC: FORDISC 3

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After attending this presentation, attendees will appreciate the power and utility of the next generation of FORDISC, and have a heightened awareness of modern American population variation. They will also use statistical procedures more critically.

This presentation will impact the forensic community and/or humanity by showing enhancements to the program and some lessons the authors have learned about multivariate analysis and American skeletal variation.

The goal of this presentation is to describe changes, additions, and improvements to FORDISC 2.0, the popular interactive computer program that uses Discriminant Function Analysis to classify unknown skeletal remains based on known samples using cranial or postcranial measurements. The presentation will introduce the power and utility of the next generation of FORDISC, and heighten awareness of modern American population variation. FORDISC 2.0 has been used extensively to aid in ascertaining the biolgical profile of skeletal remains. To date over 400 copies have been sold. The impetus to develop FORDISC came from increasingly frequent requests from forensic anthropologists to calculate "madetoorder" discriminant functions (DFs) using data from the Forensic

First, the reference group sample sizes have been increased, especially Data Base (FDB). The power of DFs lies in the fact that DFs maximize the differences in bone size and shape among groups. Such custom DFs are necessary when measurements required by published DFs, for example Giles and Elliot (1), are impossible to obtain. DFs are also desirable when one wishes to compare the unknown to different reference groups. FORDISC 2 allows anthropologists to construct DFs using two to eleven modern groups, some including males and females, using up to 34 craniometrics, or two to four groups using up to 39 postcranial measurements. Additionally, FORDISC 2 enabled the easy estimation of stature from long bone lengths. FORDISC 3 expands on the utility of FORDISC 2 in several areas and addresses many of the caveats of using discriminant functions (7) that have been derived from theoretical and empirical results.
for Hispanics from the Southwest U.S. There are approximately twice as many Hispanic males available for analysis, as well as a substantial Hispanic female sample. Additionally, samples of 19th century whites and black males and females have been added, making FORDISC more useful in archaeological, as well as forensic, contexts. Despite warnings, many users have been using FORDISC to analyze non-20th century remains anyway.

Second, FORDISC 3 incorporates more measurements in the reference databases, namely the full Howells [2] set of measurements. More useful measurements are now available to help discriminate among groups. Additionally, the basic FDB measurements have been expanded to include biasterion breadth, zygomaxillary breadth, and mid-orbital width. These three measurements vary among groups and the landmarks are easy to locate.

Third, FORDISC 3 will analyze and incorporate other data sets. This will allow different reference samples to be used for comparisons. Samples, for example, of Plains Indian tribes, can be analyzed against each other or against Howells or FDB groups. It will also analyze any set of variables, including cranial interlandmark distances (ILDs), which have been shown to be quite useful in discriminating among a variety of groups [3, 4, 5, 6].

Statistical enhancements are numerous. Stepwise selection (forward, backward, and exhaustive) of variables using multivariate criteria and classification accuracy is incorporated. DFs are sensitive to outliers, and a robust DF option will be available. Transformations of measurements into natural logs and shape variables can be easily selected. Logistic regression and non-parametric analyses are planned as well, including K-nearest neighbor classification and kernel DFs. Stature estimation will be possible through Model I and Model II Regression.

Enhancements to the program itself are numerous and will be ongoing. Graphic output will include kernel densities or adjustable histogram widths for 2-group analyses, and 2- and 3-D scatter plots of more groups. As program changes and enhancements or database updates become available, Fordisc 3 can be updated on the user's PC through an internet connection. With feedback from users, incorporate further enhancements will be incorporated.

In short, FORDISC 3 is a quantum leap in the power and utility of FORDISC 2.0.

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Discriminant Functions, Biological Profile, Multivariate Statistics

H23 Anatomy of a Cauldron: Sociocultural Contributions to Understanding a Forensic Case

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The goal of this presentation is to offer a sociocultural perspective to the medicolegal investigation of ritual objects.

This presentation will impact the forensic community and/or humanity by demonstrating the use of ethnographic data in deconstructing the elements comprised in a nganga, or ritual cauldron, found in a suburban New Orleans setting. This research will aid investigators and anthropologists in understanding the purpose and meaning of these increasingly commonly discovered religious objects and origins of the human bones contained therein.

Santeria, a widespread religious practice originating in the Yoruba culture of Northern West Africa and Palo Mayombe (also called Palo Monte), which derives from Central African Congo, are often misinterpreted as constituting the same beliefs and practices, along with other religious traditions of Afro-Caribbean origin such as Haitian Voodoo, Obeah, and Brazilian Candomble. Each is a syncretism of indigenous African beliefs and the Catholicism of the Spanish colonial cultures, and although they share a similar symbolic structure, the belief systems are distinct. However, since Palo Mayombe is traditionally associated with "black work," a practitioner of Santeria (*santero/a*) may also be indoctrinated into Palo Mayombe to perform more nefarious purposes for which Santeria offers little option [4]. Palo Mayombe rituals, then, can be adopted by the devotees of other religious traditions when harmful deeds are required.

The ritual life of Palo Mayombe is focused on an *nganga*, or cauldron, which serves as a receptacle for a spirit that will carry out supernatural work as bidden by the practitioner, or *palero*. The *nganga* typically contains sacred soil, iron implements, botanical specimens, animal bones and horn, feathers, stones, sticks, and other ritually significant items, arranged around a small collection of human bones, usually the skull and long bones [4]. Once the bones are introduced into the *nganga*, the spirit is propitiated with sacrifices and kept in the service of the *palero* by heavy iron chains and other iron objects to weight it from escape.

Cauldrons associated with Palo Mayombe religious practices have become increasingly common in forensic cases, reported first in the Florida and New York, and now in other areas of the nation as well [1, 2]. Police began discovering these cauldrons with some frequency after the 1980 Mariel boat lift, when 150,000 Cubans migrated to South Florida. With them came their culture, including their belief systems and the associated use of human bones [3]. The presence of human skeletal elements in the *nganga*, of course, brings their discovery under the purview of medicolegal death investigators and forensic anthropologists charged with analyzing the human remains and determining whether a crime has been committed.

The forensic significance of the *nganga* cannot be ignored. Police officers have encountered ceremonial sites in homes while conducting searches, serving warrants or other unrelated investigations, raising questions concerning the origins of the bones. Aside from possible grave desecration to obtain the necessary body parts, other criminal activities may be associated with Palo Mayombe as well. The religion has been associated with drug smugglers and other criminals who attempt to exploit its powers in the commission of criminal activity (3). Furthermore, as the *nganga* must be ritually dismantled upon the death of the practitioner, it is also possible that skeletal components so utilized will be recovered outside of their overt ritual context (2).

Because of the upsurge in cauldron recoveries in a forensic context, it is important to better understand the components of the material artifacts associated with these religious practices. The essentials of Santeria and Palo Mayombe have been well explicated in previous research contextualizing the religious practices within the greater cultural system (2). This research will expand upon previous studies by examining the cauldrons and their component parts specifically, in order to be able to 'read' the motives of the practitioners, which in turn will allow a better understanding of the motives of the practitioners and the most likely origins of the bones. The number of cauldrons in the home, the type of bones contained within the *nganga* (bones of a child, of a murder victim, of a politician, etc), the kinds of faunal and botanical remains employed, and the other associated materials that comprise the cauldron can all convey useful information if interpreted correctly.

Incorporating forensic sources, sociocultural literature, and interviews with local practitioners, this research serves as a starting point for understanding the ritual significance of each component of a recovered cauldron, thereby discerning its purpose. This analysis may aid the forensic community in interpreting *ngangas*: to identify the source of the bones used therein, and reveal potentially valuable details that may indicate the motive, as expressed in the desired 'work' being performed, or the identity of the practitioner.

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Santeria, Sociocultural, Ritual

H24 Not for the Passive: The Active Application of Electronic Resistivity in the Excavation of a Mass Grave

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The goal of this presentation is to demonstrate the use of geophysical examination, in this case electrical resistivity, as an active element in the excavation strategy of a mass grave located near Belgrade, Serbia, and Montenegro.

This presentation will impact the forensic community and/or humanity by demonstrating the comparison between the survey data and the use of the electrical resistivity results in excavation of this mass grave. This demonstrates that active use of geophysics can be a positive element in excavation strategy.

In the past geophysical examination has been used in the search for mass and individual graves but to the presenter's knowledge never in the planning of the actual excavation of the feature. This presentation will demonstrate the use of geophysical examination - in this case, electrical resistivity - as an active element in the excavation strategy of a mass grave located near Belgrade, Serbia/Montenegro.

An unreasonably short deadline, based on political propriety, was given to complete the full excavation, recording, and removal of all human remains and related evidence from the mass grave. While the general size of the grave feature was known through prior archaeological delimitation of the surface feature, the excavation planners could only speculate as to the contents based on other graves already excavated within the same area. The time it took to excavate all the previous mass graves exceeded the short deadline the excavation team now faced. To complicate matters, as the end of the year was approaching most team members including the principle archaeologists were scheduled to leave for winter holiday vacation. It was feared that the excavation would not be completed within the allotted time frame and no 'Plan B' was forthcoming from the political authorities in charge of the site; postponement until spring was impossible and the excavation was to be completed in the time allotted.

To assist in organizing a strategy aimed at accelerating the excavation time, geophysical testing using electrical resistivity was conducted over the targeted mass grave. Results allowed planners a glimpse at the general size and shape of the grave's forensically significant deposits. This understanding of the body mass shape in the context of the grave feature allowed for a more rapid and safe removal of forensically sterile overburden by a construction machine. It is estimated that the use of the construction machine saved at least a week of time and resulted in the safer removal of sterile overburden from the bodies than would have occurred if the planners attempted the remove of overburden without advance knowledge of the body mass shape and size.

During the excavation of the grave, electronic survey data was gathered to represent all recovered human remains, artifacts, and features in two and three-dimensional maps. This survey data was then compared to the electrical resistivity results to judge the reliability of the results and attempt to understand what type of items in the grave produced the greatest resistivity results. Unfortunately, comparison of the evidence types to the resistivity results is mixed and cannot be narrowed down to a particular type(s). However, in general, it was found that the results were very consistent with the survey data when the data was filtered to show the forensically significant deposits as a whole. The comparison with the survey data and the use of the electrical resistivity results in excavation of this mass grave demonstrates that active use of geophysics can be a positive element in excavation strategy. An understanding of soil types and geophysical equipment type limitations are of course necessary. It is suggested that survey data from future excavations where geophysics are used be investigated to gain a clearer understanding of exactly what elements in a grave give the best readings.

Geophysics, Forensic Archaeology, Excavation Strategy

H25 When Experts Disagree: There May be a Rodent Involved – Part I: The Request for a New Trial

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After attending this presentation, attendees should be alerted to the need to assess qualifications and experience of "experts," and to evaluate their findings using a comprehensive examination of the actual remains in question. In cold cases this also requires a review of all previous documentation.

The forensic anthropology component of this case began in 1981 when Dr. WM Krogman was asked to examine remains found in a sleeping bag in Chautauqua County, NY. Krogman's analysis indicated the individual was male, 35-40, and "Caucasoid (white) with an ethnic origin (nationality) probably from Central/West Europe." He was approximately 5' 7 ¼ "of moderately slender body build, weight 145-155 pounds. Time elapsed since death c 1-2 years. Additional comments included "an unhealed (recent) injury which exposes the cancellous composition of the upper orbital margin and the frontal bone above it. At first it was thought to be caused by a knife-slash, but it may have been caused by the glancing impact of a bullet." NOTE: the latter statement will be revisited inasmuch as it relates to a "new theory of the crime."

In 1992 the skeleton was positively identified dentally as Frank Carroll. The remains were shipped to Ohio because of a tip that he had been murdered in Lake County Ohio in 1980. Eyewitness testimony in a 1993 trial alleged that Carroll's death resulted from gunshot wounds fired from a 22-caliber pistol by Larry Schlee, who was convicted. Later, Schlee, with a good lawyer, found the loophole of evidence not submitted at trial. A quest for a new trial began, using affidavits from a forensic pathologist, a "forensic" anthropologist (still not Board Certified nor a member of the AAFS) best known for his work in paleoanthropology, another physical anthropologist who does "not usually use the term 'Forensic Anthropologist' as a formal title," and a "Biomechanical Consultant specializing in Forensic Biomechanics."

In 2002, at the request of Vincent Culotta, Chief Assistant Prosecuting Attorney of Lake County Ohio, the Sauls examined the skeletal remains of Frank Carroll. They looked for the presence of antemortem, perimortem, and postmortem trauma, as well as any taphonomic modifications, and attempted to evaluate and reconcile differences of opinion present in the various earlier reports. The Sauls found that the only perimortem trauma were gunshot injuries. They noted postmortem trauma/defects that included rodent damage to the supraorbital ridges (see Krogman's comment) and other bones, carnivore damage and defects due to postmortem removal of bone for analysis as well as handling.

Upon reading the expert's affidavits, they were startled to learn that a new trial was being requested based on a new "theory of the crime" - death by sharp force. This was the other experts' interpretation of the postmortem damage noted above. A linear groove in the superior surface of the 7th cervical vertebra body, noted by one expert as being "consistent with application of an edged instrumentality," was present only in a 1993 photograph as an impression in what the Sauls suspected was clay used to position vertebrae for photography.

Several of the experts stated that gunshot injuries could not have been responsible for Carroll's death for various reasons, including failure of the bullets to pass through vital structures. Although the Sauls do not consider themselves gunshot experts, Frank P. Saul is Professor Emeritus of Anatomy at the Medical College of Ohio, and felt that the experts' anatomical reasoning was deficient. Furthermore, the Biomechanical Consultant's detailed analysis of the eyewitness account of the shooting and the expected angle and direction of fire based on relative heights and handedness would not apply to all the gunshots fired ("Frank fell to the ground. Larry shot all the rounds from his automatic in Frank's head and neck") - a fact apparently never considered by the expert.

With Mr. Culotta's permission, questions concerning the gunshot injuries and survivability of the victim were reviewed by Carl J Schmidt, MD, D-ABP-FP, Chief Medical Examiner of Wayne County Michigan (Detroit), who is very familiar with gunshot wounds. Dr. Schmidt stated that aside from the life threatening damage caused by the gunshot wound in the right maxilla that exited through the right alveolus and hard palate, the gunshot wound in the right mandible was a probable "contact GSW and the blast effect would have killed him."

The Sauls received permission to forward the remains to Dr. Steve Symes, then at the Memphis Regional Forensic Center, for further analysis. Although Symes' analysis essentially agreed with and amplified the Sauls' analysis, Schlee was granted a new trial. Symes' analysis and trial testimony is continued in Part II: The New Trial.

Cold Cases, Skeletal Trauma, Rodent/Carnivore Damage

H26 An Assessment of Tissue Depth Measurement Tables Used for Facial Reconstruction/Reproduction

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After attending this presentation, attendees will see that tissue depth tables require further research and data set collection in order to produce the most accurate facial reproduction renderings.

Basic research for tissue depth measurements is limited and this presentation will impact the forensic community and/or humanity by showing how further collection of data is necessary to lend any validation to techniques in facial reproduction.

An assessment of standard tissue depth measurement tables used for forensic facial reconstruction, versus recorded postmortem tissue depth measurements, was performed. The purpose of this study is to examine current facial reconstruction standards for their accuracy related to age, sex, and ethnicity of the cranial specimen for which facial reconstruction(s) was performed. In addition, areas of future facial reconstruction research were evaluated.Previous studies and research have documented the various techniques including, computerized tomography, ultrasound, and needle insertion, for acquiring tissue depth measurements. However there is not one uniform method for acquiring these measurements.

There is debate in the field regarding the acquisition of measurements from live versus deceased individuals as well as the distortion of accurate measurements that may occur in some of the previously mentioned methods. Both experts and artists, who perform reconstruction techniques, use a variety of the tables depending on accessibility, knowledge or preference. Some of the tissue depth tables that are used were created over one hundred years ago. Additionally, a summary of previous studies, research, and tables is not available, which ultimately limits the accessibility of data necessary to accurate facial reconstruction/reproduction.

This study contributes additional data sets and elaborates on a previous preliminary tissue depth study. Cranio-facial measurements were submitted to facial reconstruction experts for a blind study examination. Tissue depth measurements were taken from a whole body donor and will be compared to the measurements used to create the facial reconstruction/reproduction model(s). Data will also be reported on accuracy of the various rendering techniques the experts chose to perform.

Tissue depth measurements were taken at twenty-one established anthropological and forensic measurement sites on the facial surface of a whole body donor. Eight other facial soft tissue measurements were taken for comparison with the facial reconstruction renderings. The cranial measurements were acquired following natural entomological decomposition techniques rendering the entire skull free of soft tissue and exposing the cranial surfaces and structures. Prior and subsequent to decomposition, photographs were taken of the donor.

The collected craniofacial measurements and photographs, as well as a questionnaire, were submitted to rendering participants. The experts were asked to create two and/or three-dimensional renderings, which will be compared to the documented tissue depths and craniofacial measurements taken from the donor. Additionally, experts were asked to report their choice of technique and/or table. Their chosen measurements will also be compared with the collected tissue depth measurements. Discrepancies between the donor measurements and the tissue depth tables will be reported as the study is concluded.

During this study, further research needs have been identified. A comparison study of tissue depth measurements performed prior to death via a computerized tomogram and another computerized tomogram after death on the same individual would answer one of the questions about the effect of dehydration on the tissue depth measurements. Potentially, this added

research data would assist those performing facial reproduction/reconstruction(s) in producing a more accurate representation of the aesthetic identity of an individual.

Tissue Depth Measurements, Facial Reproduction, Craniofacial Measurements

H27 Blasting Caps: An Alternate Source of High Velocity Trauma in Human Skeletal Remains

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The goal of this presentation is to present to the forensic community an unusual case of high velocity trauma that mimics bullet wounds to the skull.

This presentation will impact the forensic community and/or humanity by illustrating the advantage of interdisciplinary cooperation in unusual injury cases, and to document the hard tissue impact of high velocity trauma that does not involve guns.

On August 31, 2003, investigators with the La Plata County Sheriff's Office in Colorado were notified of an unattended, suspicious death of a white male in a travel trailer located at an elevation of 7000 feet. Investigators contacted Allaire, requesting assistance in estimating time since death based on the stage of decomposition and the arthropods present at the death scene.

The travel trailer was 23-feet long by 8-feet wide. No lights, air conditioning or heating source were on inside. All of the trailer's glass windows were closed and screened, except for one, which was shattered, though the screen remained intact. The decedent was lying on his back on the bed in the rear portion of the trailer. The shattered window was directly above his head. Bed linens were present beneath his lower body, while his head rested on top of two feathered pillows. He was wearing a short-sleeved pattern shirt and canvas-type shorts with a belt.

The decedent's head appeared to have extensive, "high-velocity type" damage. It was misshapen and multiple fractures were evident. Desiccated tissue held the bones together. Post cranially, the body showed skin slippage in some regions and desiccation in others.

Evidence of blood and soft tissue were found on the wall at the head of the bed, on the window screen, and on the ceiling, extending the entire length of the bed. An electrical power strip with an on-off switch was positioned between the decedent's left forearm and waist. The ends of two sets of electrical wires, which had presumably been connected to the power strip at one time, were located next to the decedent's right shoulder. The other end of each set of wires ran to what remained of a blasting cap on either side of the decedent's head. Vertical tears and burn-scorched areas were present on the pillow where both of the blasting cap ends were found.

Insect evidence collected at the scene included the Diptera species *Phormia regina*, in stages ranging from larvae to adults. Also present were yellow jackets, and various types of beetles, including Hister beetles, *C. maxillosus* and *N. rufipes*. All insect evidence present was collected for preservation, rearing and analysis. Insect evidence suggested an estimated time since death of six to eight days prior to discovery.

At autopsy, the chest cavity and abdominal regions were found to be devoid of all internal organs. Because the trauma to the skull was extensive, the coroner shipped it to Louisiana State University Forensic Anthropology and Computer Enhancement Services (FACES) Laboratory for further analysis. Once the skull was cleaned and partially reconstructed, the overall fracture pattern was evident. As expected, the damage was most significant in the temporal and parietal regions, resulting in many small fragments of bone. The blasting caps produced localized injuries on both sides of the skull similar to gun shot entry wounds and exhibiting internal beveling. In contrast, the face and mandible remained relatively undamaged and the teeth in both the maxilla and mandible were intact. By cleaning and reconstructing the skull, the damage to hard tissue caused by the blasting caps can be clearly documented.

This case provides an example of interdisciplinary cooperation involving the fields of entomology, anthropology, pathology, and law enforcement. Though the death scene appeared relatively straightforward, further analysis of the remains by forensic anthropologists helped to document the extensive nature of the trauma. This documentation provided evidence that blasting caps produce damage that may mimic bullet wounds and, thus, should be considered an alternate source of injury in cases where high velocity trauma is apparent.

Forensic Anthropology, Blasting Cap Trauma, Fracture Patterns

H28 Modern Day Cranial Trepanation: The Ventriculosotomy

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Attendees will become familiar with the recognition of a cranial surgical procedure that may be unfamiliar to the forensic anthropologist.

This presentation will impact the forensic community and/or humanity by better informing forensic anthropologists of the variety of surgical procedures that may affect the human skeleton.

This case study involves a 32-year-old Mexican man whose remains were recovered in a remote desert location in southwestern Arizona. The remains were discovered by law enforcement personnel who were patrolling an area known for illegal immigration into the United States. A presumptive identification was obtained via personal effects recovered with the decedent. The remains were partially skeletonized with extensive areas of mummification of the skin and desiccation of the tissues within the thoracoabdominal and cranial cavities. Of concern to the forensic pathologist was an apparent fracture of the left ala of the thyroid cartilage. A forensic anthropology consultation was requested to address the possible traumata and issues relating to identification.

Results of the forensic anthropology examination revealed that the decedent was likely a Hispanic male who was 28 to 38 years old. One tooth had residual restorative material present, but lacked the complete restoration. The remains were estimated to have a postmortem interval of between one and six months. Healed fractures were present to the left maxilla, the mental eminence of the mandible, and the thyroid cartilage. All of these fractures could have been produced by a single traumatic event.

The most remarkable characteristic revealed during the forensic anthropology examination was a circular defect to the right aspect of frontal squamous. This defect had been transected by an autopsy saw during the craniotomy. The external beveling of this defect suggests that the cranium had been trephined. Present within the external bevel was fibrous and fatty tissue. This defect was discussed with the forensic pathologist who opined that it was likely the result of the surgical placement of a subarachnoid screw for the monitoring of intracranial pressure.

Further history was obtained and revealed that the decedent had been involved in a motor-vehicle accident ten years earlier. The decedent had been the operator of a motor vehicle that struck a utility pole at a high rate of speed. He sustained facial fractures as well as a significant closed-head injury that required emergent ventriculostomy for intracranial pressure monitoring. No neck injuries were documented but evaluation was only clinical beyond radiographs of the cervical spine to rule out fracture. After ten days the ventriculostomy catheter was discontinued and the decedent was transferred to a rehabilitation facility from which he was eventually discharged.

Closed head injury frequently produces elevations in intracranial pressure (ICP) which requires treatment to prevent deleterious, possibly fatal, sequelae. As clinical examination is unreliable in assessment of ICP,

various invasive methods for direct measurement have been developed. In general, these invasive methods employ a burr-hole drilled into the posterior right frontal bone (assuming right hand dominance) for access to the cranial cavity for pressure transducing monitors. This site corresponds to the location where the defect was located in the decedent's cranium. Duration of monitoring is usually on the order of days and no further treatment follows the removal of the monitor except closure of the scalp defect and local wound care.

Ventriculostomy, Intracranial Screw, Trepanation

H29 SEM Analysis of Mummified Skin: A Preliminary Study of Obsidian and Chert Induced Trauma

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The goal of this study is to identify the potential for mummified tissues to retain information involving soft tissue trauma to identify classes of stone tools based on kerf wall morphology. This research highlights the capability of mummified tissues to retain wound morphology, and the value of using Scanning Electron Microscopic (SEM) analysis for identifying class characteristics of weapons in soft tissue trauma.

This presentation will impact the forensic community and/or humanity by studying the microscopic analyses of stone tool trauma from mummified skin which provides two important contributions. First, this study shows that mummified tissues are capable of retaining information pertaining to soft tissue trauma. Thus, mummified tissues may represent an alternative source for analysis of trauma and for weapon identification. Second, the results have shown consistent class characteristics that can aide in the identification of stone tool-induced trauma. These class characteristics may be identified in soft tissue trauma from both pre-historic and modern forensic contexts. Future studies should examine the mummified kerf morphology produced by other weapon types, and the effects of distortion on kerf morphology.

While osteologists typically assess biological attributes from skeletal remains – such as age, sex, and population affininity - there is growing interest in biological anthropology to identify and interpret trauma. Differentiating perimortem trauma from postmortem artifacts provides information on scavenging, cannibalism, and episodes of homicidal violence. Recently, SEM has been used to identify key features of cut bone surfaces [1, 2]. These have provided an advantage over traditional analyses using light microscopy because the SEM offers the ability to capture the third dimension in trauma. The SEM combines high-resolution and increased depth of field to produce a three-dimensional image that enhances the topographical morphology. Thus, features invisible to the naked eye become observable, discernable, and available for analysis.

Previous SEM analyses of trauma have demonstrated that the morphology of kerf surfaces can indicate the class of implements that produced the kerf [2]. Thus, SEM analysis of skin trauma from pre-historic mummies or modern homicides should reflect the class of implements that produced the trauma. Although trauma can be caused by innumerable weapons, the present study will be limited to the analysis of mummified cut marks inflicted by chert and obsidian stone tools on fresh human skin.

The tissue media used for this study were skin samples harvested from fresh bodies donated to the Maxwell Museum of Anthropology at the University of New Mexico. To simulate trauma, obsidian and chert stones were knapped and used to induce trauma by striking the stone onto the intact and in situ skin. One-inch sections of the kerf were then harvested and prepared for SEM analysis.

Tissues were harvested from three different body donors, for a total of 9 samples. The obsidian-induced trauma samples consist of two naturally mummified samples and three silica-induced mummified samples. The chert-induced trauma samples consist of two natural and two silica mummified skin samples. Mummified skin samples were taken to the Department of Earth and Planetary Sciences at the University of New Mexico to obtain SEM images of the kerf walls.

Results from the SEM analysis show that of the skin samples retain information on trauma, although the naturally mummified tissues are less detailed when compared to the silica skin samples. Nevertheless, all of the obsidian-induced traumas have flat kerf surfaces and striations that are wide and smooth, while the chert-induced traumas are characterized by rugged kerf topography, deep and thin striations, and distinctive scratches that were produced when the stone was withdrawn from the tissues.

The results from this preliminary study suggest that 1) there are distinct morphological differences between tissues that are mummified naturally versus artificially; 2) the kerf morphology in mummified tissues is typically retained and class characteristics remain discernable; and 3) SEM analyses could allow for chert-induced trauma to be differentiated from trauma produced by obsidian. Class characteristics and SEM comparisons of the mummified tissues will be presented in detail.

Studying the microscopic analyses of stone tool trauma from mummified skin provides two important contributions. First, this study shows that mummified tissues are capable of retaining information pertaining to soft tissue trauma. Thus, mummified tissues may represent an alternative source for analysis of trauma and for weapon identification. Second, the results have shown consistent class characteristics that can aide in the identification of stone tool-induced trauma. These class characteristics may be identified in soft tissue trauma from both pre-historic and modern forensic contexts.

Future studies should examine the mummified kerf morphology produced by other weapon types, and the effects of distortion on kerf morphology.

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Scanning Electron Microscopy, Kerf Wall Morphology, Mummified Soft Tissue Trauma

H30 Juvenile Idiopathic Arthritis, Pharmacological Treatments, and the Potential for Individuation in Forensic Anthropology

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After attending this presentation, attendees will be able to identify common growth abnormalities and degenerative changes associated with juvenile idiopathic arthritis and some of the pharmacological treatments used to treat the disease. The attendee will also have an appreciation for the changing face of skeletal pathology in light of advancing pharmacological treatments.

This presentation will impact the forensic community and/or humanity by shedding light on not only the importance of the study of skeletal pathologies such as juvenile idiopathic arthritis, but also encourage the investigation of modern pharmacology and its effect on the skeleton and forensic anthropology.

The goal of this presentation is to present the forensic community with an evaluation of the classic osseous changes seen in juvenile idiopathic arthritis, the osseous changes caused by the medications used in treatment, and to present the need for re-evaluation of skeletal pathologies and effects of modern medications on the growing skeleton.

This work will present the results of a thesis written for a Master of Science degree in Forensic and Biological Anthropology at Bournemouth University. This thesis is an evaluation of the past literature of representative skeletal lesions and current literature on common pharmacological treatments and outcomes of juvenile idiopathic arthritis.

One in one thousand children are affected by some form of arthritis. One of these forms, juvenile idiopathic arthritis, develops before the age of sixteen, involves inflammation of the joints, and has no known cause. Unlike arthritis in adults, juvenile idiopathic arthritis affects the skeletal system differently than adult forms of arthritis because the skeleton is still growing and developing. Not only do degenerative changes such as erosions and ankylosis occur in juvenile idiopathic arthritis, but stunted growth of the bones also occurs. Chronic inflammation may be the cause of growth disturbances in the mandible, long bone epiphyses, and phalangeal epiphyses.

The pharmacological therapies used to treat the inflammatory and autoimmune manifestations of this disease also have effects on the skeleton. The purpose of the pharmacological treatments is to reduce inflammation in affected area, and in some cases halt the progression of the disease. Corticosteroids, such as prednisone, have potent anti-inflammatory effects, but also halt growth, and promote the development of osteoporosis. Methotrexate and etanercept slow the radiographic progression of bone erosion in studies on adult arthritis, and may also have the same effect in juvenile idiopathic arthritis. Recombinant human growth hormone is often used to combat the effects of the growth cessation due to the disease and its treatments.

Pathological conditions, like juvenile idiopathic arthritis, sometimes leave specific patterns of lesions on the skeleton. Forensic anthropologists can augment their analysis and identification of an individual by looking for these patterns of lesions. Juvenile idiopathic arthritis has the potential of being this kind of individuator. There are no growth abnormalities or skeletal manifestations that are pathognomonic of juvenile idiopathic arthritis, but severe cases of the disease may be able to be identified by a forensic anthropologist. The pharmacological treatments of this disease, however, may hamper the diagnosis by the forensic anthropologist. Currently, the knowledge of and treatment of juvenile idiopathic arthritis is evolving, and this will affect the appearance of the lesions on the bones. Consequently, the usefulness of juvenile idiopathic arthritis as an individuator will change as treatment regimens progress.

The changing faces of juvenile idiopathic arthritis and adult rheumatoid arthritis in response to rapidly improving pharmacological treatments serve as examples of the changes that paleopathologists and forensic anthropologists will need to make to identify classical signs of disease. Additionally, the future of anthropological analysis will be affected by not only the treated conditions, but by the treatments themselves. The forensic community should be aware of the evolution of pharmacological treatments and their beneficial and deleterious effects for future casework.

Juvenile Idiopathic Arthritis, Pharmacological Treatments, Forensic Anthropology

H31 The Lady in the Box

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After attending this presentation, attendees will realize the importance of perseverance and interagency cooperation in the resolution of cold cases.

This presentation will impact the forensic community and/or humanity by demonstrating how cooperation of law enforcement agencies and forensic specialists is especially important in cold cases.

In 1974, five days after her divorce from John David Smith, Janice Hartman "disappeared" from Doylestown, OH. Police investigated, but the investigation went cold until 1992. In 1991 Smith's second wife, Betty Fran Gladden, also went missing in West Windsor, NJ. Her "departure" was especially suspicious because she had a broken hip. Her sister, Sherrie Gladden-Davis, learned of the 1974 disappearance of Smith's first wife. Attempts to locate the missing women in 1992 were unsuccessful.

Robert Hilland, a former West Windsor policeman now with the FBI in 1998, working with Detective Sergeant Brian Potts, Wayne County Ohio Sheriff's Department (who had pursued Hartman's case) was able to establish rapport with Smith's younger brother, who revealed John had constructed a plywood box (58" x 18") for "storing his estranged wife's clothing." In 1979 he looked inside and saw his sister-in-law wearing a strange multi-colored rainbow wig. He telephoned John, in Indiana, to ask him about the box. His brother quickly returned, put the box into his Corvette, and drove off.

In 1999, following a lead from the brother, the Wayne County Sheriff's Office and Cleveland FBI ERT brought in GPR specialists and the Sauls (ERT consultants) to search under the floors of garages in Seville, OH, that were under construction by Smith's stepfather's company when the box disappeared. Nothing of consequence was found. Later, Potts helped by Sherrie Gladden-Davis, contacted coroners and law enforcement agencies along the route (80) that Smith would have taken back to Indiana, asking about human remains discovered subsequent to Smith's departure with the box. Amazingly, these inquiries produced a response in March 2000 from Morroco, Indiana, where a box with decomposed remains and clothing was found in 1980 near Route 80.

A 1980 "autopsy" and skeletal analysis indicated the remains were a "Hispanic" female, 20-35. The skull and mandible were retained in the coroner's office, while both proximal tibiae and left fibula (the remainder had been cut off below the knee), the intact right femur and both patellae were stored in the Indiana State Police evidence locker. The rest of the skeleton and clothing were interred in the local cemetery.

In March 2000 a court order was obtained based on the probability that the remains found in 1980 were those of Janice Hartman. Following exhumation the Sauls received three separate sets of skeletonized remains at the Lucas County Coroner's Office. Although the three sets of remains were presumed to belong to the individual found in a box in 1980, their original continuity had been disrupted. All sets were considered to be from the same individual based on direct articulation. The Biographic Profile of each set matched, and there was no duplication of elements. The skeletal remains were those of a 20-30-year-old white female who was about 5'3"–5'6" tall. In the absence of antemortem radiographs, the FBI DNA laboratory used bone samples for positive identification. No cause of death could be determined.

Both tibiae and the left fibula in Set 2 and the right fibula in Set 3 were severed below the knees. The Sauls forwarded the cut bone to Dr. Steven Symes, Memphis Regional Forensic Center to obtain information on the tool(s) used for dismemberment as well as the dismemberment process itself. Symes determined the cutting instrument was a serrated knife, not a saw as previously believed. He also determined that the right tibia was cut from front to back while the left tibia was cut from back to front. Since the striated side of the blade was applied to the proximal surface of each bone, it was likely that one leg was removed and the body rolled over before the second leg was removed. The instrument used was never located.

Why were the lower legs removed? Was the box too short? Why were the missing portions not in the box into which he put her clothing? FP Saul and SA Symes testified at the trial. Prosecutor Jocelyn Stefancin's final remarks revealed the meaningful secret of the "rainbow hair" seen by Smith's brother in 1979 – "The Shroud of Janice." Smith was sentenced to 15 years to life.

Cold Cases, Forensic Anthropology, Tool Mark Analysis

H32 Forensic Anthropologist and Forensic Pathologist: Why Work Together? Some Illustrative Cases of Homicide

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After attending this presentation, attendees will understand the importance of interdisciplinary cooperation for the resolution of current forensic cases involving bodies in various states of preservation.

This presentation will impact the forensic community and/or humanity by showing the experience of two European countries in this field.

It is well known that while the forensic pathologist mainly deals with fresh cadavers, the forensic anthropologist "prefers" skeletonized remains. Yet, very often, bodies present an array of preservational states which fall in between these two extremes. In all such situations, from putrefied to skeletonized remains, the presence of both experts should be mandatory. In order to construct accurate biological profiles and, particularly, to interpret traumatic injuries to the skeleton, both anthropological and pathological expertise are crucial from the crime scene, where retrieval of every bone and tooth is significant, to the actual autopsy.

Four homicide cases are discussed, two performed at the Portuguese National Institute of Forensic Medicine and two cases from the Institute of Legal Medicine in Milano, which emphasize the need for interdisciplinarity to increase the frequency of successful cases.

In one case, a routine autopsy of a partially skeletonized body found at a residence revealed apparent perimortem blunt force trauma to the skull. It was concluded that this injury was the cause of death. This led to the conviction of a suspect. A second case involved a suspected gunshot wound to the head. In this case, an examination of the nearly skeletonized remains was conducted five years after the initial incident and revealed concentric and radiating fractures involving the parietal and temporal bones. Although a gunshot wound could not be excluded as the cause of death, the injuries were more consistent with blunt force trauma. The third case, involving skeletal remains found in a cellar, illustrates the necessity of the anthropologist in distinguishing between very recent antemortem trauma and periostitis. Finally, the fourth case, involving a badly decomposing body, demonstrates the importance of osteological expertise in the recovery of skeletal elements at the scene.

Skeletonized, Homicide, Interdisciplinarity

H33 Reducing Intra- and Inter-Observer Error Through Histomorphometric Variable Selection

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After attending this presentation, attendees will understand how the selection of variables can affect the precision and, in turn, the accuracy of histological age estimation.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of exploring the precision of histological variables before they are entered into prediction equations where the output may mask precision issues. This will ultimately lead to better selection and definitions of variables for future methods. This research also provides an indication of the experience needed to perform certain histological analyses, concern for which may be the cause of non-integration of quantitative bone histology in forensic examinations.

Associated with histological methods of age estimation are the numerous ways to count and define histological structures. For most methods, intact and fragmentary osteons are the core variables that carry the most statistical weight with known age at death. These variables are often entered separately into regression equations. The inability to correctly identify osteon types directly affects age estimations. Using osteon population density (OPD), which combines the intact and fragmentary osteon counts and divides them by the amount of cortical area evaluated within a cross-section of bone, is a technique designed to reduce the counting error if an intact osteon is misidentified as a fragment or vice versa. The goal of this project is to determine the precision of osteon population densities versus separated intact and fragmentary densities ($_{I}$OPDs and $_{F}$OPDs) within and between observers. Intra-observer analysis, performed by a researcher with histological experience, and inter-observer analysis, incorporating observations by a researcher with no histological experience, will determine how well the OPD variable corrects for inconsistency and inexperience in identifying osteonal structures.

Rib cross-sections from 234 individuals of known age and sex from the cemetery site of Spitalfields, London, were evaluated. An independent researcher randomly selected 30 individuals for the analysis of intra-observer error (14 male, 16 females; aged 27-79 yrs.) and another sample of 30 individuals were selected for the analysis of inter-observer error (18 females, 12 males; aged 23-80 yrs). The independent researcher was instructed to select non-diagenetically modified samples for the inter-observer sample. Data was collected using osteon definitions from Cho and colleagues [1] and the grid counting method from Stout [2]. Plotting the difference between observations against the mean of the first and the second observation was utilized for OPDs, $_{I}$OPDs and $_{F}$OPDs. Absolute mean percent differences were calculated to quantify the magnitude in variability between measurements with the 10% error level as the cutoff for acceptance.

The results for the intra-observer analysis show that absolute mean percent difference in OPD values is 8.5%. The mean difference is not significantly different from zero, further indicating that repeatability was achieved. Considering the OPD variables separately increases the absolute mean percent difference to 11% ($_{I}$OPD) and 22% ($_{F}$OPD). The mean difference for $_{I}$OPD is significantly different from zero indicating a lack of variable agreement. The $_{F}$OPD mean difference is not significantly different from zero, but less than 95% of the differences are within the limits of agreement, indicating a lack of agreement.

The results for the interobserver analysis show that absolute mean percent difference in OPD values is 11.4%. A plot of the mean differences indicated a magnitude bias in measurements requiring the data to be logged transformed to provide a clearer picture of agreement. The overall mean difference of the transformed data is significantly different from zero and less than 95% of the values are within the limits of agreement, thus indicating lack of inter-observer agreement. Considering the OPD variables separately produces larger error levels ($_{I}$OPD=20%, $_{F}$OPD=27%). The $_{I}$OPD mean difference is significantly different from zero and the $_{F}$OPDs mean difference is not significantly different from zero; however, less than 95% of the $_{F}$OPDs values are within the limits of agreement. Both $_{I}$OPD and $_{F}$OPD demonstrate a lack of inter-observer agreement.

Analysis of the OPD variable indicates that the combination of intact and fragmentary osteon densities reduces overall intra- and inter-observer error compensating for some identification inconsistencies. Individually the measurements exceed the 10% error level, indicating difficulty in differentiating or identifying osteons. The larger differences in $_{F}$OPD compared to $_{I}$OPD indicates a bias in identification and/or counting possibly due to the subjectivity in determining if more than 10% of the Haversian

canal is remodeled or differentiating a fragment without any remnant of a Haversian canal from crowded interstitial lamellar bone. Observer 2 demonstrated more difficulty in differentiating intact osteons from fragments. Despite the higher individual variable error levels, observer 2's combined OPD error level was just above the 10% cutoff. While this indicates that some histological training/experience is needed, it also demonstrates the ability of the consolidated OPD variable to compensate for identification inconsistencies. Fragments consistently produce higher intra- and inter-error levels, indicating that better definitions may be needed. For example, it may improve accuracy to define intact osteons as having a complete Haversian canal removing the subjectivity in deciding what percentage is unremodeled. This research has shown that more error is associated with individual intact and fragmentary osteon counts. Histological methods of age estimation that do not consolidate counts are subject to significantly higher levels of precision error.

References:
1. Cho H, Stout SD, Madsen RW, and Streeter MA. Population-specific histological age-estimating method: a model for known African-American and European-American skeletal remains. *J Forensic Sci*, 2002; 47(1):12–18.
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Observer Error, Histomorphometry, Osteon Population Density (OPD)

H34 Dental Enamel Thickness as a Method of Subadult Sex Determination

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After attending this presentation, attendees will learn about efforts to further explore dental enamel thickness as a possible subadult sex determination method from the dentition.

This presentation will impact the forensic community and/or humanity by providing awareness of a new potential subadult sex determination method for unknown human remains.

There is a paucity of sex determination methods for subadults. The methods that do exist can be highly subjective and/or variable in accuracy. The purpose of this study was to determine if dental enamel thickness could be used to determine sex in subadults. Past studies have shown that females with two X chromosomes generally have thicker enamel than males with one X chromosome and one Y chromosome. In order to test if females have thicker dental enamel than males, data were collected from bitewing radiographs from an ethnically diverse group of 89 children between the ages of two to 13 years. Dental enamel thickness measures were recorded from up to as many as eight separate teeth: right and left mandibular first and second molars, and right and left maxillary first and second molars (i.e., two teeth in each of the four quadrants). For each tooth, two measures were recorded: mesial enamel thickness and distal enamel thickness. Data for as many as 16 variables were recorded for each of the 89 children in the sample.

Results indicate statistically significant sex differences in the enamel thickness for the left maxillary first molar distal ($p<0.027$) and the left mandibular second molar distal ($p<0.050$). It is interesting to note that nearly significant sex differences were found for the enamel thickness measures of the right maxillary first molar ($p<0.056$) and right mandibular first molar distal ($p<0.068$). Further, the right maxillary second molar distal ($p<0.053$) and the left mandibular first molar mesial ($p<0.064$) were nearly significant. In all cases, the *distal measurements* showed greater sex differences than the mesial measurements of enamel thickness. Thus, of the teeth studied, the measures of distal dental enamel thickness for the left maxillary first molar and the left mandibular second molar appeared to be the best discriminators of sex in subadults.

The utility of these preliminary findings for assessing sex in forensic cases will be presented. The goal is to continue to research dental enamel thickness on additional known populations which could further substantiate this feature as a method of subadult sex determination.

Subadult Sex Determination, Dental Enamel Thickness, Forensic Anthropology, Human Identification

H35 Sexual Dimorphism in Vertebral Dimensions at the T12/L1 Junction

Robert F. Pastor, PhD, University of Bradford, Department of Archaeological Sciences, Bradford, West Yorkshire BD7 1DP, United Kingdom*

The objective of this presentation is to demonstrate new methods of accurate sex assessment from the axial skeleton based on dimensional variation of the lower thoracic and upper lumbar vertebral column, specifically the twelfth thoracic (T12) and first lumbar (L1) vertebrae.

This presentation will impact the forensic community and/or humanity by demonstrating that the lower thoracic and upper lumbar vertebrae are highly dimorphic. Measurements for centrum diameters, length of the spinous and transverse processes, and articular facet width were found to provide reasonably accurate sex classification in the range of, or higher than, other postcranial elements such as the lower limbs or pelvis. Both vertebrae should be considered for metric sex determination with complete skeletons and especially in fragmentary forensic assemblages from aircraft and other mass disasters.

The dimensions of many skeletal elements, such as the long bones and pelvis, have been shown by numerous workers to vary systematically with sex. Evidence also exists from several previous studies for sex-based metrical variation in parts of the axial skeleton, such as the atlas and axis, basocranium, sacral elements, and there is preliminary evidence for metric sex and age differences in the lower thoracic and lumbar centra. Reliable metric methods are still in need of development, especially because of the taphonomic problems with buried or otherwise degraded forensic cases and archaeological remains where preservation of the skeleton is often poor. This is especially true for fragile bones of the skull, hands and feet, and pelvis. Due to their weight-bearing function and relative density, the lower thoracic and lumbar vertebrae are often preserved well in archaeological skeletal assemblages and forensic contexts. Even when bone preservation is problematic for the axial skeleton, the unique morphology of the twelfth thoracic (T12) and first lumbar (L1) vertebrae means these can be readily distinguished even when fragmentary. It has also been widely acknowledged that population variation in skeletal element size differences needs to be considered when producing specific standards for accurate determination of sex.

All measurements were collected to the nearest 0.1 millimeter using a Mitutoyo digital sliding caliper. One variable, the AP diameter of the foramen, required measurement with a Mitutoyo vernier sliding caliper with elongated points. Only mature (adult) vertebrae free of pathological insult were measured. All specimens were selected 'blind' to avoid measurement bias for known sex.

A pilot study revealed significant sex differences for several vertebral metric traits (centra diameters) measured in the Hickelton and Raunds historical British archaeological samples (Biological Anthropology Research Centre, Bradford). However, undocumented archaeological samples are limited by the inherent and uncertain variation in sexual dimorphism. Therefore, two documented skeletal collections were used for testing and refining the method and developing discriminant functions for sex determination, because such series provide samples where factors of sex and age can be tested and controlled for statistically. Variation

associated with population differences was also investigated. An expanded suite of metric characters consisting of twelve diameters and dimensions were examined, including the height of the anterior centrum at midline (CENAN), antero-posterior and medio-lateral diameters of the centrum (CENAP and CENLAT, respectively) and vertebral foramen, maximum medial-lateral width across the transverse processes (TRANPRO), maximum spinous process length (SPINPRO), maximum distance between the inferior articular facets (INTFAC), and the maximum height and width of the articular facets (ARFACVER, ARFACWID, respectively). The first phase of this study was conducted on the 18th/19th century Spitalfields documented collection comprising a White immigrant population (French Huguenots) housed at the British Museum of Natural History, London. A total of 53 vertebral pairs from a split-sex sample consisting of 23 males and 30 females were analyzed. The ages of this group ranged from 18-89 years. Significant sex differences were determined for 7 of 12 traits and 8 of 12 traits for the T12 and L1 vertebrae, respectively (Student's t-tests, $p < 0.05$ to 0.001).

Subsequently, a larger study was conducted to investigate the degree of sexual dimorphism and potential population variation for these traits in a second documented sample, the Smithsonian's Terry Collection (Washington, DC), with the aim of developing discriminant functions useful for sex determination. The Terry sample consisted of T12/L1 vertebral pairs (n=124) from 27 White males, 26 White females, 41 Black males, and 30 Black females with ages ranging from 19-63 years. Two additional variables (n=14) were added to the suite of metric traits: the maximum diameter in the sagittal and transverse (medio-lateral) planes between the limits of the superior annular epiphyses (rings) of the centra (CENAPA and CENLATA, respectively).

Separate discriminant function analyses were conducted on the datasets to control for differences by skeletal element and race. The results showed significant sex differences for both vertebrae in the Spitalfields and Terry samples. Using T12, White males and females in the Terry Collection were correctly sexed on average 88.9% of the time using two of the fourteen measurements (CENAP, SPINPRO). Using L1, Terry White males and females were correctly sexed on average 91.8% of the time with the variables CENAPA and INTFAC. For Terry Black males and females, two variables (CENAP, CENLAT) yielded an average correct sexing of 86.6% for T12 and 85.1% for L1. Discriminant function analyses of the Spitalfields male and female sample yielded widely different results for the two vertebral elements. For T12, the highest average correct sexing was 76.7% using the single measurement CENLAT, but for L1 a high of 100% average correct sexing was provided predominantly by the variable TRANPRO, with smaller contributions from the variables ARFACWID, CENAP, and CENAN. The more disparate results for the Spitalfields sample may be due to greater occupational or other sex differences, to secular differences between this and the more contemporary Terry sample, or as a result of the overall younger age range in the Terry sample.

The results of this study demonstrate that the lower thoracic and upper lumbar vertebrae are highly dimorphic. Of the 12-14 metric variables examined, a small subset of measurements for centrum diameters, length of the spinous and transverse processes, and articular facet width were found to provide reasonably accurate sex classification in the range of, or higher than, other postcranial elements such as the lower limbs or pelvis. This is especially true for the first lumbar vertebra of the two White samples. Both vertebrae should be considered for metric sex determination with complete skeletons and especially in fragmentary forensic assemblages from aircraft and other mass disasters.

Sex Determination, Thoracic-Lumbar Vertebrae, Discriminant Functions

H36 Race as a Variable in Dental Health of Korean War Military Personnel

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The goal of this presentation is to educate the forensic anthropological community on the impact of dental health and dental treatment of Korean War military personnel as it relates to race and sociocultural and historical events.

This presentation will impact the forensic community and/or humanity by de-emphasizing the importance of acknowledging the potential influence of pre-conceived notions concerning dental care as related to race, ethnicity, and national origin. In this case, data analysis provided objective statistical support for subjective experience-based assessments. The potential effect of historical events and psychosocial factors on characteristics of dental and skeletal remains should not be ignored during forensic analysis.

This paper will present data concerning the influence of race on dental treatment and health of soldiers, sailors, airmen, and marines serving during the Korean War. This research was spurred by a realization that pre-conceived notions regarding dental health as it varies by race, ethnicity, and national origin (and as reflected in forensic analyses of human remains) can affect the analyst's perception of racial classification. Specifically, in the case of a Korean War-era individual with mixed skeletal indicators of race, extremely poor dental health led one analyst to surmise that the individual was of Korean descent, while another analyst noted that similar degrees of dental disease were frequently seen in African Americans of the same era. This paper is an effort to quantify and/or verify these subjective observations using a sample of individuals from a temporally and occupationally similar background.

The sample for this research was drawn from a database of unresolved Korean War casualties and consists of individuals whose racial classifications were recorded by military officials as "W" (White) or "C" (Colored). All data were taken from original military dental records and represent the most recent documentation available for each person. The age of the White individuals in this sample ranged from 17 to 36 years (average age = 22.7), while the age of the non-White individuals ranged from 17 to 33 years (average age = 21.3). Data coded by the researchers included untreated carious lesions, restoration locations and materials, extractions, degree of calculus buildup, presence or absence of periodontoclasia, dental prostheses, and other oral diseases or anomalies. Class of dental health (a military designation between I and IV that ranks a service member's need for dental treatment) was also recorded.

Preliminary analyses indicate that degree of calculus differed slightly between groups, with non-Whites being more likely to have heavier buildup. Periodontoclasia was uncommon in both groups. The number of non-White individuals whose records showed unfilled/untreated carious lesions was more than double the number of untreated White service members ($p < 0.01$, Fisher's exact test). The number of extracted teeth in the White group was nearly double that recorded for the non-White group ($p < 0.01$, Fisher's exact test), and White individuals were far more likely to have dental prostheses, including fixed bridges and dentures, than their non-White counterparts ($p < 0.01$, Fisher's exact test). More than three times as many restorations were recorded for White individuals when compared to non-White service members ($p < 0.01$, Fisher's exact test), although the material used (i.e., silicate versus amalgam) did not vary significantly between the two groups on an individual basis ($p > 0.10$, Fisher's exact test). Somewhat surprisingly given these figures, dental class (I through IV) did not vary significantly by race ($p > 0.10$, Fisher's exact test).

These findings seem to indicate that the two groups experienced differential dental treatment, with White service members being more likely to have sought and received dental care than non-White individuals. Previous research on modern military samples indicates that non-White

military recruits are less likely to have sought dental care prior to entering the military [1], a phenomenon that seems to be reflected in this Korean War sample. Furthermore, some research indicates that race influences the perceived need for dental care in modern military personnel[2]. Pre-recruitment socioeconomic status of military personnel and ethnic/cultural perceptions of dental care may have played a role in this disparity. Two other events, namely integration of troops and a dramatic increase in the number of military dentists, may have influenced access to dental care for Korean War-era service members.

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Race, Dental Health, Military

H37 Stable Strontium and Geolocation: The Pathway to Identification of Unidentified Mexican Aliens

Chelsey A. Juarez, BA, UC Santa Cruz, Department of Anthropology, 1156 High Street, Santa Cruz, CA 95064*

After attending this presentation, attendees will understand the incorporation of stable strontium into human teeth and bone, and how inductively coupled mass spectrometry analysis of this material can assist the process of identification.

This presentation will impact the forensic community and/or humanity by providing the assessment of a new technique to the troubling and complex issue of cross boundary forensic identification.

The goal of this presentation is to present the progress on the development of a mass spectrometry-based method for the identification of an individual's region of origin through analysis of strontium in the permanent first molar. The application of stable strontium to the identification of deceased Mexican undocumented aliens is a new frontier for this type of research.

Background: Strontium isotope ratios and strontium concentrations collected in teeth and bones have been analyzed by archaeologists to investigate patterns of residential mobility and migration among prehistoric peoples. In this study a similar methodology is applied to forensic material to determine the region of origin for Mexican individuals who died while crossing the border into the United States. Strontium, absorbed through the small intestine, commonly substitutes for calcium and becomes fixed in the crystalline lattice of bones and teeth. Unlike oxygen or nitrogen, the isotopes of strontium are geologically specific, and through mass spectroscopy analysis can be traced to their original source. Strontium levels in bone vary depending on bone structure. Cancellous bone has higher rates than cortical bone, but is also subject to higher rates of diagenesis (fractionation as a result of burial or leaching). The strontium present in cortical bone reflects a fifteen year history of incorporation, a change that is a result of the remodeling behavior of compact bone[1]. Conversely, strontium levels in the roots of permanent teeth reflect the geochemistry of childhood residence and, unlike bone, do not go through significant diagenesis or remodeling. Tooth enamel incorporates strontium only during amelogenesis (process of enamel formation), which for most teeth takes place in early childhood. This strontium signal would provide the region of the individual's origin and potentially narrow down the search area.

Methodology: The teeth for this project came from several bay area clinics that donated the extracted teeth of their Mexican- born patients. This preliminary investigation utilized the permanent first molars of 25 individuals originating from four different Mexican states. These tooth samples were accompanied by information on the individuals' regions of origin within Mexico, their ages, and sex. Each tooth was washed with diluted acetic acid to ensure the removal of any depositional contamination and processed. The tooth strontium was then analyzed using Inductively Coupled Plasma Mass Spectrometry (ICPMS). The delta units obtained through this analysis were compared to known geological ratios for the provided areas.

Results and Discussion: The goal of this project is to provide the most accurate pathway to identification possible. In order to achieve this goal, region of origin information has been broken down into the two-tiered analyses of state identification and region identification (within the state). The Strontium database initial results reveal four specific ranges for each of the four states involved in the analysis. The presence of these complex but clear ranges demonstrates the possibility to identify individuals at a state level. At this point in the study, within-state regional identification is highly complex because the strontium signatures demonstrate a significant amount of overlap. While providing a glimmer of hope, this information suggests the need for study expansion and the incorporation of other lines of evidence.

Stable Strontium, ICPMS, Mexican Aliens

H38 Stature Estimation of Hispanics: The Most Appropriate Stature Regression Equations

Vincent H. Stefan, PhD, Lehman College - CUNY, Department of Anthropology, 250 Bedford Park Boulevard, West, Bronx, NY 10468*

After attending this presentation, attendees will be aware of the most appropriate stature regression equations for the prediction of stature for individuals of Hispanic biological affinity. This presentation will illustrate various methods, and their results, which can be utilized to estimate the stature of Hispanic individuals. Discussion of the most appropriate stature regression equations for stature estimates of individuals of Hispanic biological affinity will provide invaluable knowledge to forensic anthropologists and pathologists who wish to provide more accurate stature estimation.

This presentation will impact the forensic community and/or humanity by demonstrating, discussing, and illustrating the various stature regression equations available for individuals of Hispanic biological affinity and identify the most appropriate equations.

Background: The debate as to the "biological reality" of "race" is still ongoing and heavily contested even within the field of forensic anthropology. Yet, even among the more generally accepted racial groups of Caucasian (White), African American (Black), Native American Indian, Asian, etc., there is debate as to whether "Hispanics" (Mexicans, Puerto Ricans, Cubans, etc.) should be considered a "biological race" or a "social race." As noted by Ross *et al*. (2004:1), "the term 'Hispanic' includes all persons of Spanish speaking countries. However, in the forensic setting, the use of such an umbrella term is problematic because it ignores the distinct ethnohistories and migration patterns of each geographical region. The use of 'Hispanic' as a classification or category does not provide an adequate biological profile." Despite the ambiguities in the classification and/or identification of Hispanic individuals, forensic anthropologists are still required to develop a comprehensive biological profile of an individual who may be of an Hispanic biological affinity. Outside of the racial assessment itself, stature estimation is potentially among the most problematic aspects of the biological profile.

Depending on the geographic region, an Hispanic individual may be a genetic and morphological mosaic of European (Spanish), Native Amerindian and/or African biological elements. Hispanics from Mexico and the Southwest United States have varying degrees of European and Amerindian biological affinity, while Hispanics from the Caribbean (Puerto Rico, Cuba, etc.) have varying degrees of European biological affinity, and may have a stronger African biological affinity with minimal Amerindian

biological affinity. Traditionally, when it came to estimating the stature of an Hispanic individual, forensic anthropologists have relied on the stature regression equations developed by Genoves (1967), which were built on data from Central Mexican (Mesoamerican) males. As result of the reference data set Genoves utilized to build those stature regression equations, they may not be appropriate for Caribbean Hispanics. What may have been overlooked by some or many forensic anthropologist is a recommendation made by Trotter and Gleser (1958), which may resolve this problem. In their classic study of Caucasian (White) and African American (Black) male and female stature estimations, and Native American Indian (Mongoloid) male stature estimations, a small sample of Puerto Rican individuals were also included. Ultimately stature regression equations were not developed for the Puerto Rican sample, however, Trotter and Gleser recommended utilizing the Negro (Black) stature regression equations due to the similarities in limb proportions and relationships of long bone lengths to stature seen in both the Puerto Rican and Negro (Black) samples (Trotter, 1970:82; Trotter and Gleser, 1958: 113-114). This preliminary study will test the various stature regression equations for the estimation of stature of known "Caribbean" Hispanics.

Anthropological Examples: In order to evaluate the various stature regression equations available and traditionally utilized to estimate the stature of Hispanic individuals, and to identify the most appropriate stature regression methods, long bone measurements of two positively identified "Caribbean" Hispanic individuals were taken to calculate estimated statures via these various stature regression equations.

The first individual, Case No.WCME02-1574, was from the Dominican Republic; and the second individual, Case No. SCME03-3734, was from Puerto Rico. The table below displays the results obtained from the various stature regression equations. As is evident from the table, for the "Caribbean" Hispanic individuals the old Negro male stature regression equations from Trotter and Gleser (1958) provided the closest stature estimations to the actual recorded stature for those individuals.

Case	Measurement	White*	Negro-New*	Negro-Old†	Mexican*	Genoves‡
"Caribbean" Hispanics						
WCME02-1574 – Reported Stature: 70," ~177.8cm						
Femur	49.9	180.172	175.639	**177.01**	180.426	179.153
Difference		2.372	-2.161	**-0.79**	2.626	1.353
SCME03-3734 – Reported Stature: 66," ~167.64cm						
Humerus	33.1	172.398	170.006	170.808	170.592	
Radius	24.4	171.242	165.008	166.438	167.33	
Ulna	26.7	172.84	166.332	168.21	169.612	
Femur	45.5	169.7	166.355	167.77	169.69	169.209
Tibia	37.5	173.12	168.145	167.485	169.12	167.252
Fibula	37.2	171.476	167.118	167.118	168.44	
Fem + Tib		171.19	166.49	167.2		
Average		171.71	167.06	**167.86**	169.13	168.23
Difference		4.07	-0.58	**0.22**	1.49	0.59

*Trotter, 1970
† Trotter and Gleser, 1958
‡ Genoves, 1967

Conclusions: The estimation of stature for "Hispanic" individuals is not a simple and straight forward process. The morphological assessment and biological affinity determination of Hispanic individuals is complicated and difficult on its own; now the geographic origin of a Hispanic individual needs to be considered in order to ensure the most accurate and thorough assessment of not only race but stature as well. Because of the differing genetic and morphological composition of "Caribbean" and "Mexican/Southwest" Hispanic individuals, the forensic anthropologist needs to consider the potential geographic origin of the individual when selecting the appropriate stature regression equation. These preliminary results indicate that the old Negro (Black) stature regression equations of Trotter and Gleser (1958) may be the most appropriate equations for estimating the statures of "Caribbean" Hispanic individuals. Additional data from "Caribbean" Hispanic individuals will be obtained to further test and confirm the results seen in this preliminary investigation. Additionally, data from "Mexican/Southwest" Hispanic individuals will be obtained to compare the results obtained through application of the Genoves, as well as the Trotter and Gleser stature regression equations.

Stature Estimation, Stature Regression Equations, Hispanics

H39 Anatomical Stature Estimation: Why Not Fully Accurate?

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After attending this presentation, attendees will understand the possible problems associated with the anatomical method of stature estimation.

This presentation will impact the forensic community and/or humanity by helping to more accurately estimate statures of unknown individuals in a forensic context.

The purpose of this paper is to introduce and discuss a possible bias in the estimation of statures using the Fully Anatomical Method.

Traditional regression equations require knowledge of an individual's sex and ethnicity (and often age) in order to be applied correctly. The anatomical method proposes that an individual's stature may be determined - if the skeleton is sufficiently complete - without regard to these variables by determining an individual's skeletal height and adding a soft tissue correction of 10 to 11.5 centimeters. This correction factor, purportedly applicable to all individuals regardless of ethnicity, sex, and age, will be tested in this paper using regression analysis.

Skeletal heights of 129 individuals from the Terry Collection were obtained using the anatomical method. This included measurements of the head height (basion-bregma), anterior vertebral heights from C2 to S1, the bicondylar length of the femur, maximum length of the tibia, and the height of the articulated calcaneus and talus (ankle height). To these skeletal heights, the correction factor (based on overall skeletal height) was added to each individual. All of the individuals used in this study had cadaver lengths on file. These were converted to an estimate of living stature by subtracting 25 mm, an adjustment which had been determined by previous researchers. Each anatomical stature was then compared to the adjusted cadaver length to determine the accuracy of the estimation. The differences between the "living statures" and the anatomical statures ranged from -9.00 to +7.10 centimeters with an average difference of -1.36 and a Pearson correlation of 0.935. While these results were an improvement over long bone regressions, such as those of Trotter and Gleser, the fact that error still remained required further explanation. Mean soft tissue correction values were calculated for each group; with both black and white females having an average adjustment of 101 mm and black and white males an average of 104 mm. Lowess regressions on the data set, however, suggested that the original soft tissue correction factor may be too low, and in most cases in this study the differences between skeletal height and cadaver length were between 110 and 115 mm.

Typically, errors resulting from long bone regressions are due to differences in body proportions such that statures of individuals with long trunks and short legs are generally underestimated and vice versa. The original soft tissue correction factors calculated by Fully were based on French citizens in an Austrian concentration camp, and while Fully's data set has never been published, it is possible to conclude that the French *may* have had shorter trunks, either due to shorter vertebral heights, thinner intervertebral discs, or both. More research is needed to determine whether the soft tissue corrections calculated by Fully may truly be applied to other populations and both males and females.

Stature, Fully, Regression

H40 The Effects of Skeletal Preparation Techniques on DNA From Human and Nonhuman Bone

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After attending this presentation, attendees will understand the negative and positive effects that standard and alternative methods for cleaning skeletal material have on the DNA found within human and non-human bone.

This presentation will impact the forensic community and/or humanity by encouraging anthropologists and others who analyze skeletal remains to refrain from using bleach cleaning techniques on bone, and instead adopt alternative methods such as the powdered detergent/sodium carbonate technique tested here. Subsequent DNA analysis of cleaned skeletal material will not be negatively impacted, and in fact may even be improved.

The goal of this presentation is to inform the forensic community about the effects bone cleaning techniques have on subsequent DNA analysis.

A common technique used by anthropologists and others who work with skeletal remains is to clean bone with adherent soft tissue by boiling it in a bleach solution. This method, while effective, causes damage to the exposed surfaces of the bone, which may have detrimental consequences in a forensic investigation. Furthermore, bleach, owing to its strong oxidative properties, is known to damage DNA, although the extent of which, if any, in a boiled bone sample, is not clear. In response to bleach's known detrimental effect on bone, alternative cleaning techniques have been proposed. A skeletal cleaning method is considered successful if it is as fast and effective as commonly used techniques, while being less destructive to the sample. The impact these procedures have on the DNA within bone is, however, more difficult to discern.

In the study presented here, an alternate tissue removal technique that consists of boiling bones in powdered detergent and sodium carbonate[1], a standard bleach boiling protocol, and a control of boiling bones in water, were examined. Animal bones with adhering tissue, as well as human bones from a forensic case, were cleaned using all three techniques. DNA was then isolated from each of the samples using a standard organic extraction, and DNA yields quantified using UV spectrophotometry or Real Time PCR. Gel electrophoresis or PCR amplification of progressively larger pieces of mitochondrial DNA were then used to determine how degraded mtDNAs were following each cleaning.

These experiments demonstrate that significantly less DNA is recovered from bone samples cleaned in bleach than from water cleaned controls. Further, bleach cleaning was shown to cause DNA degradation. In contrast, the powdered detergent/sodium carbonate cleaning method[1] produced DNA for which quantity and quality were similar to or even exceeded the water control. The results from these experiments indicate that not only does bleach cause damage to the bone in addition to having a notable negative effect on DNA when compared to the water control, but the powdered detergent/sodium carbonate technique may protect DNA during bone cleaning procedures.

The results presented should encourage anthropologists and others who analyze skeletal remains to refrain from using bleach cleaning techniques on bone, and instead adopt alternative methods such as the powdered detergent/sodium carbonate technique tested here. Subsequent DNA testing of cleaned skeletal material will not be negatively impacted, and in fact may even be improved.

References:
1. Fenton TW, Birkby WH, J Cornelison. A Fast and Safe Non-Bleaching Method for Forensic Skeletal Preparation. *J Forensic Sci* 2003; 48(1):274-276.

Skeletal Remains, DNA Degradation, Bone Cleaning Procedures

H41 An Assessment of DNA Degeneration Due to Air-Drying Preservation for the Remains of the World Trade Center

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The goal of this presentation is to detail the results of genetic tests performed on the human remains from the World Trade Center from before and after preservation through air-drying. These results help to assess the drying process as a viable option for preservation in future mass fatality incidents. The details of the drying process itself were presented in a paper at the 2003 meetings in Dallas, TX.

This presentation will impact the forensic community and/or humanity by presenting an assessment of possible DNA degradation due to a preservation process that has not been used previously in a forensic context before. This information will allow forensic professionals to judge the viability of air-drying as an option for the preservation of human remains from future mass disasters.

This paper will present a statistical analysis of DNA tests performed on the human remains from the World Trade Center before and after their preservation through air-drying. The results of this statistical analysis illustrate the effect the air-drying preservation method has on the genetic material held within the remains.

The remains recovered from the World Trade Center site in the months following September 11th, 2001 were preserved using a method of air-drying. The air-drying method was utilized as an attempt to preserve the remains without significantly degrading the genetic material contained within, allowing for future DNA testing if warranted.

To assess the impact of the drying process on the genetic material in the remains, two different experiment designs were used. For the first experiment, soft tissue samples were extracted from a random sample of the remains during their preparation for the drying process. A second sample was extracted from the remains after the drying process was completed.

The second experiment was designed to control for sample location, length of time spent drying, and size of sample. In this test, strips of muscle of approximately 50ml were taken from 30 sets of remains. Each sample strip was divided in half; with one half sent directly for DNA testing. The second half of each sample was subjected to the drying process, then, upon completion, sent for DNA analysis.

All tissue samples were taken following a strict sampling process. Samples were taken from portions of remains featuring large muscle groups enclosed under unbroken skin to ensure both ample size and no contamination. New, sterile disposable scalpels were used for each sample. At least one scalpel was used to make the initial incision through the outer skin layers, while another was used to cut out the tissue to be taken. The muscle strips were extracted using reusable forceps thoroughly cleaned with 10% bleach water.

The samples were tested using both DNA IQ and Organic DNA techniques, with the results ranging from 0 - 16 loci. For both experiments, a paired samples *t* test was performed using the corresponding pre-dried and dried variables. The *t* tests will show if there is a significant increase or decrease in the average number of loci recovered from the dried samples when compared to the pre-dried samples.

Statistical analysis of the test results from both experiments shows that a significant decrease in loci yields did occur between the pre-dried and dried samples. After a number of other possible factors were ruled out, it was concluded that the drying process itself was the cause of the decrease in loci through the combination of temperature shock, the high temperature

itself, and the already fragile state of the DNA. However, while the experiments showed that the drying process did significantly degrade the DNA of the remains, they also show it was still possible to retrieve DNA. The DNA was not completely degraded in every sample, as other preservation options would have done.

Because the remains were preserved and DNA can still be retrieved, drying may be a viable option for preservation in the future should the needs of a particular disaster warrant its use and available resources allow for it. In addition, until now, research on DNA stability in a forensic context has been limited to the effects of various environmental factors occurring in common situations and do not reflect those that occur at the extremes. Information may be drawn from this research regarding the stability of DNA in extremes of both high temperature and low humidity.

Mass Disasters, Preservation, DNA Degradation

H42 Elemental Analysis of Human Cremains Using Inductively-Coupled Plasma Optical Emission Spectroscopy (ICP-OES) to Distinguish Between Legitimate and Contaminated Cremains

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After attending this presentation, the forensic anthropology community will be exposed to new technology that can aid in the analysis of human cremains. The purpose of this project is to develop an objective and more definitive means of identifying whether human cremains are legitimate or contaminated.

Following recent crematory controversies, many families question whether the cremains returned to them are human or not. This presentation will impact the forensic community and/or humanity by offering an objective method to distinguish between legitimate and contaminated human cremains.

The purpose of this project is to develop an objective and more definitive means of identifying whether human cremains are legitimate or contaminated. The need for this information has arisen from dissatisfaction and limitations in the current methods of cremains analysis available to forensic scientists. The most common methods of cremains analysis employed by forensic anthropologists are visual inspection, x-ray analysis, and microscopic analysis. Visual inspection is useful to determine whether or not the cremains contain identifiable bone fragments. X-ray analysis is helpful to detect radiopaque objects that may be helpful to the examination. Microscopic analysis is useful to examine not only small bone fragments, but also other non-bone items such as contaminate inclusions. Contaminate inclusions are burned or non-burned items including, but not limited to, small rocks, textiles, sand, staples, screws, or durable clothing items like metal buttons. These items provide even more clues as to the history of the cremains. Unfortunately, the laboratory hours needed to completely examine a set of cremains by microscopic means could take weeks or months. Some contaminate inclusions should be expected due to the construction of cremation boxes, how retorts are built and swept out, and how ashes are processed. Only in rare instances has any examiner made a positive identification of cremains. This project does not purport to be able to identify a person from the ashes, only whether or not the cremains given to a family are legitimately human or not. Nor does this project intend to supplant existing analytical techniques, but rather enhance the analysis with advanced technology. The goal is to develop a technique to analyze human cremains that is relatively affordable in forensic investigations and available at many different laboratories and universities, instead of relying on exotic and expensive machinery.

To determine what survives the cremation process, this project has tested the technologies of Gas Chromatography–Mass Spectrometry (GC/MS), Total Attenuated Reflectance Infrared Spectroscopy (IR), and Inductively-Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Organic extractions of the cremains were analyzed by GC/MS, but no organic compounds were detected. Additionally, the cremains analyzed by IR only exhibited absorption due to the phosphorous/oxygen bond found in phosphate. Due to the elevated temperatures of the cremation process (1625ºF, or 885ºC), organic residues were not expected. Therefore, an in-depth elemental analysis was undertaken using ICP-OES.

Five sets of cremains were tested using ICP-OES: two human cremations (one embalmed, the other not embalmed) performed by the author (TEB) and a professional crematory; a cremated dog as a mammalian comparison; a set determined to be questionable by current analytical methods; and a set known to be questionable by its medicolegal context. Results show the elemental profiles (inorganic metals) of the two known human cremains were consistent with one another, indicating that it is possible to develop expected concentration ranges and mean values using this technology. There was no apparent difference between the embalmed cremains and non-embalmed cremains, which was expected because modern embalming fluid is a hydrocarbon molecule that completely combusts at cremation temperatures. Problems to be addressed in this study include calibration issues with the ICP-OES instrument, sample preparation and variation, and sociocultural obstacles in obtaining known human samples (to increase sample size). Following recent crematory controversies, many families question whether the cremains returned to them are human or not, and this project hopes to offer an objective method to distinguish between legitimate and contaminated human cremains.

Cremains Analysis, Cremation, Forensic Anthropology

H43 Elemental Characterization of Skeletal Remains Using Laser-Induced Breakdown Spectroscopy (LIBS)

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The goal of this presentation is to discuss unique elemental profiles differentiating human and animal bone which could accelerate skeletal element identification in the field through the use of laser-induced breakdown spectroscopy (LIBS).

This presentation will impact the forensic community and/or humanity by allowing the forensic community to become aware of an extremely useful forensic tool with many applications and advantages, which could be used in the field for evidence analysis with real time results. It is expected that this presentation will make the forensic community, criminal investigators, and the legal community aware of the potential value of LIBS and hopefully, they will adopt this technology for future use in their organizations.

The first question asked of the forensic anthropologist and/or medical examiner when presented with skeletal remains is, "Are they human?" Identification as human initiates legal investigation whilst animal does not. An individual experienced in mammalian osteology can readily make the distinction when presented with as little as a single fragmentary bone. More difficult is the separation of remains by less experienced osteologists or in cases of unidentifiable, or extremely fragmented, remains. Traditional methods of differentiating human from animal bone rely on macroscopic and microscopic evaluation; however, the margin of error associated with these methods is dependent upon experience and some fragments are indistinguishable to even skilled osteologists. Additionally, microscopic evaluation is time consuming and destructive to the specimen. Given the legal ramifications involved in accurate identification of skeletal remains, a

more reliable means by which to distinguish human from animal bone is desirable. This research utilized Laser-induced breakdown spectroscopy (LIBS) for nondestructive characterization and separation of elemental bone composition profiles from several commonly recovered mammalian species.

LIBS is an established, versatile method of determining elemental compositions. Laser pulses are delivered to the sample from a laser spark, or plasma, for vaporization and atomization of the target material. Spectroscopic detection of the light released from the plasma contains the emission spectra which permits identification of the elements through their unique spectral signatures. Advantages of LIBS compared to conventional methods of elemental analysis include:

- Rapid (seconds) sampling
- Minimally destructive (1.0 - 0.1 mm diameter)
- Simultaneous multi-element detection
- Low detection limits
- Little or no sample preparation
- Ability to remove surface contaminants and provide depth-profile

Eight adult human femora (two of each: male, female, African American, European American) and a tibia or femur from 14 skeletally mature animals - pig, gray fox, raccoon, dogs, bear, pig, rabbit, cows, deer, and sheep - were selected from the William M. Bass Forensic Skeletal Collection for LIBS analysis. Mammals selected represent a continuum of dietary trophic levels and commonly recovered species in forensic cases involving skeletal remains. The outer cortical shaft of bone was targeted by the Nd-YAG laser and multiple shots were delivered over a representative area to ensure adequate sampling. Adult cortical bone contains less intra-individual variation than cancellous and is more stable having a slower turnover rate (3-5% turnover rate per year) ensuring greater representation of an individual's lifetime. Preliminary comparison of spectral data showed sufficiently significant elemental differences among humans and between humans and animal bone. It was specifically noted that there was a significant amount of titanium present in white male and female bones but not in black female bones. The amount of barium was also quite substantial in the white female, present in small amounts in the black female but noticeably absent in the white male bones. These differences could be attributed to the uptake capacities of the different elements based on their respective bone densities and porosities. This would lead to the identification of the bones based on gender, sex, and race in the case of human bones.

Identification of compositional differences between human and animal remains may provide an elemental fingerprint by which to distinguish human from animal bone for more efficient and rapid identification of fragmentary remains. As a minimally destructive method of elemental analysis, LIBS provides many benefits for use in a variety of trace evidence analyses.

Bone, LIBS, Elemental Analysis

H44 An Experimental Test of the Accuracy of Human Forensic Identification Techniques for Analysis of Burn-Damaged Bone and Tissue

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The goal of this presentation is to provide the forensic community with information about the potential for errors in DNA-based forensic identification of hard and soft tissues with increasing burn damage.

While technical methods continue to improve the potential for the analysis of degraded DNA samples, forensic analysts should be cautioned that, especially in cases involving highly degraded skeletal material where the amount of DNA extracted is very small, the potential for problems may be of concern. Further study and improved coordination between DNA analysts and forensic scientists will impact the forensic community and/or humanity by becoming useful in the development of guidelines for forensic identification of different types of highly degraded human remains.

Forensic scientists have been challenged by recent events, such as the tragedies of 9/11 and genocide incidents abroad, which have highlighted the difficulties of DNA analysis from fragmented and thermally degraded remains. Previous studies have investigated the effectiveness of alternate methods for extraction of highly degraded DNA. Here, the authors use an experimental framework to investigate the accuracy, relative to results from unburned tissue, of the commonly used molecular forensic identification methods. Specifically, the authors address how results vary with increasing temperature and duration of the thermal event, document the consequences for identification methods as human DNA is exposed to heat of varying intensity, and discuss the limitations of current technologies in cases involving burned tissue and bone.

Microsatellite (STR) loci, mitochondrial and nuclear DNA have been amplified with varying degrees of success from burn-damaged tissues. Thermally induced deamination with increasing DNA chain fragmentation in burned samples has been implicated as the mechanism of DNA damage that has made molecular analysis difficult in some cases. This study tested samples from fleshed, human remains, not embalmed, without burning, and with increasing levels of burn damage. Prior to burning, unburned control samples for muscle, skin, bone, and teeth were collected from seven individuals, then the remains were burned in simulated forensic fire environments fueled by wood without accelerants. Scorch-damaged soft tissue and tooth samples were collected following charring of the muscle and skin (after 42-45 minutes of burning at a fire temperature of 600-700^{O}F). With increasing time and temperature, superficial soft tissues retract and burn away, leaving *charred bone* from carbonization of organic materials, and prolonged heat exposure results in brittle grayish calcined bone *(*samples taken after 90-100 minutes of burning at a fire temperature of 600-800^{O}F*)*.

DNA was extracted from hard and soft tissues with increasing burn damage using three extraction methods: CTAB/QIAquick, DNeasy, and CTAB/phenol-chloroform/QIAquick. Amplification of three types of genetic markers (mitochondrial control region HV1, microsatellite and a sex chromosome marker) was attempted for each tissue type and burn damage level. For testing potential variability in the effect of burn-induced DNA degradation, five microsatellite loci representing small to large amplicons were analyzed in this experiment. A series of control region primers covering the HV1 region were used to determine the maximum amplicon size associated with different tissue types and burn damage levels. Amelogenin primers flanking a sex-specific indel were used to assess variability in the effectiveness of sex determination.

All extraction methods were successful; however the CTAB/phenol-chloroform /QIAquick combination produced the highest DNA yield (consistent with results reported by Ye *et al*., 2004). As expected, amplification of larger control regions segments was more difficult with higher levels of burn damage. Potential difficulties associated with increasing burn damage include: (1) DNA so highly fragmented that amplification of some loci (especially larger amplicons) is difficult or impossible; (2) inhibition of amplification by chemical byproducts that persist despite purification procedures during extraction; (3) PCR artifacts resulting in altered control region sequences and microsatellite allele sizes, resulting from chemical byproducts in burned tissues; and (4) bias in microsatellite amplifications due to fragmentation damage leading to a higher percentage of null alleles. While technical methods continue to improve the potential for the analysis of degraded DNA samples, forensic analysts should be cautioned that, especially in cases involving highly degraded skeletal material where the amount of DNA extracted is very small, the potential for problems as listed above may be high.

Experimental verification of which molecular markers and analysis methods are robust to progressive stages of thermal degradation in various tissue types, and when such methods may be inaccurate, biased, or misleading, is needed to produce guidelines for effective and appropriate analysis of burn-damaged human remains. The preliminary results suggest that further study and improved coordination between DNA analysts and forensic scientists are needed to clarify if and when DNA analysis techniques can effectively be used in forensic identification.

Forensic Identification, Burned Bone, DNA Degradation

H45 Semi-Automated Ultrasound Facial Soft Tissue Depth Registration: Method and Preliminary Results

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The goal of this presentation is to provide an update of facial soft tissue depth data for the European Caucasoid based on a scientifically sound registration method.

The database of facial soft tissue depths for the European Caucasoid based on in vivo measurement of a large population will impact the forensic community and/or humanity by leading to more accurate manual, as well as computer-aided, facial reconstructions.

Introduction: Trying to recreate the face of a deceased individual based on his or her remains, with the hope that recognition would be triggered, researchers developed different two- and three-dimensional facial reconstruction techniques. Several of these techniques use soft tissue depth tables.

Aim: A mobile semi-automated ultrasound echographic system is presented, the validation procedure, and preliminary results for the European Caucasoid.

Materials and method: As a part of an ongoing project on computer-aided 3-D craniofacial reconstruction approximately 1,000 White Belgian volunteers subdivided following gender, age, body mass index, and facial profile had to be scanned on 52 different facial landmarks. For this purpose a mobile and user-friendly ultrasound scanning system was conceived enabling in vivo, fast, non-destructive soft tissue depth measurements.

The system is composed of a compact and lightweight mobile digital ultrasound "A-mode" scanner (Epoch 4B with a 10MHz 0.6mm∅ transducer, Panametrics Inc., Waltham, USA), a database (MySQL), and a self-designed interface program. The interface program controls the bi-directional data transfer between the database and the scanner, which allows automatic depth calculation to avoid interpretation errors of the scanner signal, automatic storage of the result and automatic adaptation of the scanner settings for every specific landmark.

The next step in the project consisted in defining an exact measurement protocol. Reviewing the literature the researchers decided to measure three times the tissue depths of 52 facial landmarks (10 midline + 21 bilateral).

Results: A repeatability test was performed with an interval period varying between 2 and 57 days on a test group of 33 volunteers. Intra-observer agreement was statistically analyzed using a paired t-test. Eighty-eight % (n=46) of the landmarks showed no significant difference ($p>0.05$) between the first and second measurement. For 5.7% (n=3) of the landmarks no significant difference was found at the $p>0.01$ level. Only 5.7% (n=3) of the landmarks showed a significant difference ($p<0.01$). The accuracy of the system is actually being tested using CT-scanning. For this purpose another interface program was conceived enabling "digital echography." The results of the statistical analysis using Blant Altman, preliminary results of the tissue depth measurements on the 52 anatomical landmarks, comparison with former soft tissue datasets of Caucasoids and the use of the authors' database in 3-D cranio-facial reconstruction program will be presented.

Cranio-Facial Reconstruction , Soft Tissue Depth Data , Computer-Aided

H46 Quantification of Commingled Human Skeletal Remains: Determining the Most Likely Number of Individuals (MLNI)

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Attendees will learn about a new technique (MLNI) that can be used to estimate the actual number of individuals represented by a commingled assemblage of human skeletal remains. This technique may be more useful to forensic anthropologists than methods currently employed.

This presentation will impact the forensic community and/or humanity by describing a new technique for the quantification of commingled human skeletal remains. Case examples will be used to demonstrate the utility of the technique.

Most anthropologists rely on the Minimum Number of Individuals (MNI) for the quantification of commingled human remains. In its most common application, the MNI is derived by simply counting the most frequently observed element or element portion (e.g., proximal right femur). As the name indicates, this estimate represents the *minimum* number of individuals necessary to be represented by the skeletal assemblage. In cases where the recovery of major skeletal elements is near 100%, this estimate will be reasonably accurate. In situations where element recovery is not complete due to various taphonomic forces, the MNI may present misleading estimates regarding the *actual* number of individuals. As an alternative, a technique is described which can provide more realistic values of the true number of dead.

The Lincoln Index (LI) is a method that will provide more accurate estimates of the *original* number of individuals represented by a commingled osteological assemblage, especially when random loss of skeletal elements has occurred. A critical step in the use of the LI is pair matching of homologous bones (e.g., right and left femora) to determine if they come from the same individual. For calculation of the LI, the total number of rights (R), the total number of lefts (L), and the total number of pairs (P) are used for any paired element. In its most basic format, the LI is calculated as $N = L*R/P$.

A minor modification by Chapman (1951) was recommended to account for potential bias with the LI. The modified equation is simply $N = [(L+1)(R+1)/(P+1)]-1$. The integer value produced by this equation is referred to as the Most Likely Number of Individuals (MLNI). By using the hypergeometric distribution (available in such programs as Excel™ spreadsheets) it is possible to provide confidence intervals around this value. (See http://konig.la.utk.edu/MLNI.html for more information.) As long as accurate pair matching of elements can be accomplished, the MLNI provides unbiased number estimates that reflect the actual population represented by the commingled skeletal assemblage. The MLNI can be calculated from a single element type (e.g., femur), or multiple paired elements (e.g., femur, humerus, and tibia) can be used together to derive an estimate of population size.

An example is provided using a protohistoric massacre site (Larson Village). Numerous lodge features at this site contained well-preserved commingled remains. Analysis of one of the lodges revealed that there

were 43 left femora and 36 right femora, of which 31 femur pairs could be found. The MLNI estimate based solely on these femora is 49 individuals, with an approximate 95% confidence interval ("highest density region") of 48-54 individuals. A combined estimate using the pair-matching results for the tibia, os coxa, humerus, and femur is an MLNI value of 50, with an approximate 95% confidence interval of 48-52 individuals. The MNI for this example is only 43.

The MLNI technique could be easily applied to modern forensic contexts and these figures will provide number estimates that are of much greater interpretive value than the MNI counts.

Lincoln Index, Commingling, Statistics

H47 Osteometric Sorting of Commingled Human Remains

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After attending this presentation, attendees will gain knowledge of osteometric sorting methods that can be used to sort commingled remains.

This presentation will impact the forensic community and/or humanity by introducing and describing methods that can be used to sort commingled human remains. Commingled human remains frequently result from mass disasters such as warfare, aircraft crashes, and terrorist attacks.

Assemblages of commingled human remains present special problems in the identification process. Biological profiles of individuals cannot be developed until the remains have been segregated into individuals. Though the presence of soft tissue can, in some cases, usefully inform the process (i.e., hair color and texture, skin tone, etc.), most of the information used to resolve commingling is obtained from the skeleton. The primary categories of information used to sort commingled remains are age, articulation, visual pair matching, size, build, taphonomy, and DNA sequence data. No one of these categories is sufficient as a sole basis for sorting most assemblages. The authors advocate the systematic use of these methods to sort commingled remains, so that each step in the sorting process is documented and can be replicated by other anthropologists [2, 4].

There are strong correlations among the sizes of the bones of the skeleton. Thus, a large humerus is associated with a large femur and a large metatarsal. This allometric reality can be exploited in the sorting process by formally comparing the sizes of two bones. Byrd and Adams [4] propose that a test of the null hypothesis that the two specimens are of a size to have originated in the same individual with the use of statistical tests. This approach requires the calculation of statistical models from a large reference data set appropriate to the population of interest. This method can be effectively applied to comparison of right with left paired bones, but has the advantage of being applicable to comparison between virtually any two elements in the skeleton. Naturally, some elements exhibit greater correlations in size with one another than with others. Recommend are three basic approaches to osteometric sorting: 1) comparison of left and right bones with models that key on shape, 2) comparison of adjoining bones with models recognizing that corresponding areas tightly covary [3], and 3) comparison of the sizes of bones with the use of regression models. Each approach is described below following a brief description of the reference data.

The reference data used in this study (hereafter referred to simply as "the reference data") was developed at the JPAC CIL for broad applications in research and casework. The data is comprised primarily of postcranial measurements. The measurements include the standard measurements found in the Forensic Databank at the University of Tennessee, Knoxville[5] as well as new measurements designed by the authors to be taken on fragmented bones. The measurement numbering scheme was designed to integrate with the forensic databank. A considerable portion of the reference data consists of Forensic Databank data generously given to the authors by Dr. Richard Jantz. The individuals in the reference data set are as listed in Table 1.

TABLE 2- ***Reference sample broken down by collection, race, and sex.***

COLLECTION	*SEX*	*BLACK*	*WHITE*	*ASIAN*	*TOTAL*
CIL	F	0	1	0	1
	M	5	42	4	51
CMNH-HT	F	2	2	0	4
	M	7	7	0	14
SI-TERRY	F	14	10	0	24
	M	14	2	0	16
UT-BASS	F	3	9	0	12
	M	4	7	0	11
FDB	F	12	46	0	58
	M	17	108	0	125
ICMP	F	0	0	0	0
	M	0	41	0	41
TOTAL		78	234	4	316

CIL, JPAC Central Identification Laboratory
CMNH-HT, Cleveland Museum of Natural History Hamann-Todd collection
SI-TERRY, Smithsonian Institution Terry collection
UT-BASS, University of Tennessee Bass collection
FDB, University of Tennessee Forensic Data Bank
ICMP, International Commission on Missing Persons

Models for comparison of right and left paired bones were developed that emphasize shape. These models respond to many of the same attributes that make visual pair matching[2] possible and in some cases perform equally well. Measurements of length and of girth at numerous positions along each bone are utilized. Where length measurements are not available (due to fragmentation), models utilizing only girth measurements are calculated. These models take the general form,

$$D = \Sigma (a_i \_ b_i) \qquad (1)$$

where a is the right side bone measurement, i and b is the left side bone measurement, i for each of the measurements included in the comparison. The null hypothesis of no difference is tested by way of a t test comparing the value of D against "0" (no difference) and using the reference data standard deviation for D. The authors recommend the 0.05 significance level for this test. This method has performed well in test applications, but would benefit from a larger reference sample.

Models for comparison of adjoining bones are calculated using the difference in size of adjoining areas as their basis. See Buikstra *et.al*., 1984, for an example of this approach. For example, the innominate and femur are compared by subtracting the maximum diameter of the femur head (measurement #63 in Moore-Jansen et.al. 1994) from the maximum diameter of the acetabulum[1]. The model takes the general form,

$$D = c_i - d_j \qquad (2)$$

where measurement i of bone c is subtracted from measurement j of bone d. The null hypothesis that the two specimens are of an appropriate size to have originated in one individual is evaluated with a t test comparing the D value obtained from the case specimens to the mean D value calculated from the reference data. The 0.05 significance level is recommended.

Models for comparison of different bone sizes are generally more complex in their derivation. After experimenting with numerous approaches, Byrd and Adams[4] settled on the following linear combination as an acceptable index for bone size. The available measurements on a bone are simply summed and the natural logarithm of this sum is the value

used in regression models. Since length measurements typically show the highest correlations with one another, models including length measurements perform best. The addition of breadths and girth measurements into the indices offers a slight, but noticeable improvement in the statistical models. A surprising finding is that models utilizing several breadth and girth measurements, with no length measurements, perform nearly as well in some cases as those including length [4]. This fact has great significance when working with highly fragmented assemblages. Error rate for the method as a whole, using the 90% prediction interval, has been found in one study to be approximately 5%. See Byrd and Adams[4] for a full account of this method.

The application of osteometric sorting in case work at the JPAC CIL is currently done in an ad hoc manner, where the appropriate statistical models (utilizing measurements available in the case specimens) are calculated from the reference data as the need arises. Osteometric comparisons of paired bones and adjoining bones are most advantageous when sorting large assemblages where it is impractical to make visual comparisons of every possible match. Further, this method is superbly suited to computer automation. The authors hope to develop an approach whereby all available measurement values for the case specimens are entered in advance, and all relevant comparison results can be produced as the analysis proceeds, without having to generate the statistical models for each comparison as separate steps for the anthropologist. As specimens are sorted apart by the various methods described in this report, they can be eliminated from consideration within the software application.

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Osteometric Sorting, Commingled Remains, Forensic Identification

H48 Resolving Commingling Issues In Mass Fatality Incident Investigations

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Attendees will gain an understanding of the forensic and ethical issues pertaining to commingled remains from mass fatality incidents. The concept of a triage station in the disaster morgue operation will be presented. Additional concerns, such as the decision to identify all remains or all victims and the impact of commingling on the notification of identification and release of remains to family members, are examined.

This presentation will impact the forensic community and/or humanity by providing the forensic community an understanding of the role of the triage process in managing mass fatality incidents.

Mass fatality incidents often expose human remains to a variety of factors causing fragmentation, thermal modification, and commingling. Resolving the complexities of identification and re-association of highly fragmented remains recovered from disasters requires not only the use of DNA technology but the application of certain management principles in morgue operations. Establishing a triage station to sort remains before processing by forensic specialists is an effective way to categorize remains based on their potential for identification and re-association. This paper examines the use of triage in resolving issues of commingling, identification, and remains re-association, and explores some issues related to next-of-kin considerations.

Identifying fragmented and commingled human remains from mass disasters involves both scientific methods and ethical considerations. The role of DNA technology gives forensic scientists powerful tools to identify and re-associate remains that would have been previously considered unidentifiable. However, the existence of these tools does not argue for their exhaustive application. Before the processing of remains, thought should be given to whether the focus will be on identifying all the victims or on identification of all remains. This decision is based on the degree of fragmentation, the family and public expectations, the quality and quantity of antemortem information, and the resources available. Complete or nearly complete remains (where the ratio of remains to victims is near 1:1) demand the identification of all remains because, in this case, it refers effectively to all victims. Typically, dental and fingerprint methods are used to identify whole remains and the process is completed fairly quickly and at relatively low cost.

In the case of high fragmentation, the number of remains per victim increases which influences decisions about the use of the limited resources of personnel, time, and funds. At the disaster site, fragmented remains are by definition commingled. Only remains connected by anatomical tissues are considered a single specimen. Proximity of remains cannot be used as a method of re-association; each remain must be examined on their own for identification.

In the morgue operation, developing and applying a probative index system allows triage personnel to systematically classify human remains according to their identification potential or investigative value. A categorization system relates the number of positive and presumptive identifying features to the potential for a DNA, dental, fingerprint, or medical identification. The probative index needs to be incident-specific, as factors such as availability and accuracy of antemortem information can impact the value of data.

Triage brings an additional benefit for understanding taphonomic processes related to the disaster. Because it is the only morgue section staffed by a multidisciplinary team, the triage station can be used to observe patterns in the types of remains as they relate to search areas. These patterns could suggest improper recovery techniques and thus assist in guiding search and recovery efforts. Effective triage serves as a communications link between search and recovery and the morgue, one that can minimize the potential for recovery-induced commingling. In addition, patterns may also help elucidate some aspects of incident causation.

Resolving the biological issues addresses only one part of the overall problem commingling represents. Commingling also impacts the family members of the victims, particularly in the areas of notification of identification and return of remains. Current practice dictates that family members of the deceased are allowed to choose when and how often they are contacted about the identification of remains. Because the DNA identification (and thus the re-association) often takes weeks or months, families often choose to be notified of the initial identification and then once again at the completion of the identification and re-association process. Families rarely choose to be notified each time a specimen is identified.

In nearly all recent aircraft accidents involving fragmented remains there have been remains that are unidentifiable, despite the liberal application of DNA technology. Often referred to as common tissue or group remains, they represent tissues potentially from all victims. Current practice dictates that the family members, as a group, decide upon the final disposition of these remains.

Mass Fatality Incident, Commingling, Human Remains

H49 Methods and Techniques for Sorting Commingled Remains: Anthropological and Physical Attributes

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After attending this presentation, attendees will have a basic understanding of the methods and techniques commonly utilized by the federal government for sorting of commingled remains.

This presentation will impact the forensic community and/or humanity by assisting forensic scientists with the sorting and re-association of commingled remains. Methods will be discussed which have been utilized for a number of years in a federal capacity which have greatly improved the processing of human remains in mass fatalities.

With reference to personal identification, one of the most difficult tasks facing forensic scientists is the sorting of commingled human remains. Incidents commonly resulting in commingling of remains include explosions, fires, and genocide involving mass burials. Four major factors that determine the degree of difficulty in sorting commingled remains include 1) the number of deceased involved, 2) the degree of body fragmentation, 3) the degree of biological diversity among the deceased, and 4) the survivability of skeletal structures. The difficulty of sorting remains increases exponentially with the increase of the number of deceased, and the same is true with the increase of body fragmentation. In retrospect the greater the biological diversity among the deceased, and increase in the survivability of skeletal structures can lessen the complexity of sorting commingled remains.

Separation of commingled remains can be accomplished utilizing a combination of anthropological and serological methods. Anthropological methods can be broken down to osteological comparisons based on gross and metrical osteological analysis, and also by physical comparisons which include biological attributes such as hair and epidermal characteristics, evidence of scars, tattoos, pathological conditions or prior surgical intervention. Serological methods can include ABO blood typing and DNA comparisons.

The first step in dealing with commingled remains is the initial triage of the remains. Each body portion/fragment should be carefully examined to insure that it represents a single specimen. In many cases, the remains examined may initially appear as a single anatomical specimen – however, detailed examination can reveal the specimen to be actually composed of two or more anatomical structures that are not physically bound to one another. One cannot assume that the multiple anatomical specimens are from the same individual even though they may have been recovered together, or in close proximity to one another. Once a single specimen is identified it should be x-rayed as well as photographed. Radiographic examination provides a detailed record of what skeletal structures are present and can greatly assist in the anthropological assessment of the specimen/s. Additionally, radiological examination can help limit the amount of soft tissue dissection required for determining what skeletal structures are present. If a question about a certain specimen occurs later in time, it is much easier to access and examine the radiographic record vs. locating and examining the actual specimen.

Although soft tissue structures are important, it is the skeletal structures, which, in many cases, will provide the most meaningful answers relating to human identification. Upon documenting the skeletal and soft tissue structures present, including size and weight of the specimen an anthropological assessment based on gross morphology and/or osteometrics should be conducted. Biological assessment should include if possible sex, age, race, and stature in the case of intact long bones. Age estimates do not necessarily have to be specific, as a specimen can be assigned to a general age group such as infant, child, teen, young adult, middle age or senior. Other techniques, which can be useful in sorting remains, are alternate light sources such as UV lamps. Alternate light sources are particularly useful in the sorting of skeletonized remains. Skeletal elements, which share commonalities of physical make-up, environmental exposure will also share patterns of florescence. Similarity in the physical coloration of a skeletal specimen, such as in the case of tetracycline labeling which results in a yellow discoloration of the bone is also another comparative technique for separating remains. Other physical methods of sorting/re-associating skeletal elements include similarity of size, muscle marking and foramina patterning, articular surface morphology, matching of fracture sites, and articular fit.

Not only is the task of sorting commingled remains difficult but so are the issues concerning the final disposition of remains which cannot be separated or identified. Issues involving cultural or religious burial practices, family objections to common/group burials, and objections to common burial when commingled remains may contain anatomical portions belonging to a terrorist/s are problematic. The purpose of this presentation is to review the primary methods and techniques utilized by the federal government in sorting commingled remains in a number of different scenarios.

Commingling, Identification, Physical Anthropology

H50 The Importance of Using Traditional Anthropological Methods in a DNA-Led Identification System

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The goal of this presentation is to demonstrate, using several case studies, that even with the use of advanced DNA technology for the identification of large numbers of missing persons, traditional methods of anthropological analysis are still necessary.

This presentation will impact the forensic community and/or humanity because it is an illustration that commingling, from whatever source, cannot be totally resolved using DNA. Traditional anthropological methods are not only more cost-effective, but they allow more complete resolution of commingled case, as it is not possible to produce a DNA profile for every bone and bone fragment. It is important for the forensic community as well as for non-forensic scientists and laypersons to dispel the myth that using DNA for identification of individuals is the only step in identification.

In Bosnia-Herzegovina, the International Commission on Missing Persons (ICMP) is using a large-scale DNA-led system to identify approximately 30,000 individuals who went missing as a result of the conflict in the 1990's. This has led to a misconception, especially among laypersons, that a positive DNA match between a set of remains and his or her family members constitutes a positive identification of that individual. Unfortunately, due to various taphonomic factors, such as scavenging, deliberate attempts to hide evidence and poor excavation methods, many of these remains are highly commingled.

Cases that have positive DNA matching reports are examined by anthropologists; during anthropological analysis, a complete biological profile of the individual is created in a specially designed database. The methods commonly used for age determination are the Suchey-Brooks and Todd methods for pubic symphysis development, the Iscan-Loth method for the sternal rib end, the Lovejoy method for the auricular surface, the Lamendin dental method and sternal clavicle, vertebral ring and S1-S2 unions. The Trotter and Gleser formulae are used for stature determination. The pathologist then uses this report during antemortem-postmortem comparison, in association with other information such as clothing and personal effects, to reach an identification.

Case 1: A partially complete body from a secondary mass grave near Srebrenica, missing the lower left arm, lower left leg and right femur, and a few other fragments. The age-at-death estimation was 45-55 years; however, the chronological age of the individual represented by the DNA

was 23. The femur, which had been sampled, appeared consistent with the rest of the skeleton, and the articulation of the femoral head with the acetabulum was not inconsistent. A second DNA sample was taken, from the left humerus, confirming that two individuals were present.

Case 2: A virtually complete body from the same secondary mass grave, missing several fragments, including most of the right os coxae. The DNA report on the right femur was for an individual in his early 20s; however, most of the remains belonged to an individual over 60 years old. The results of the second DNA test are pending.

Case 3: A DNA report for a male individual was issued for a partially complete female body. Only the femur which had been sampled belonged to the identified individual with the rest of the skeleton representing a very robust female.

Case 4: Two virtually complete individuals were collected from the field in one body bag. Both were almost the same stature, but one was slightly more robust and one individual was in his early 20s and the other in his mid-30s. Using pair-matching and articulations to separate the uppers and lowers into two individuals, and using the ages to distinguish the skulls, vertebrae and ribs meant only two DNA samples had to be taken from each, one from a femur and one from a humerus, to ensure they were correctly separated.

Examination of the remains and the creation of a biological profile ensure that the remains present belong to only one individual and that the remains are consistent with the individual represented by the DNA matching report. This not only helps to return the correct and most complete remains to family members, it also reduces the number of bone samples that need to be cut to test for DNA.

Forensic Anthropology, DNA Identification, Bosnia-Herzegovina

H51 The Importance of Body Deposition Recording in Event Reconstruction and the Re-Association and Identification of Commingled Remains

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After attending this presentation, attendees will understand how proper mass grave excavation and recording techniques can assist in the re-association and identification of remains.

Proper mass grave excavation techniques are not ideas that should be lightly tossed aside when time and money constraints are considered. This presentation will impact the forensic community and/or humanity by demonstrating how such techniques have direct influences on mortuary analysis and the identification process and so should be considered just as an important part of the process as laboratory work.

Dumping of bodies in a mass grave usually happens in stages where several loads of bodies are deposited one after the other. Careful excavation and recording of these separate deposits and their contents can assist in the understanding of the grave formation process. The past activity that created the grave is thus better understood. Physical evidence recovered and recorded from the grave can then be used to corroborate witness statements. In addition to assisting criminal investigations, recording of body deposits can directly help in the re-association of disarticulated body parts to their bodies and in identification process as a whole.

Bodies buried within mass graves have usually been subjected to massive trauma both from the wounds that lead to the death and often from the burial activity usually carried out by heavy machinery. Trauma caused by the digging activities of heavy machinery is especially noted in secondary graves where remains have been dug up from their first resting place and reburied with the intention of concealing them in a better or more secure location. In addition, the regular taphonomic conditions within the grave, particularly older ones where the remains have had longer exposure, will have taken their toll on the remains. As a result remains are often recovered with parts missing.

The re-association of hundreds of disarticulated body parts from a large mass grave is a complex and time-consuming process. However, the identification and recording of deposits within the grave and the human remains within a particular deposit can help lessen the burden of the anthropologist in the mortuary by first limiting search parameters. Instead of trying to match a particular body part to all the bodies missing that part within the entire grave, the search can first be limited to just those elements within the same deposit. The assumption here is that those disarticulated remains within a deposit are most likely to belong to bodies or other body parts within the same deposit. Searching elements by deposit instead of grave could be particularly helpful in mortuaries with limited space to layout all the body parts and bodies missing parts from the whole grave.

Recording of deposits may also assist in identifying bodies that have resisted DNA analysis and traditional mortuary identification methods. It can be assumed that vehicles used to transport the bodies were loaded at or near the location where the people were killed and/or buried. If a number of bodies from a specific deposit are positively identified then, through those identifications, it may be learned where those bodies generally originated. Often this origin will often be the location near where the people lived or were last seen. It is very probable that the unidentified bodies within that same deposit originated from the same area; that those unidentified bodies were loaded up on the vehicles at the same time and place as those that have been identified. Thus, it would be prudent to inquire as to who may still be missing from that point of origin. Additional blood and antemortem data could be collected from the surviving family members, friends and neighbors in that location. In essence this gives a direction from where next to search for information (or collect blood) regarding the remaining unidentified.

This presentation will outline the process of identification of deposits within mass graves and demonstrate some examples of re-association of body parts within deposits, and the potential of locating the area of origin of unidentified bodies from mass graves containing the remains of Kosovar Albanians killed in 1999.

Mass Grave, Forensic Archaeology, Commingling

H52 Commingled Skeletonized Remains in Forensic Cases: Considerations for Methodological Treatment

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After attending this presentation, attendees will understand some of the considerations on the application of standard forensic anthropology procedures to investigations of human rights violations involving the commingling issues of skeletonized remains.

This presentation will impact the forensic community and/or humanity by contributing to the discussion, development, and dissemination of the best forensic anthropological practices for the treatment of commingled skeletonized remains in the investigation of human rights violations.

Based on the Argentine Forensic Anthropology Team's (EAAF) experience in forensic investigation, the scope and limitations related to recovery procedures, osteological analysis, and use of historical documentation with skeletonized commingled remains will be addressed.

In forensic cases, the methodological treatment of commingled skeletonized remains presents specific challenges that need to be discussed

in order to reach a consensus on the best guidelines for their anthropological treatment. These guidelines should fall within the framework of general forensic principles. The cases evaluated were carried out in the context of forensic investigation of human rights violations in Argentina and El Salvador which presented different conditions for the burial and recovery of human remains. The cases in which the remains were recovered by personnel without training in forensic techniques are differentiated from those in which the EAAF participated in the exhumation and analysis.

In both cases, the impact of the recovery procedure is considered to be particularly relevant. In addition, the burial context in both cases was different: in one case from Argentina there were mostly single burials in cemeteries; in the second case from El Salvador, there were partially or completely disarticulated remains which were buried after having been exposed on the surface for several weeks.

In the case from Argentina, several exhumations were ordered by the Federal Tribunals at the beginning of 1984 after the return to a democratic government. Because the exhumations and analyses were conducted by personnel without training in forensic anthropological and archaeological techniques in the early cases, there was minimal possibility of identifying the remains and contributing substantive information to the judicial investigation. The majority of these exhumations took place in the Province of Buenos Aires, and most of the remains were sent to the Medical Legal Institute of the La Plata Department of Justice *(Asesoría Pericial)*. In addition, inadequate storage conditions led to the loss of reference labels, the jumbling of remains, and the damage and loss of bones, thus making their analysis even more difficult.

At the same time, the historical background research that EAAF carried out in Argentina led to the presumption of the identity of missing persons whose remains could be found among the *Asesoría Pericial* cases, making their analysis an increasingly pressing issue. Finally, at the end of 2002, a judicial order enabled EAAF to retrieve 91 containers with skeletal material, clothing, ballistic evidence, documents, and labels with partially legible references for analysis. Because they were exhumed in an unscientific manner, these skeletal remains and the associated evidence, which originally came from single graves of articulated individual found in cemeteries, were commingled when EAAF retrieved them twenty years later.

In the case from El Salvador, commingled skeletal remains in different degrees of articulation were exhumed from graves after having been exposed to natural elements on the surface during different periods of time. This case reflects the EAAF's experience in the investigation at El Mozote, the largest massacre in El Salvador's 12-year civil war. In December 1981 the Salvadorian armed forces conducted a large-scale operation in the northeastern region of the country, during which they allegedly massacred approximately 800 civilians in six neighboring villages. Over 40% of the victims were children under ten years of age. Most of the victims' bodies were buried in clandestine graves or left where they had been killed.

Because the troops returned to their temporary camp each night, the surviving residents of the other villages were able to sneak into the massacre sites after dark to inter as many of the victims as they could in common graves. For a variety of reasons, however, they could not bury many of the victims, whose bodies remained where they had been killed. After remaining on the surface for more than three weeks, these remains were eventually interred by the villagers.

Based on the experiences in these two cases, the goal of this presentation is to present the scope and limitations related to the recovery procedures, osteological analysis, and use of historical documental sources with skeletonized commingled remains.

Forensic Anthropology, Commingled Remains, Methodological Procedures

H53 Exhumation and Identification of a Particular Individual in a Mass Grave

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After attending this presentation, attendees will understand the importance of the recovery of remains and the collection of antemortem data on victims for the purpose of individualizing commingled remains for identification.

This presentation will impact the forensic community and/or humanity by providing knowledge of the forensic anthropology work performed in Portugal and the need for interdisciplinary teams to deal with the type of mass graves found there.

In June 2003, the authors were sent to East Timor to exhume the remains of a former member of the Portuguese military force who was executed along with 25 other prisoners during the invasion of the territory by Indonesia, in 1975. Portuguese authorities sponsored a mission to recover the remains of the military individual in order to deliver them to his family in Portugal. The bodies had been buried in a mass grave in Asirimou, a location in the mountains, about 45 Km from Dili. The excavation took place over three days. This presentation will discuss some of the major difficulties involved in the complex field work, including: 1) the individualization of the target individual from among the remains of at least 16 other individuals, 2) a hostile taphonomic environment, and 3) disarticulated and commingled skeletonized remains with a majority of the clothes preserved.

The relative position of the individual in the pit was a major contributor to the poor preservation of the remains. It is also possible that the grave may have been disturbed at some point. During the extraction of the individual involved, it was necessary to manipulate several of the adjacent sets of human remains. The process of identification was carried out mainly on the basis of sociocultural affiliation, individualizing traits, and personal belongings. Contextual information and associated artifacts were crucial to the identification. The previously collected antemortem data on the victim was paramount to the resolution of this difficult case, as a reliable assignment of the disarticulated, commingled and fragmented bones to the victim was particularly challenging.

Personal Identification, Mass Graves, Exhumation

H54 Separating Commingled Remains Using Ancient DNA Analysis

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Attendees will learn strategies and capabilities of using DNA testing in conjunction with other lines of evidence to resolve commingled skeletal remains.

This presentation will impact the forensic community and/or humanity by providing an understanding of the advantages and disadvantages of mtDNA analysis, and its benefits to forensic anthropology. When used in conjunction with other lines of evidence, mtDNA sequencing strengthens a case for postmortem identification and facilitates the segregation of commingled remains.

This presentation combines the analysis of ancient DNA with other lines of evidence to achieve segregation of commingled skeletal remains. The authors examine strategies and capabilities of using DNA testing to resolve commingling, including advantages and shortcomings of

conventional mitochondrial (mtDNA) analysis, recent advances in mtDNA technology mitigating the common-sequence problem, prospects for other types of DNA testing, and summarize expectations of likely success or failure in testing ancient remains. These issues are addressed through a case study from the Joint POW/MIA Accounting Command Central Identification Laboratory (JPAC CIL) where mtDNA was used to augment and test osteological and osteometric techniques for the segregation of commingled remains.

During a 1942 combat mission over Kiska Island, a United States Navy PBY-5 aircraft was lost. In August 1943 the U.S. regained control of Kiska; the remains of the seven crewmembers were recovered and buried in a common plot near the crash site. In 2001 a wildlife biologist on Kiska discovered aircraft wreckage, including a data plate inscribed with the number 04511 and a bone. The number correlated to the lost PBY-5. Armed with this new information, a JPAC CIL Search and Recovery team located and recovered human remains.

Laboratory analysis of the remains indicated a skeletal MNI of seven. An initial sorting hypothesis utilizing pair matching, osteometric analysis, articulation, and taphonomic indicators identified seven clusters of partial upper and lower bodies, leaving several duplicated elements not associable to an individual.

Elements from each skeletal cluster and the unassociated elements were sampled for mtDNA analysis. Sample selection was guided by MNI and preservation. Twenty-nine samples were taken from skeletal and dental elements. DNA test results were used to associate and segregate remains, confirming and challenging initial sorting hypotheses, and ultimately strengthening postmortem identification by adding an additional line of evidence.

DNA analyses confirmed the presence of seven individuals by identifying seven different mtDNA sequences. However, formal differentiation of sequences requires a minimum of two polymorphic differences. In this case, two sequences could not be excluded from one another because of sequence similarities and additional sequencing outside the standard hypervariable region was required. Recently developed mtDNA SNP assays offer additional means to discriminate individuals with shared haplotypes.

Any sequence consistency between evidence samples and staff requires added procedures to identify potential contamination. Sequences derived from skeletal elements in this case were consistent with the mtDNA sequence of a JPAC CIL external consultant. A review of evidence management records showed the evidence had not been exposed to the consultant, thus excluding him as a potential contaminator. Multiple evidence samples consistent with a staff sequence typically indicate a shared type, not contamination.

Locating reference samples for casualties can be a lengthy process. Genealogists are frequently contracted to locate a maternal relative. In this case, no references were available; however, a unique resolution to this problem is proposed. Six of seven individuals are linked to dental elements. DNA samples from these teeth serve as internal references, associating postcranial remains. Using internal references works here only because the individuals form a closed population. Through exclusion, the seventh sequence must represent the seventh individual.

MtDNA is not unique to an individual, which can complicate segregation of commingled remains; however, new techniques are increasing individuation power. Points to consider when applying mtDNA analysis to commingled remains include population parameters (i.e., case background), skeletal MNI, and efficient sampling strategy. Understanding advantages and disadvantages of mtDNA analysis adds value to forensic anthropology. When used in conjunction with other lines of evidence, mtDNA sequencing strengthens a case for postmortem identification and facilitates the segregation of commingled remains.

Commingled Remains, Ancient DNA, Forensic Anthropology

H55 Marrying of Anthropology and DNA: Essential for Solving Complex Commingling Problems in Cases of Extreme Fragmentation

Amy Z. Mundorff, MA, Robert Shaler, PhD, Erik T. Bieschke, MS, and Elaine Mar, MS, Office of Chief Medical Examiner, 520 1st Avenue, New York, NY 10016*

The goal of this presentation is to describe how a combined effort of anthropologists and DNA scientists is essential to sorting out undetected commingling in cases of extreme fragmentation from mass disasters.

This presentation will impact the forensic community and/or humanity by providing useful tools to be used in large-scale identification efforts from mass disaster situations. This has been one of the largest identification efforts, and many lessons have been learned. It is important to disseminate this information for future use.

On September 11th 2001, American Airlines Flight 11 and United Airlines Flight 173 crashed into the twin World Trade Center towers and initiated a sequence of events that eventually felled both towers and five other commercial buildings, murdering 2749 individuals, of which 1565 have been identified to date. The rescue and the subsequent recovery lasted until May 2002, but the identification of the almost 20,000 fragments of human remains is on going with no end in sight. The World Trade Center work is the largest forensic identification effort in U.S. history and the problems have been magnified by the extreme fragmentation and commingling of the human remains.

Massive fragmentation of the victims and extensive commingling of the bodies characterized the World Trade Center disaster. The commingling had several contributing factors: two airplane crashes causing multiple building collapses where people died together, long recovery time, extensive watering from fire management, decomposition, the recovery techniques requiring large mechanical equipment, and attempted reconstruction of remains at the site by untrained personnel.

The DNA scientists did not initially believe commingling was a problem as long as it could be identified and the appropriate pieces could be separated. However, the DNA scientists were not in a position to see when duplicate pieces, such as two right feet, had identical DNA profiles. This is a problem that can have many origins: poor sampling techniques during the autopsy, tissue commingling within the remains, DNA contamination in the laboratory, and simple transcription errors.

This made commingling one of the most confounding problems encountered during the identification process. Initially, this was thought to be easily identified when tissue and bone samples ostensibly from the same case were giving different DNA profiles in the laboratory. However, in one case, a requested review of the remains uncovered the top and bottom portions of a torso did not actually articulate with each other indicating possibly two different individuals. The imminent release of the torso identified by DNA, to a single family, created concern about the accuracy of the identification. DNA typing of only one of the torso pieces tested identified the appropriate family. The other torso fragment, however, did not have a DNA test. Subsequent DNA testing after re-sampling confirmed the anthropologist's suspicions. This case initiated a new protocol where a 'final anthropological review' of all remains was necessary before the confirmation of every identification and subsequent release to the families.

After any identification is made, regardless of the scientific modality, an anthropologist does a visual inspection of the remains to confirm the level of detail recorded in its file as well as its congruity to the previously identified fragments of that individual. Often times, many fragments have been identified to one person. To date, the most fragments identified to one person are 209. Information such as the sex and age of the identified victim is considered, as well as a detailed review of all of the other fragments previously identified to that victim. Because the identification efforts have lasted so long, multiple fragments of remains have been identified to a single person years apart. These previously identified remains often have already been released to funeral homes. It has been through this final

review process, that the majority of commingling and contamination mistakes have been identified and corrected. This paper will describe in detail how this task was accomplished.

Marrying both sciences, the authors discovered that the synergy of the two disciplines was necessary to ensure that commingling was found. Using World Trade Center examples of each of the different mechanisms of commingling, this paper will demonstrate how to identify that a problem exists and trace back to its root and from this information, solve the problem and put procedures in place so they can be recognized or avoided in the future.

Commingling, Identification, Mass Disaster

H56 Mass Graves, Human Rights and Commingled Remains: Considering the Benefits of Forensic Archaeology

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The goal of this presentation is to consider the primary role of archaeological recovery methods in the excavation of mass graves and eventual prosecutorial efforts.

This presentation will impact the forensic community and/or humanity by reevaluating the immediate and long range goals of mass grave recovery in human rights cases, and the implementation of comprehensive forensic archaeological methodologies

The widespread investigation of human rights violations and abuse in many areas of the world during the past few decades has attracted a renewed interest to the recovery and investigation of human remains from multiple victim burial features (*i.e.* "mass graves"). Understandably, focus has been placed on personal identification issues and efforts to return the remains of victims to their families as soon as possible. However, as noted by Rothenberg (2002), the number of perpetrators that have faced prosecution is far below the number of episodes of gross human rights violations and abuses documented during this period, even when just considering the cases of extraordinary brutality. This situation stands in stark contrast with the strict juridical definition of the *human rights* concept, including the *right to an effective remedy by the competent national tribunals for acts violating the fundamental rights* of any individual (Article 8 of the Universal Declaration of Human Rights, UN General Assembly resolution *217 A (III)* of 10 December 1948).

The corollary of these considerations is that any investigation of human rights violations or abuses must be conducted in such a way as to allow for effective presentation of the case in a court of law. Failure to do so, or any destruction or negligent recovery of significant evidence will, in fact, result in a new violation of basic human rights.

With respect to the recovery of multiple-victim burial features ("mass graves") in human rights cases and eventual successful prosecutorial efforts, the proper documentation of contextual data through formal forensic archaeological protocols, standardized to allow for inter-site comparison, is especially critical in attempts to sort out specific depositional episodes, sequences of body deposition, and understanding associations between physical evidence, including human remains, even in complex commingling situations.

Mass grave features may appear, at first glance, to represent very unique and recent scientific situations, requiring special techniques and methodologies; however, professional archaeologists have been excavating and analyzing these rather complex features for many years. Precedent in recovery techniques and methodologies can be found, therefore, in the field of contemporary archaeology.

In this presentation, a prehistoric Native American ossuary feature, containing the remains of over 160 individuals, will serve as a conceptual model of how the implementation of appropriate contemporary archaeological methods, especially, comprehensive mapping protocols, can address multiple issues related to the commingling of human remains and depositional events within the burial feature itself; methods and analyses that are directly applicable to modern forensic settings, including mass graves in human rights cases.

As a result of the rigorous, comprehensive and standardized collection of contextual data, it is possible to identify and interpret the effects of a broader range of taphonomic agents and depositional sequences, leading to a much better reconstruction of past events (especially, with respect to human behavior), including, possibly, determinations of individual body placement sequences and the ability to more precisely define associations between artifacts/physical evidence. In addition, with the embellishment of contextual data, more sophisticated statistical analyses can be brought to bear on relevant issues such as commingling patterns.

Regarding the Orton Quarry ossuary site, the marked commingling of remains within the burial feature led to preliminary observations that the cranial elements were clustered in one area of the ossuary, while the post-cranial elements exhibited no recognizable pattern of spatial distribution (with respect to original anatomical articulation). Indications were that very few skeletal elements, if any, were articulated (i.e., no tissue remained on the bones, or processing of fresher remains resulted in disarticulation of all elements) at the time of deposition in the burial feature. In order to test this observation scientifically, a sequential battery of statistical tests was designed, based on formal hypotheses of spatial distribution patterns of skeletal elements.

In this case, the bivariate Ripley's K function $K_{12}(t)$ was used to study the interaction of multiple series of points (proximal and distal locations of long bones) distributed on a plane. This method is more informative than its equivalent parametrical counterparts, such as *nearest-neighbor* analyses, as it provides information not only on the presence and type of spatial association, but also on its intensity and scale (range).

Results indicate that, in fact, at least some of the individuals or anatomical units were placed in the Orton Quarry burial feature in an articulated state. Further, these findings suggest that spatial proximity of anatomical units (such as proximal tibia/distal femur) can be used effectively as a valid criterion for selecting potential matches of bones from the same individual.

The implications for addressing issues of commingling within mass graves in human rights cases are clear. Although most attempts to determine which bone belonged to which individual rely almost exclusively on skeletal features such as size, chronological age, sex, idiosyncratic variation, or even taphonomic modification of elements, significant stream-lining of the process can be accomplished through the careful recovery of contextual information during the recovery phase of the project.

Finally, if these investigations are to be considered "forensic" in nature, and if they follow the original intent of human rights legislation, the goal should not be confined to the identification of the victims. Forensic evidence takes the form of not only the biological remains of humans interred in the burial feature, but the contextual relationship of all associated evidence, such as personal effects, weapons, trace evidence; as well as, environmental evidence, such as stratigraphic data, faunal, botanical, and geological evidence (soils types, water movement through deposits, etc.). The collection and ultimately, the interpretation of this collage of evidence permits investigators to not only identify the victims but to provide a comprehensive, testable hypothesis of events surrounding the burial episode.

Mass Graves Excavation, Context, Prosecution Consideration

H57 Advances in the Assessment of Commingling Within Samples of Human Remains

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Attendees will gain an understanding of the issues involved in the assessment of commingling in the analysis of human remains.

This presentation will impact the forensic community and/or humanity by offering an overview to the symposium on commingling being organized by others. It will synthesize concepts and issues presented by others in the symposium as well as present the authors' own views on the methodology and logic of such analysis.

This presentation provides an overview of approaches to the study of commingling in the analysis of human remains and discusses the potential for new research.

Forensic anthropological analysis of human remains routinely includes assessment of commingling. Such evaluation is a component of the study of apparent single individuals to assure that remains of others are not included. Commingling analysis is especially important in complex assemblages of multiple individuals and in cases of extreme fragmentation.

Inventory represents an important first step in commingling analysis. Careful inventory can immediately yield evidence of multiple individuals in the form of duplicated bones. Inventory of bone type (including side) can be supplemented with information on age at death, sex, bone size, and robusticity, other aspects of bone morphology and patterns of articulation.

Specialized techniques that have been used to further commingling analysis include ultraviolet light analysis, radiography, serological study, neutron activation, bone weight, trace element analysis, molecular analysis, and bone density study.

If evidence of multiple individuals is detected, it is important to establish the minimum number of individuals represented. This number can be generated through combinations of the procedures summarized above but may under-represent the actual number of individuals present.

Additional research is needed to evaluate the effectiveness of the varied approaches to commingling analysis, in consideration of human variation and the complex taphonomic factors that frequently are involved in the preservation of human remains in forensic contexts.

Commingling, Human Remains, Forensic Anthropology

H58 Closed Case Files: Sequelae of a Case of Complex Postmortem Mutilation

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After attending this presentation, attendees will understand the potential usefulness of anthropological analysis in the reconstruction of a complex postmortem mutilation.

This presentation will impact the forensic community and/or humanity by presenting a detailed case study of a complex dismemberment which underscores the utility of anthropological analysis in the corroboration of documented details of a crime.

This poster describes the follow-up to a serial murder case that is being presented as a paper at these meetings (Dr. John Verano, Tulane University), in which the perpetrator and his accomplice strangled, dismembered, and dispersed the parts of three women. Whereas Dr. Verano has amply covered the details contributing to the resolution of the case, this poster details the follow-up examination of the torso of one of the victims as a case study in complex postmortem treatment involving dismemberment and extensive fragmentation. This case is unique in that the accomplice has provided law enforcement personnel with a detailed confession chronicling the murders and their aftermath, against which the accuracy of the anthropological analysis could be tested.

The perpetrator had intentionally disfigured and dismembered the victim after her murder, in an effort to both dispose of the body and to prevent her identification in the event that the parts were discovered. Working on information provided by the accomplice in the murders, the Jefferson Parish Sheriff's Office recovered a severed Caucasian female head from a St. Charles Parish swamp. Separately, New Orleans Police recovered the partially decomposed torso of a Caucasian female in the New Orleans area in January 2002. Because the torso bore characteristics similar to open dismemberment cases in Jefferson Parish, the N.O.P.D. transferred the torso to the Jefferson Parish Coroner's Office for autopsy and analysis. The torso was recovered in a state of moderate decomposition, and was comprised of the thorax from cervical to lumbar vertebrae with the right shoulder and arm attached, but the fingers removed. The other appendages, pelvis and sacrum were never recovered, although the head collected by J.P.S.O. from a separate context was suspected to be from the same victim. Relevant portions of the skeleton were removed for anthropological analysis by Dr. John Verano of Tulane University, and the remainder of the torso was stored in the morgue freezer at the Jefferson Parish Forensic Center. The head was ultimately determined to be from the same individual and a positive identification was made. Due to the preponderance of evidence, both perpetrators eventually plead guilty in the case.

After adjudication and before interment of the victim's remains, the torso was also analyzed to examine the extent of the perpetrators' efforts to conceal the body. The bulk of decomposed tissue was first removed mechanically by gentle manipulation with wooden tools by the death investigator in the case, Bill Donovan of the Jefferson Parish Coroner's Office, and the presenting author. The bones were then macerated and degreased using a non-bleaching method (1). Due to extensive fragmentation, some adherent soft tissue was left surrounding shattered elements, which were wrapped individually in cheesecloth during the process to retain all fragments. Subsequent to removal of soft tissue, the skeletal elements were refitted and analyzed by the presenting author to determine the type and sequence of damage, which included various forms of cut marks and extensive fragmentation. Anthropological analysis revealed significant fracturing and cutting consistent with both the observed damage to the head of the same victim and with certain damage to the remains of the successive victims. An unusual tool mark on the clavicle was also consistent with distinctive tool marks observed on the head.

The tool marks and degree of destruction observed in anthropological analysis were then compared with the tools used by the perpetrators, which were collected from a local bayou by law enforcement agents based on a statement from one of the perpetrators. The cause and sequence of damage surmised by the anthropologist was also compared with the actions of the perpetrator and his accomplice, as gleaned from extensive taped confessions made to law enforcement officers. Comparison with documented details of the case supported the anthropological analysis, stressing the effectiveness of anthropological analysis in reconstructing complex postmortem treatment.

References:

1. Fenton TW, Birkby WH and Cornelison J. A fast and safe non-bleaching method for forensic skeletal preparation. *J Forensic Sci* 2003; 48(1): 274-476.

Dismemberment, Reconstruction, Forensic Anthropology

H59 A Tale of Two Bodies: Separating Commingled Skeletal Remains With Similar Biological Profiles

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After attending this presentation, attendees will gain insight into how separation of two biologically similar commingled individuals can be achieved through meticulous examination, anatomical congruencies and differential weathering patterns.

This presentation will impact the forensic community and/or humanity by presenting two individuals recovered from a remote desert area. At the time of recovery, the skeletal remains were commingled and spread across a square mile. Careful examination of the condition of the remains, anatomical congruencies and radiographic analysis allowed the authors to successfully separate the remains and achieve positive identification on one individual. These results allow the investigators to more aggressively investigate the circumstances surrounding the deaths and the families to bury their loved ones.

Commingling of skeletal remains often confounds investigators attempting to discover the identity of unknown individuals. A recent case in Arizona highlights the difficulties with commingled remains and offers an example of how radiographs, condition of the remains and anatomical congruencies can assist in the separation of individuals in these types of cases.

On June 1, 2004, Sheriff's deputies from Maricopa County, Arizona convened in a remote desert area to recover skeletal remains allegedly discovered by a camper. The first author accompanied the detectives in order to assist with the recovery. Initial survey of the scene indicated that the skeletal remains represented at least two individuals. The anthropologist was able to quickly confirm these findings. Clothing and other artifacts from two individuals were also located during the search. The remains were documented according to standard scene processing protocols. The skeletal elements and clothing were bagged and transported to the Maricopa County Forensic Science Center for examination by the pathologist and anthropologist.

The skeletal remains were incomplete and had suffered from carnivore predation. In addition, one of the initial findings at the autopsy was that these two individuals were both males, very similar in age and height and had little to distinguish them from one another. However, the two skeletons had responded to the environment in very different ways, allowing a preliminary division that could then be verified by more scientific means. The coloration, degree of adherent tissue and overall texture and quality of bone was very different between the two men. The first author performed the initial partition and then the second author confirmed her findings.

After the separation, anatomical congruencies between the recovered elements were evaluated. These confirmed the findings based strictly on observed differences. At the end of this procedure, there were two phalanges, a fibula shaft and miscellaneous bone fragments that could not be assigned to either decedent.

Anthropological assessment based on sternal rib ends, pubic symphysis and epiphyseal closure revealed that the men were in their twenties at the time of death. Long bone lengths produced living stature estimates of 5 foot 10 inches and 5 foot 8 inches respectively. Ancestry could not be accurately assessed due to incomplete recovery. One of the males had bilateral septal apertures of the humeri, a non-metric trait with a frequency of between 4 and 13% based on assessment of known human skeletal series. The other male had a more robust skeletal structure, with heavier elements and more developed muscle attachment sites.

At the time of the autopsy, the case agent had delivered radiographs of a male missing from the area. The radiographs contained images of the thorax, abdomen and right arm. Comparison of the right arm in the antemortem radiographs to the anatomy of the recovered right arm from one of the skeletal remains revealed morphological similarities that supported a positive identification. The right arm in the antemortem and postmortem radiographs exhibited a large sternal aperture in the olecranon fossa of the humerus. Given the low frequency of this non-metric trait in human skeletal series, as well as its proclivity to manifest more often in females and on the left side, this supported the ten other morphological similarities identified between the films. Further investigation by the sheriff's office revealed that this man had gone missing with his close friend and neither had been seen for several months. These findings were in concordance with the condition of the remains.

This poster presents two individuals recovered from a remote desert area. At the time of recovery, the skeletal remains were commingled and spread across a square mile. Careful examination of the condition of the remains, anatomical congruencies and radiographic analysis allowed the authors to successfully separate the remains and achieve positive identification on one individual. These results allow the investigators to more aggressively investigate the circumstances surrounding the deaths and the families to bury their loved ones.

Skeletal Remains, Commingling, Radiographic Comparison

H60 Performance of FORDISC 2.0 Using Inaccurate Measurements

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The goal of this presentation is to present to the forensic anthropological community the necessity of proper training in the collection of metric data for use in discriminant function analysis.

This presentation will impact the forensic community and/or humanity by showing the sensitivity of discriminant function analysis to measurement errors. These results demonstrate the necessity of receiving proper training in the collection of metric data as well as the need to check instrumentation used to collect metric data. It is suggested that only individuals who have received a substantial amount of training should be using FORDISC 2.0 in a professional arena.

Once decomposition has progressed beyond the point of recognizing the soft tissue indicators of an individual's sex and ancestry ("racial" affiliation), it becomes the job of the forensic anthropologist to make these determinations. The determination of sex and ancestry are part of the biological profile that the anthropologist constructs during a skeletal analysis. The anthropologist uses both non-metric and metric analyses to determine these characteristics. However, the determination of ancestry is not always a clear or simple task. In recent years the use of metric analysis has become more prominent due to the advancement of computers and use of statistical software. FORDISC 2.0, distributed by the University of Tennessee at Knoxville, is a program that facilitates the collection and use of metric data in discriminant function analysis to determine sex and ancestry from the skeleton. The program was developed using the Forensic Data Bank, which is an electronic accumulation of data from modern forensic cases from around North America. The use of FORDISC 2.0 is prevalent in the field of forensic anthropology and at times it may be used by individuals having only a cursory knowledge of measurement techniques and morphometrics. This poster will examine the outcome of poor data input into FORDISC 2.0 to determine how well the program performs with inaccurate data.

The 24 standard FORDISC 2.0 cranial measurements were taken on four carefully-selected crania that had been positively identified or had enough soft tissues at autopsy to make a determination of sex and ancestry. The measurements were entered into the program to classify each specimen using the "White" male, "White" female, "Black" male, and "Black"

female reference groups. Two of the specimens were chosen because they were classified as strongly belonging to one of the reference groups, while the others were weakly classified. The measurements with the highest relative weights in the discriminant functions were then selected and manipulated by the addition and subtraction of 1 to 5 mm from the original measurement, and the changes in probabilities and classification were recorded. Measurements were changed all at once and in isolation. Results demonstrate that individuals who are classified strongly into a reference group remain strongly classified in that same group even with significantly altered measurements. Individuals with a weak classification into a reference group can be subject to a significant change by the addition or subtraction of even as little as 1 mm to a single measurement. It is generally accepted that interobserver error among trained individuals can reach 2 to 3 mm. Depending on the measurement and the morphology of the subject, errors of this magnitude can have a significant influence on the discriminant function analysis. These results demonstrate the necessity of receiving proper training in the collection of metric data as well as the need to check instrumentation used to collect metric data. These findings in no way suggest the abandonment of the use of FORDISC 2.0 or other forms of discriminant function analysis, however, the authors suggest that only individuals who have received a substantial amount of training should be using FORDISC 2.0 in a professional arena.

Ancestry Determination, FORDISC 2.0, Discriminant Function Analysis

H61 Testing Determination of Adult Age at Death Using Four Criteria of the Acetabulum

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The goal of this presentation is to evaluate the usefulness of a new aging technique based on degenerative changes to the acetabulum.

This presentation will impact the forensic community and/or humanity by demonstrating how accurate aging techniques are integral to identification of human remains. A method of age assessment from the posterior os coxa, such as the acetabulum, is desirable since this region is commonly preserved in forensic and archaeological contexts.

This poster will present the results of a study testing a recently published aging technique. This method, developed by Rouge-Maillart and colleagues (2004), sought to quantify degenerative changes to the acetabulum and equate these to age ranges. Because the acetabular region of the os coxa tends to be preserved in both forensic and archaeological contexts, an accurate aging method utilizing this area could increase the amount of useful information gained from the analysis of human skeletal remains.

Four features were scored based on degenerative changes: the rim of the acetabulum, porosity of the acetabular fossa, porosity of the lunate surface, and "apical" activity (degenerative changes of the posterior cornu of the lunate surface). The original study examined 30 white males, ranging in age from 24 to 81. Results showed a "significant" correlation between age and the acetabular rim and fossa. The purpose of the current research was to test the method for the ability to replicate the results as well as to expand the sample to include white females. In this study, all observations were made on adult Caucasians between the ages of 19 and 100 in the documented skeletal collection housed at the University of New Mexico's Maxwell Museum. The sample size was 103, with 53 females and 50 males. During the data collection phase of this research, the observer was unaware of the age of the individuals observed. Scores for each of the four criteria were recorded and documented ages were matched to the individual scores for the final statistical analysis.

The results of this study show statistically significant correlations between age and acetabular rim, and age and acetabular fossa for males. For the female sample, age correlates with the acetabular rim, acetabular fossa and also with apical activity. The results of the porosity of the lunate surface are not significant for either sample population (? α 0.05). Despite the significance of the results, the correlations are not strong, with apical activity in females having the highest correlation (0.63). Also, the results of the current study are not discreet; there are large age ranges and significant overlap of ages between the stages. In addition, a high rate of intra-observer error was noted for both sexes.

A useful refinement to this method would be to create more descriptive definitions of each stage. Clearer descriptions of "extensive" osteophytes vs. "substantial" osteophytes in stages three and five of the acetabular rim, for example, will help other observers to apply this method. Further clarification of what is meant by "localized" destruction of the rim and when it becomes "generalized" destruction and thus progresses to the next stage of degeneration may also make this technique replicable by other observers as well as improving intra-observer error.

Rouge-Maillart's *et al*. method may be most effective for categorizing specimens into broad age ranges because of the large overlap in scoring for all age groups. Perhaps this technique may be best applied in conjunction with other methodologies, such as the auricular surface. Although the present study found that the technique did not produce highly accurate results when tested on specimens drawn from the Maxwell Museum's documented collection, the method may still contribute useful data for the assessment of age from skeletal remains, particularly when other diagnostic features are not observable. It may be possible in the future to narrow the ranges and increase accuracy if more detailed descriptions of the stages are produced.

Acetabulum, Degenerative Changes, Aging Technique

H62 A Potential New Morphological Indicator of Biological Affinity in Human Skeletal Remains

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The goal of this study is to introduce a new cranial non-metric trait which can aid investigators and anthropologists in assessing the population affinity of unidentified skeletal remains.

This presentation will impact the forensic community and/or humanity by presenting a new method of assessing biological affinity in unidentified remains.

Establishing population affinity in cases involving unidentified decomposed or skeletal remains is an integral part of a complete osteological analysis. Determining the ethnic affinity of skeletal remains found in forensic contexts greatly reduces the number of antemortem records searches needed to establish identity. Anthropologists have traditionally relied on both morphological and metric indicators to determine racial identity. Determining ancestry from non-metric traits relies on a skull exhibiting traits believed to be representative of a particular population.

This study introduces a new morphological indicator, the infraorbital "fold," which demonstrates the potential to differentiate White individuals from those of Black, Hispanic or Native American ancestry. The morphology of the lateral infraorbital margin, specifically the presence/absence of an "infraorbital fold," appears to be an accurate indicator of ancestry.

The infraorbital fold, when present, is a projection or crest of bone emanating from the lateral portion of the infraorbital margin. The superior, medial portion of the zygomaticomaxillary suture protrudes anteriorly, forming a transverse crease. This bony projection is restricted to the zygomatic bone; the fold terminates medially at the zygomaticomaxillary suture. The trait was scored as present if the fold was evident bilaterally; the trait was scored absent if neither infraorbital region displayed the fold.

The sample was drawn from the documented collection housed at the Laboratory of Human Osteology of the Maxwell Museum at the University

of New Mexico. Additional individuals were taken from the Office of the Medical Investigator's forensic collection, also housed at the Maxwell Museum. All individuals included in the sample had known sex, age, and ethnic affinity. This trait was scored on a total of 418 adult skulls; 276 were males, 142 were females. The sample included 228 White, 104 Native American, 77 Hispanic, and 9 Black individuals.

The fold was present in 93.4% of the White individuals but only 2.6% of the Hispanic, and 6.7% of the Native American individuals. The fold was completely absent in the small number of Blacks included in the study.

Knowledge of the anatomy of the suborbital region aids in understanding why the trait varies among populations. The orbital surface of the zygomatic bone is the site of the orbital fat pad and the insertion for the inferior oblique muscle of the eye. The lateral infraorbital margin serves as the site of attachment for the palpebral and orbital portions of the orbicularis oculi muscle as well as the levator labii superioris and zygomaticus major and minor. Variations in these soft and hard tissues among racial groups have been reported previously.

Population variation of a closely associated trait – the angle of the zygomaticomaxillary suture – provides further insight. The morphology of the suture varies among Whites, Black and Native Americans. Suture structure typifying Whites is described and illustrated as "s-shaped," with the superior and inferior portions of the suture oriented medially and the midpoint of the suture deviating laterally. It is the upper portion of the zygomatic, superior to the suture's midpoint deviation, which makes up the infraorbital fold (when present). Although described respectively as "angled" or "curved," suture morphology for both Native Americans and Blacks is illustrated as an arc with its medial most point inferior to the orbit. The absence of a sharp change in direction within the suture may provide greater joint stability and raises the possibility that the infraorbital fold represents a buttress for muscle attachment.

Ethnic affinity cannot accurately be determined by a single indicator or isolated trait. The infraorbital fold trait, when used in concert with other cranial non-metric traits, appears to contribute significantly to the correct assignment of ancestry in unidentified crania. Additional studies on larger Black samples, as well as other ethnic groups, are warranted.

Osteology, Population Affinity, Identification

H63 An Evaluation of Racial Differences in the Human Mandible Using Discriminant Function Analysis

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After attending this presentation, attendees will understand the potential value of mandibular measurements in the assessment of ancestry in the human skeleton, specifically focusing on discriminant function analysis.

This presentation will impact the forensic community and/or humanity by demonstrating that the determination of race from the skeleton is one of the most difficult areas of assessment in forensic anthropology. This presentation will provide another technique in such assessment using a bone that is often well preserved.

As most in the forensic community are aware, determination of ancestry using the human skeleton is often challenging. The mandible is not traditionally regarded as featuring many reliable indicators of race with only a few non-metric differences, such as the more pointed chins seen in whites, having been noted in discussions of racial assessment (Rhine 1990). Researchers, however, have observed that at times entry of ascending ramus data into Fordisc 2.0 analysis changed the racial assignment of a particular skull. Although this is likely attributable to the small sample sizes of the referent populations used in generating the statistical functions employed, it also suggests that a comprehensive study of mandibular metrics for blacks and whites might prove useful. The mandible would be an especially valuable bone since it is often well preserved. Consequently, such an analysis was undertaken, using the Terry Collection at the Smithsonian Institution to determine which parts of mandible, if any, are diagnostic in assessment of ancestry.

The Terry Collection is composed of complete skeletons from medical school cadavers dating to the first half of the 1900s. As a result, individuals are of known sex, race, and age. Some 211 mandibles were evaluated with sample selection being severely limited by extensive antemortem tooth loss. It was desired that individuals have at least three of the six molars present to minimize the effects of loss on ramus morphology. The final sample was distributed as follows: black males – 68; white males – 68; black females – 33; and white females – 14. An additional 28 individuals composed a control sample. Eighteen measurements were taken using sliding calipers or a mandible board. Most measurements were standard for the mandible, although several concerning dental arcade dimensions were created for this project. Data were evaluated using stepwise discriminant function analysis in SPSS with groupings comprised of the entire sample, only males and only females.

The variables that statistically entered into the three functions were consistently drawn from the same set: M2-prosthion length, bigonial breadth, minimum ramus breadth, alveolar length, and ramus height. All of the functions had Eigenvalues greater than 1.0, canonical correlations over .700, and Wilk's lambda values less than .500. Classification success rates were 75.3% for the entire sample (BM, BF, WM, WF), 86.2% (males alone), and 93.0% (females alone). When the discriminant functions were applied to the control sample, the success rates were 72.0%, 89.5%, and 87.5%, respectively.

These results suggest that consistent metric differences are present in mandibles between whites and blacks, although the diagnostic features do not seem to cluster in one area of the bone (i.e. the ramus or the dentition). The similarity in variable selection for the functions for each sex was surprising, suggesting that racial differences are indeed being detected. It should be noted, however, that the classification results were much better when the sexes were separated. Although these findings are very encouraging, further work still needs to be conducted, especially with a larger sample size of white females. It is also important that the role of antemortem tooth loss be more directly addressed since individuals evaluated by forensic anthropologists often suffer from extensive dental pathology.

Mandible, Measurements, Ancestry

H64 Evaluation of Regression Equations to Estimate Age at Death Using Cranial Suture Closure

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The goal of this presentation is to present to the forensic anthropological community the utility of regression formulae to estimate age at death using cranial suture closure.

This presentation will impact the forensic community and/or humanity by demonstrating that cranial suture closure can be a useful tool to estimate age.

Age at death is one of the primary components of the biological profile constructed by forensic anthropologist during a skeletal analysis. There are several indicators used to estimate age at death for adults, however, some are employed more frequently than others. The study of cranial suture closure and its relationship with age dates back to the 16th century. However, since that time and continuing into the present, there have been doubts about the applicability of suture closure to age estimation. Even with this skepticism, researchers continue to examine suture closure as an indicator of age at death. Most recently Nawrocki (1998) introduced

14 regression equations to estimate age using cranial suture closure. Testing of the performance of these equations as well as their applicability as an age estimator has been limited. This study examines 6 of the regression equations (Equations 1, 2, 3, 4, 7, and 8) created by Nawrocki using recently deceased individuals. The test sample contains 356 individuals (111 females, 255 males) of European ancestry. The majority of the test sample is derived from documented skeletal collections curated by the University of Tennessee and the Maxwell Museum at the University of New Mexico. A small percentage of individuals were forensic cases processed by the University of Indianapolis Archeology and Forensics Laboratory.

In total, 31 landmarks were scored on each specimen: 18 ectocranial (external) surface, 7 endocranial (internal) surface, 2 facial, and 4 from the palate. Following Meindl and Lovejoy (1985), one-centimeter segments along the cranial sutures were scored from 0 to 3, where 0 is no closure, 1 is 1-50% closure, 2 is 51-99% closure, and 3 is complete obliteration. The endocranial and palatal sutures were scored following Nawrocki's (1998) guidelines. Age was estimated for each individual using up to 4 different equations: 2 general equations (EQ 1 and 2) and 2 group-specific equations (i.e. all females, European females). Inaccuracy and bias were calculated for each equation to assess its performance. The percentage of individuals whose estimated age falls within each equations ± 2SE prediction interval was also calculated. An analysis of covariance (ANCOVA) was used to determine if suture closure is influenced by an individual's sex.

Inaccuracy is the average absolute error of the estimate. For Equation 1, inaccuracy was 12.81yrs (M + F). Inaccuracy for Equation 2 was 13.44yrs (M + F). The 2 male-specific equations (EQ 4 and EQ 8) had inaccuracies of 12.58 and 15.64 years respectively. The inaccuracy for the 2 female-specific equations (EQ 3 and EQ 7) was 22.18 and 18.84 years respectively. Bias is a measure of the overall under- or over-estimation. Bias for EQ 1 was –5.61yrs (M + F). Bias for EQ 2 was –7.61yrs (M + F). Bias for the 2 male-specific equations (EQ 4 and EQ 8) was 2.21 – and 8.25 – years respectively. For the 2 female-specific equations (EQ 3 and EQ 7), bias was –19.13 and –4.21 years respectively. The percentage of individuals falling within ± 2SE for the general equations ranged from 73.6 to 93.5. For the male-specific equations (EQ 4 and EQ 8), 84.4% and 74.7% respectively fell within ± 2SE. The percentage for the female-specific equations (EQ 3 and EQ 7) was 52.6% and 59.5% respectively. The ANCOVA results suggest that summed suture score is influenced by sex. This study found that the general equations performed well and in general had better results than the group-specific equations. The male-specific equations performed better than the female-specific equations. The poorer performance for the females may be due to a larger number of older individuals in that subgroup compared to the males. Cranial suture closure does correlate with age, however, sex influences that relationship and needs to be accounted for when using sutures to estimate age. In conclusion, cranial suture closure can be a useful tool to estimate age and the long-lasting skepticism should be reconsidered.

Cranial Suture Closure, Age at Death Estimation, Forensic Anthropology

H65 Test of an Alternative Method for Determining Sex in the Hip: Applications for Modern Americans

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The goal of this research is to test the success rate of a recently published method for sexing the pelvis in modern American populations.

This presentation will impact the forensic community and/or humanity by providing information on a new technique, which could be used in cases where sex determination is ambiguous.

Many techniques exist for determining sex in the skeleton based on pelvic morphology. These methods yield success rates that vary between 80-95% depending on the methodology and population. In the last decade, violent crime rates have been consistently high in south Louisiana[1]. This increased crime rate has resulted in an augmented number of forensic cases in which an anthropologist has been needed to determine the sex of the individual in putrefactive or skeletal remains. An investigation of alternative techniques for sexing the pelvis may prove beneficial in identifying unknown individuals in such cases.

A recently published method for sexing the pelvis alleges a 98% success rate[2]. This methodology is based on five "characters" of the hip, including aspects of the preauricular surface, greater sciatic notch, form of the composite arch, morphology of the inferior pelvis, and ischiopubic proportions. Using these characters, eleven possible "conditions" are observed that can be scored as male, female, or intermediate. For each character, the conditions are combined to form a composite score. Then, the sum of the composite scores is used to determine the sex of the individual. While the accuracy of this method reportedly is high, all collections used in this research are European (specifically, French and Portuguese), and one cannot assume the methodology would yield equally high success rates in other populations. Therefore, further testing, specifically on modern American collections, is necessary to ensure the technique's applicability in the United States.

The purposes of the present study are: 1) to evaluate the success rate of the Bruzek methodology for modern American pelves using different population subgroups; 2) to compare the success rate of this method with traditional techniques[3]; and 3) to determine the replicability and ease of this method for other observers.

A total of 450 os coxae from individuals of known sex have been evaluated from the Donated Collection housed at the Forensic Anthropology and Computer Enhancement Services (FACES) Laboratory at Louisiana State University, the William M. Bass Donated Collection housed at the University of Tennessee, and the Robert J. Terry Anatomical Collection housed at the Smithsonian. All data were collected using macroscopic visual examination and photographic images of the os coxae.

Preliminary results from a subset of the data demonstrate that the Bruzek method correctly identified sex in 81% of the cases, with 9.5% classified as "ambiguous" and 9.5% assigned the incorrect sex. The traditional methods yielded a success rate of 86%, with the remaining 14% classified as "ambiguous." Additionally, many aspects of the Bruzek method were difficult to replicate, which therefore increased the potential for inter-observer error.

The overall applicability of the Bruzek method is questionable given these preliminary results. However, certain aspects of this methodology, such as analyzing the greater sciatic notch by dividing it into proportions, provided new ways of evaluating conventionally subjective regions of the hip. Combining such aspects with traditional methods may be useful when trying to determine sex in ambiguous or fragmentary remains.

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Forensic Anthropology, Sex Determination, OS Coxae

H66 Sexing the Zygomatic Bone

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Attendees will learn the zygomatic bone is sexually dimorphic and has a potential to be used when addressing questions of sex, especially when using the skull in creating a biological profile.

This presentation will impact the forensic community and/or humanity by demonstrating the sexual dimorphism of the zygomatic bone and its applicability to sex estimations through traditional cranial measurement and geometric morphometric approaches.

The goal of this presentation is to demonstrate sexual dimorphism in the zygomatic bone and its potential for metric sex estimations through the use of a Microscribe 3-DX Digitizer.

This poster will demonstrate the potential of the zygomatic bone for sex estimation. The attribution of sex is an important component of the biological profile, and relies on the sexually dimorphic characteristics of the human skeleton for its assessment. Sexing involving the skull relies on non-metric traits, such as mastoid size, and/or comprehensive cranial measurements. Investigating individual components of the skull, such as the zygomatic bone, metrically, could strengthen sex estimation using the skull. However, measuring the zygomatic bone is problematic when using a traditional caliber approach, since intra-observer variation in measurements is often the same as the corresponding error. Geometric morphometrics, using coordinate data could eliminate much of this problem.

As early as Woo (1930-31), the need for focusing on the metric assessment of individual elements of the skull was established. Ancestral differences in the zygomatic bone cannot be properly assessed without addressing intra-population sexual dimorphism first. A metric analysis of the zygomatic bone will demonstrate its potential to become a criterion in the suite of characteristics examined when assessing sex, especially when using the cranium.

The zygomatic bone is situated in the superior, lateral aspect of the face comprising the cheek, lateral wall of the orbit, and the infratemporal fossa (Gray 1973). It has three surfaces: the lateral, which bears the malar tubercle, the temporal for attachment of the temporalis muscle, and the orbital, which bears the eminentia orbitalis for attachment of the check ligaments (Gray 1973, Whitnall 1911). Three processes: the maxillary, frontal, and temporal with corresponding borders are discernable. On the posterior-superior border, a tuberosity, called the tuberculum marginale or marginal process, is located for attachment of temporal fascia (Oxnard and Wealthall 2003). This process tends to be more strongly developed in males (WEA 1980). The marginal process appears early in childhood development, between the second and third years, whereas the malar tubercle and masseteric attachment do not form until puberty (Scheuer and Black 2002). This marginal process, the height and width of the zygomatic bone will be assessed for significant sex differences.

Coordinate data were collected from a random sample of 60 males and 60 females of European ancestry using a mechanical arm Microscribe-3-DX digitizer. 14 landmark data points were taken to provide an accurate depiction of the bone. A centroid point was established and was the basis for calculating three measurements: the height, width, and projection of the marginal process. These measurements were evaluated using the SPSS statistical software package for significance at a $p < 0.05$. When analyzed separately, the mean and standard deviation of the height, width, and marginal process projection suggest the zygomatic bone displays sexually dimorphic features. However, in a multivariate analysis, the height and width were the only measurements significant at the $p < 0.05$ level suggesting that the sexual dimorphism seen in the marginal process is eliminated when size is controlled-for.

This research indicates the zygomatic bone is sexually dimorphic within a European population. Further research addressing shape characteristics and inter-population variation needs to be completed before the utilization of the zygomatic bone in sex estimation. While there are implications for its use in sexing, further investigations must be conducted to verify its utility, especially in accurately determining sex.

Forensic Anthropology, Zygomatic Bone, Sex Estimation

H67 The Morphometric Study of the Hyoid Bone for Sex Determination of Koreans

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The goal of this presentation is to present research on the hyoid bone which might be useful for sex determination of Koreans in archaeological and forensic studies.

This presentation will impact the forensic community and/or humanity by investigating sexual dimorphism in the hyoid bone and the usefulness of the hyoid bone as a sex indicator. Use of the hyoid bone would make sex determination more scientific and exact, and racial differences by this study would be easier than before.

Sex determination is usually the first step of the identification process because many of the subsequent methods for age and stature estimation are sex-dependent. Most of the older studies of sex differences are centered on morphological traits. For example, the shape of the hyoid bone is sex-related. Newer studies on the hyoid focus on morphometry in a largely quantitative and statistical sense. This study focuses on morphometry of the hyoid bone for sex determination.

The hyoid bones were examined from 52 Korean males and 33 Korean females. As for the age range of the subjects, all age categories over 20 years took part in the data, for both males and females. In each case, the hyoid bone was separated from the larynx and dissected surrounding connective tissue. Each specimen was photographed with a digital camera. For each bone 34 measurements were taken directly from the photograph with a computer program, and statistically analyzed with the computer program SPSS 11.0.

Twenty of 34 measurements have significant sex differences. They include maximum sagittal length, width of body of the hyoid bone, and length of greater horn, etc ($p<0.05$). In the case of males, the discriminant function follows $F = 4.021\times X1+4.496\times X2+1.541\times X3-74.251$. In the case of females, it follows $F = 3.520\times X1+3.295\times X2+1.138\times X3-52.145$. 'X1' is the length between the midpoint of the left side of the hyoid body and the midpoint of the right side of the hyoid body measured through the central axis of the hyoid body. 'X2' is the maximum width of the proximal end of the greater cornua, measured perpendicular to the internal surface of the bone on the left. 'X3' is the length of the distance from the narrowest segment of the greater cornua to a point equidistant between the distal and proximal ends of the greater cornua, measured through the central axis of the greater cornua on the right.

The canonical correlation of discriminant function is 0.720. Based on these results, it is possible to statistically discriminate males from females.

Hyoid Bone, Sex Determination, Koreans

H68 Evaluation of the Sternal Rib End Age Estimation Technique Using a Modern Medical Examiner Sample

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Following this presentation the audience will have an understanding of the value of the sternal rib end aging technique in the medical examiner's setting.

This presentation will impact the forensic community and/or humanity through the evaluation of a well respected age estimation method by applying it to a modern medical examiner sample.

The phase method using the sternal end of the fourth rib for estimating age at death developed by Iscan, Loth, and Wright (1,2) has been shown to be a reliable and accurate method. This method is also enriched by several advantages. Sternal rib end changes do not appear to be effected by biomechanical stresses and no consistent association between accuracy of age determination and cause of death, medical history, height, weight, or occupation has been found. The sternal rib end is easily accessible in a medical examiner setting, especially when working with fresh or only moderately decomposed bodies. Unlike the pubic symphysis, it is harvested easily without excessive cutting of the body. Finally, commercially available casts (3) enable the practitioner the benefit of comparing the specimen to a three dimensional object. Given the advantages of this method, the goal of this study is to evaluate the phase method by applying it to a modern medical examiner sample of known individuals.

Evidentiary skeletal materials archived at the Regional Forensic Center, Memphis were used in this study. The right and left fourth rib sternal ends of 50 individuals were examined. The sample included Black and White males and females ranging in age from 13-75 years. The specimens were harvested during autopsy for bone trauma analysis or identification purposes during a 14-year period (1990-2003). The soft tissue was removed from the specimens by soaking them in a water and degreaser bath at an elevated temperature. Marrow was removed by soaking them in a water and peroxide bath at an elevated temperature.

Three independent judges evaluated each specimen in a blind test. The true ages were concealed until all specimens were assigned a phase. The race and sex of the specimen was known in order to apply the appropriate standard. Both the photographs and text of the original articles (1, 2) and the commercially available casts (3) were used. The judges are forensic anthropologists working in medical examiners offices. All have a minimum of a Master's education level and several years of field experience.

Thirty-seven percent of the sample was correctly assigned the age corresponding phase. Eighty-one percent of the sample was correctly assigned within one phase and 97% were correctly assigned within two phases of the age corresponding phase. Of the subgroups, Black males were the only group of reasonable size for statistical analysis, 28 individuals. The results show this group was significant over-aged. The tendency to overage Black males is consistent with Iscan *et al*. findings that Black males were younger for each phase and emphasizes the need to develop race specific standards (4).

The value of the study is the evaluation of a well respected age estimation method using a modern medical examiner sample and the most appropriate tools: the original articles and the three-dimensional casts (1, 2, 4).

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Forensic Anthropology, Age Estimation, Sternal Rib Ends

H69 A Test of Four Macroscopic Methods for Age Estimation of Human Skeletal Remains (Lamendin, Lovejoy Auricular Surface, Iscan, Suchey-Brooks)

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The goal of this presentation is to show how to combine the Lamendin, Lovejoy, Iscan, and Suchey-Brooks methods for age estimation.

This presentation will impact the forensic community and/or humanity by demonstrating how macroscopic methods for age estimation are well-known but they are not often compared. Forensic anthropologists may be interested to have a comparison of those four methods on the Terry collection

Age estimation at death of human skeletal remains or non-identified bodies is a difficult task in forensic practice, because no method has proven to be both accurate and simple. Four macroscopic indicators for age estimation were tested and compared (pubic symphyseal face, auricular surface, sternal end of fourth rib, translucency of the tooth and periodontosis).

Method: This study compares the accuracy of those four methods when applied to the Terry collection housed at the Smithsonian's National Museum of Natural History. The sample consists of 210 individuals with a balanced number of males and females, and black and white subjects, ranging in age from 25 to 90 years. For the pubic symphysis the authors use the Suchey-Brooks method (SB), for the auricular surface the Lovejoy method (LJ), for the ribs the Iscan (IC) method and for the teeth, the Lamendin method (LM). Each of the indicators was applied with complete independence from all others. For this reason, pubic symphyseal faces were covered during auricular aging. Bias, inaccuracy, and the intraclass correlation coefficient (ICC) was calculated which assesses similarity and proximity between quantitative data.

Results: The inaccuracy was for each method and all ages (mean +/ - standard deviation) as follows: IC 10 +/- 8.6 years, SB 10.7 +/- 9 years, LM 11.3 +/- 8.2 years and LJ 11.6 +/- 9.1 years. Taking in account age group by decade, from 25 to 40 years the most accurate method is the SB method and from 40 to 60 years the most accurate method is the LM method. Between 61 and 70 years of age, all methods are quite equivalent. After the age of 70, all methods are inaccurate although the IC method is the most outstanding. Concerning bias, results show a global underestimation for all methods, although less using the LM method. By decade, as in several studies, this study highlights the tendency to overestimate the age of young individuals, and vice versa. The Spearman correlation coefficients were respectively 0.67 for the IC method, 0.66 for the SB method, 0.59 for the LM method and 0.57 for the LJ method. The ICC was respectively 0.62 for the IC method, 0.55 for the SB method, 0.43 for the LM method and 0.45 for the LJ method.

Discussion and conclusions: Overall, the accuracies of these four anthropological methods for age estimation are close, but when age groups

are taken into account, each method may not be applied during all of the lifespan with the same weight. The difficulty is to find the good combination of methods. Two approaches could be distinguished – the multifactorial aging method described by Lovejoy and the Two Step Procedure proposed by Baccino. For aging techniques, the correlation coefficient is not the best informative parameter. Inaccuracy and bias are more useful. Experience and training may change results obtained by the various methods, and more particularly for the LJ method which is less useful in forensic practice.

Age Estimation, Forensic Anthropology, Comparison of Methods

H70 The Application of the Lamendin and Prince Dental Aging Methods to a Bosnian Population: Formulas for Each Tooth Group Challenging One Formula for All Teeth

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The goal of this presentation is to evaluate the application of the Lamendin dental aging method and Prince's modification of the Lamendin method to a Bosnian population. This research project tests the accuracy of formulas developed for dental age estimation for each tooth group in comparison with one formula for all teeth, made by Lamendin and Prince's modification of the Lamendin method as applied to a Bosnian population. The sample consists of 847 teeth (incisors and canines) from 200 males of known age.

This presentation will impact the forensic community and/or humanity by demonstrating a successful application of this technique, which can be used as a tool for age determination of skeletal remains.

The unique DNA led identification process created by ICMP in Bosnia and Herzegovina on such a large number of missing persons also requires accurate aging techniques for antemortem-postmortem comparison.

One of the more recently developed techniques, which has proved to be simple and accurate (Soomer *et al*. 2003), is the Lamendin method for age determination of adults from single-rooted teeth (Lamendin *et al*. 1992), as derived from a French population. The primary components of this method are measurements of periodontosis and root transparency. Lamendin presented the following simple equation for age assessment: A = 0.18 x P + 0.42 x T + 25.53 (where: A = age in years, P = periodontosis height / root height x 100 and T = transparency height / root height x 100).

Prince and Ubelaker (2002) modified Lamendin's method by adding root height (RH) to the equations for white and black males and females. The equation for white males is: A = 0.15 x (RH) + 0.29 x P + 0.39 x T + 23.17. Prince claimed that inclusion of root height reduced the mean difference and therefore improved accuracy.

Skeletal remains found in mass graves in Bosnia and Herzegovina present additional problems that can be addressed with improved age determination techniques. The remains are often commingled or incomplete, with skulls often separated from the rest of the skeleton. Therefore simple, quick and accurate dental aging methods may facilitate the re-association of crania and mandibles to postcranial elements. With passing time, exhumed remains are more deteriorated and sometimes only teeth are available for age estimation.

The Lamendin method and Prince's modification of the Lamendin method have already been proven useful when applied to a Bosnian population (Sarajlic *et al*. 2003) but both authors, Lamendin and Prince, developed only one formula for all single rooted teeth. According to their methodology, the authors developed six formulae for dental age estimation, three for maxillary and three for mandibular teeth: central incisors, second incisors and canines. The estimated ages obtained by those formulas have been compared with the estimated ages obtained with the original Lamendin and Prince formulae as well as with the estimated age from the formula developed on the whole sample.

The estimation of age according to the formulae developed for each tooth group was significantly more accurate than the estimation of age from Lamendin's and Prince's formulae and than the estimated age from the formula developed on the whole sample.

The best results were obtained with the second maxillary incisors giving mean error of 6.60 years with standard deviation of 5.08 and standard error of 0.50. The lowest mean error, 4.82 years, was produced by the age group of 40 – 49 years.

However, regardless of which formulas are used, there is a consistent overestimation of age in younger individuals and underestimation of age in older individuals.

Dental, Age Estimation, Bosnian

H71 Age Determination From Adult Human Teeth: Interest of Gustafson's Criteria

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The goal of this study is to test a simple method using the Gustafson's criteria and to compare it with the Lamendin method.

This presentation will impact the forensic community and/or humanity by demonstrating a new method for age determination that may be most effective on older individuals.

Materials: A total of 43 teeth were examined (38 extracted teeth, and 5 teeth were removed from corpses at autopsy). The age range of the individuals sampled was 13-73 years. The authors worked with the entire group to test this method, but to compare the method with Lamendin's method; only the teeth were worked with issuing from individuals greater than 30 years of age. Teeth were intact without pathological processes and marginal periodontitis.

Method: The age estimation of each tooth was carried out by one examiner. First, periodontitis was estimated. The labial and lingual faces of teeth were drilled to obtain a central section 1mm thick. At this stage, researchers estimated root transparency. Then, a central section 0.25 mm thick was obtained. The four other criteria were estimated. Then the point allocated to each of the six age related changes listed above were summed and used the Gustafson's regression line.

Statistical Analysis: Descriptive and comparative statistics using SPSS software was produced. After having determined the ages according to the authors' method, the results were compared with the real age and the mean of the errors was calculated. Then, methods were compared with Lamendin, using only the teeth from individuals more than 30 years of age. Parametric methods were used in view of the small sample size (test of student).

Result: This method is easy. All that is needed is a drill and a turbine. Preparation takes only half an hour. The results show that this method had a mean error of approximately 6 years. In age groups under 60 years, error was important and underestimates were predominant. Concerning age groups between 30 and 60 years, the differences between this method and Lamendin were not statistically significant. Concerning the oldest people (> 60 years), the range of error is very significant for the two methods. But, it was noticed that when ages were underestimates, root transparency was right quoted (2 or 3). The criteria was corrected (adding a coefficient) in

the cases where root transparency was estimated at stage 2 or 3 with all others criteria estimated at stage 1. This eliminated the error in the case of the oldest individuals.

Conclusion: This method is easier than Gustafson's method and there's a good correlation between criteria and ages. This method isn't as effective for estimating ages between 30 and 60. Lamendin's method is simplest. But this method can be used because there are no significant differences between the two methods. However, this method can be used with the youngest people. It can be an easy method when pubic symphysis aging is not an option, or to complete the estimation. Perhaps this method will be most useful to estimate ages of people in the oldest age group, using a coefficient.

Physical Anthropology, Age Estimation, Teeth

H72 Serial Bone Histology: Inter- and Intra-Bone Age Estimation

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After attending this presentation, attendees will better appreciate bone micro-morphology, attendant visualization, and quantification methods used to histologically discern differences throughout the human cortical long bone shaft.

This presentation will impact the forensic community and/or humanity by identifying the degree of differentiation of microstructures used for histological aging throughout the shafts of the long bones, in order to determine the validity/accuracy of aging fragmentary remains using microstructures.

Few publications are available on the histological (microscopic) differentiation throughout human or non-human mammalian long bone cortices. That is, are osteon population dynamics specific to proximal, midshaft of distal segments? This study utilizes Kerley's (1965) four quantification categories (non-Haversian canal, osteon, and old osteon fragment number, and percent circumferential lamellae) to estimate age as well as to quantify the differential structure counts from human femur, tibia and fibula based upon section location. Each long bone was evaluated metrically following the Chicago Standards. From each midshaft one-centimeter increments were marked moving proximally and distally, which resulted in twenty-five to forty segments per bone. Three thin sections were cut from each one-centimeter segment using a high-concentration diamond blade mounted on a Buehler Isomet 1000 saw. This technique employed a modification of the methods individually created by Stout and Ubelaker.

The Kerley quantification categories were used to enumerate the same microstructures in the humerus, radius, and ulna to identify structural change from the proximal to distal ends. Age estimation via the Kerley method is not made on the pectoral girdle elements, because the method was not intended for these bones. All sections were subjected to quantification identical to Kerley's quadrant (anterior, posterior, medial, and lateral) using a Leica DMRX light microscope at 5x, 10x and 20x power magnification. Morphometric analysis of the Kerley's quantification categories was conducted using Image-Pro Express software on the Dell Optiplex GX270.

Quantification of the aforementioned microstructures indicates there are statistically significant differences throughout the shaft, which will create significantly different age estimations depending upon section location. Paired T tests were conducted on the above categories to discern the mean intra and inter bone differences. ANOVA used the variables of osteon population, old osteon fragment number, and non-Haversian canal populations against the variables of within and between bones. Age assessments using the Kerley method based on the femur, tibia, and fibula revealed that estimates made on segments away from midshaft were significantly different to the .05 level.

These findings generate two related conclusions. First, metabolically, histological bone maintenance/remodeling varies greatly throughout the shaft. Second, it is imperative that the fragment location is correctly identified and that midshaft is used for this method, because, as this research explains, moving away from midshaft when using this method can lead to significantly different age estimations. These results are particularly pertinent to fragmentary remains, suggesting that quantification on fragmentary remains can provide incorrect age estimates. Furthermore, this research underscores the fact that age estimates of fragmentary human remains must account for significant difference of microstructure populations throughout the shaft as well as within one thin section.

Skeletal Biology, Bone Microstructure, Histological Aging

H73 Measure Twice, Cut Once? Measurement Error Levels in Histomorphometry

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After attending this presentation, attendees will understand a method to assess repeatability between measurements, the amount of measurement error within rib cross-sections and between serial cross-sections, and if multiple cross-sections are warranted for evaluation.

This presentation will impact the forensic community and/or humanity by underlining the importance of exploring measurement and sampling error levels in histological methods. This research stresses that the repeatability of measurements is paramount and demonstrates a statistical method to evaluate measurement agreement. Addressing issues surrounding repeatability are the first steps to further the use of quantitative bone histology in the field of forensic anthropology.

Compared to the myriad of gross morphological methods available to forensic anthropologists, histological methods for estimating age at death are underutilized. Uncertainties regarding how much bone to evaluate and the associated levels of sampling error may cause this underutilization. Significant sampling error can occur within and between cross-sections, with the latter's sampling error increasing dramatically as the amount of cortical area evaluated decreases(2). A rib cross-section with 10mm^2 of cortical area may demonstrate several hundred percent difference in bone formation between serial bone cross-sections(5). Frost(2) recommends a minimum of 50mm^2 of cross-sectional bone in non-pathological individuals be analyzed to minimize sampling error. Stout(4) asserts that the time necessary to increase the amount of histological samples must be weighted against the gains. It is for this reason that he recommends the evaluation of two rib cross-sections per individual. Conflicting reports of measurement error within and between studies may arise due to inadequate methods of error assessment, such as correlation or paired t-tests, producing misleading results(1). Another issue is the absence of clear guidelines for how much error is acceptable. This ultimately means that it is the decision of the researcher; however, a 10% error level is commonly used. The goals of this research are to evaluate precision in rib intra-site histomorphometric measurements and assess inter-site measurement agreement to determine if two cross-sections are adequate.

Two rib cross-sections were evaluated from 30 individuals of known age and sex (14 females, 16 males; aged 27-79 yrs) selected at random from a collection of 234 individuals from the cemetery site of Spitalfields, London. None of the individuals demonstrate any gross or histological morphology indicating a pathological condition. Osteon population densities (OPD = number of intact + fragmentary osteons ÷ surface area) were recorded following the Stout (1986) method. A plot of the difference between measurements against the mean of the first and the second measurement was utilized for both intra- and inter-site values. Absolute mean percent differences were calculated to quantify the magnitude in variability between measurements with the 10% error level as the cutoff for acceptance.

The results show that absolute mean percent difference in OPD values for the intra-site evaluation is 8.5% indicating repeatable measurements. The mean difference is not significantly different from zero, further indicating that repeatability was achieved. The absolute mean percent difference in OPD values for the evaluation of serial cross-sections is 15%. The plot of the mean difference indicates a magnitude bias; therefore, the data was logged transformed to provide a clearer picture of agreement. The overall mean difference was significantly different from zero indicating that repeatability was not achieved. Interestingly, the minimum difference in error between serial sections was less than 1% and the maximum was ~ 50%.

Overall intra-site precision error is below the 10% level, but individually 7 of the 30 samples exceeded the acceptable error level. Fifteen of the 30 samples demonstrate moderate to large amounts of diagenesis. Six of the 7 samples that failed acceptance are within the diagenetic group. When diagenesis is present a cross-section should be measured twice and the average value recorded in order to minimize the chance of intra-site measurement error.

Overall the inter-site error for the serial cross-sections failed to meet the 10% level of acceptance, but individually 12 out of the 30 were below the 10% level. These samples have a mean cortical area of 16.5mm^2 (range: 9-24mm^2), while the rejected samples have a mean cortical area of 13.8mm^2 (range: 8-20mm^2). The amount of cortical area overlap and the lack of a pattern between error levels and diagenesis, indicates that serial section measurement variability is random. A slight magnitude bias in the error was detected, indicating a systematic increase in error as OPD increases. Because OPD is a calculated value, it is difficult to determine the cause. Most likely, it is a combination of the decrease in cortical area and the increase in fragmentary osteons over time. Because substantial differences can exist between serial cross-sections, measuring one section twice will not account for this error. This indicates that the evaluation of multiple cross-sections is required. As a result of the random nature in measurement error (despite the slight trend with increased error and decreased cortical area), Stout's recommendation for the use of only two rib cross-sections from a normal individual should be sufficient in the attempt of minimizing the potential error.

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Precision, Histomorphometry, Osteon Population Density

H74 The Effects of Cerebral Palsy on Age Indicators in the Human Skeleton

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Attendees will learn how systemic diseases like cerebral palsy may have dramatic effects on skeletal indicators of age at death.

This presentation will illustrate the potential effects of systemic disease on skeletal indicators of age at death and address how such diseases can impact other aspects of a forensic case, such as identification.

In 2002 the authors were asked to examine human remains believed to be those of a 25-year-old male with a known history of severe cerebral palsy (CP). While the circumstantial evidence for a correct identification is compelling, there are significant inconsistencies between the biological profile indicated by the remains and the profile of the missing person. Most of the age indicators on the skeleton suggest an age of 12-18 years at the time of death with the highest likelihood at around 15 years (10 years younger than the known age of the victim). Since current estimates place the number of individuals with some form of CP in the United States at around 500,000, it is important to know if this case is an exception or if such variation is to be expected in known or suspected cases involving cerebral palsy. This paper has two objectives. First, a case is presented involving a CP patient and attendant maturational disparities to the forensic anthropology community; and second, the authors report on existing medical literature on the effects CP on growth and maturation.

The skeletal remains in question presented with unfused long bone epiphyses and sphenooccipital synchondrosis and partially fused ilium, ischium, and pubis. According to the anthropological literature on skeletal development in the general population, such conditions are associated with an age at death of 12-18 years. In general the skeleton is unusually gracile and individual bones are quite small. In addition, the remains display several developmental anomalies, such as proximal epiphyses on the 2nd metacarpals and a midline defect on the anterior arch of the first cervical vertebra. In contrast to the immature developmental indicators, dental attrition is extensive and suggestive of a much older individual. It is possible that this wear is related to the involuntary contraction of jaw muscles, a condition often associated with CP.

The effects of systemic disease on rates of skeletal maturation are poorly understood. For example there are indications that acromegaly may lead to premature suture closure (Marushia, M. and N.J. Sauer 1997) and diseases like osteoarthritis may suggest that a skeleton represents a much older individual. With respect to CP, Worley, *et al*. 2002 report on a cross sectional study of 207 affected children, that the completion of sexual maturation was significantly delayed compared to the general population. It may be that there is a causal relationship between delayed sexual maturation and skeletal development. This relationship in general and with respect to congenital diseases warrants further study.

Forensic anthropologists need to be aware of the variation in age indicators that may be associated with certain systemic diseases. This case is an important warning for anthropologists pay attention to indicators of disease stemming directly from the remains under study or from supporting documentation such as medical records.

Age Indicators, Cerebral Palsy, Dysmaturation

H75 The Impact of Age Related Changes in Vertebral Column on Age Determination for Identification Purposes

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The goal of this presentation is to introduce the impact of a recently improved method of age-at-death estimation using progressive morphological changes in the vertebral column for the identification process in Bosnia and Herzegovina.

This presentation will impact the forensic community and/or humanity by showing the results of using changes in the vertebral column on age determination and their impact on narrowing age ranges and therefore increasing the accuracy of predicted ages.

The exhumation and identification process in Bosnia and Herzegovina began in autumn 1995 and during the first years, only traditional methods were used for establishing the identity of unknown human remains. The

basic method that was used relied on the recognition of clothing, personal artifacts, and eventually documents that were rarely recovered with the victim. If the recognition of clothing and artifacts was supported by positive results during postmortem and antemortem comparison of the individual's biological profile, such as sex, age, stature, and dental status, the remains were declared identified and released to the family. With the lack of other more sophisticated methods (at the beginning of the exhumation/identification process, costly DNA testing was not available) this procedure was accepted and widely used all over Bosnia and Herzegovina. Traditional methods worked well in the identification of victims buried soon after death by surviving family members or neighbors in single or multiple graves; however, when it came to identify victims recovered from mass graves, traditional methods failed. The sheer number and state of the remains representing victims of similar age, mostly male, combined with a lack of detailed medical and dental information reduced the effectiveness of traditional identification. Despite intensive efforts, a very limited number of victims were identified from mass graves.

The situation changed significantly when ICMP was established to help clarify the fate of the missing persons in the Former Yugoslavia. Using recent advances in DNA technology, ICMP introduced a pioneering DNA program on a massive scale as a new strategy for the identification of unknown remains. In two and half years, 4,163 individuals have been identified with help of DNA. However, even with the tremendous success of the DNA matching process, it is essential that the biological profile of the remains generated by anthropologists during postmortem examinations is as accurate and close to the chronological age of the decedent as possible. A high accuracy of age determination is particularly important in the case of remains that have been exhumed from mass graves containing the victims of ethnic cleansing in 1992 and the fall of Srebrenica in 1995. During both events thousands of men were killed and many families lost all male family members. It is not uncommon that three or four brothers lost their lives. Since a DNA match cannot distinguish their identity, it is essential to determine narrow age ranges that will help in identification.

During the examination of skeletal remains exhumed in BiH several methods are routinely used for age at death determination of mature remains. They are: Suchey & Brooks and Todd methods for the pubic symphysis; Iscan & Loth method for sternal end of rib, epiphyseal closure of sternal end of clavicle, closure of S1 and S2; Lovejoy method for auricular surface of ilium; Lamendin dental method; Albert & Maples for union of vertebral ring; and Drukier *et al*. for absorption of vertebral ring and age related changes in vertebral body.

Within 5703 positive DNA matching reports, almost 500 were issued for more than one name. In a situation when none of the brothers had children, an accurate age at death determination can be one of the most helpful factors in successful identification. Routinely conducted comparisons of chronological and estimated age at death show that age related changes observed in the vertebral column have a distinctive influence on narrowing estimated age ranges. They are regarded by the authors as one of the most useful age indicators, especially for individuals from 20 to 40 years of age, who make up the majority of missing persons in Bosnia and Herzegovina. This presentation will show the results of using changes in the vertebral column on age determination and their impact on narrowing age ranges and therefore increasing the accuracy of predicted ages.

Aging Techniques, DNA Supported Identification, Forensic Anthropology

H76 Finding Clues on the Bony Surface: The Use of Markers of Occupational Stresses as Aids to Identification and Age Determination in Skeletonized Remains

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Attendees will gain an understanding of methods for assessing osteoarthritis and musculoskeletal stress markers, and the importance of these morphological features in forensic casework.

This presentation will impact the forensic community and/or humanity by highlighting the importance of assessing all features from skeletonized remains; and suggesting the use of standardized methods to assess osteoarthritis and musculoskeletal stress markers in forensic cases to aid identification and supplement age estimations

Forensic anthropologists often have a limited amount of physical material with which to investigate the possibility of a crime or to attempt to identify human skeletal remains. Therefore, it is important to incorporate as many lines of evidence that can be observed from the skeleton as possible. It has been noted that frequently forensic anthropology case reports include basic data on sex, age, race, stature estimates, and trauma from the skeleton, but they may not include additional morphological characteristics such as patterns of osteoarthritis (OA) or musculoskeletal stress markers (MSM). These bony changes are considered to result from biomechanical stresses applied to the bones during life and can be used to suggest possible lifestyles or activity patterns of the individual. Since bone progressively responds differently to such stresses with age, the degenerative nature of OA could provide additional clues as to the age at death of the individual.

In New Orleans in 2004, a case was investigated where the particular features of osteoarthritis of the shoulders, hands, and spinal column of the deceased could have provided important clues to identification had antemortem records been available. The suspected decedent was described as an elderly female who worked as a local seamstress in her home. The results of an osteological examination of the skeleton demonstrated that the deceased had extensive degenerative change in both shoulders, as well as severe bilateral changes in the 1st metacarpal-trapezium joint. The individual did not exhibit typical clinically reported patterns of joint degeneration of the hand, in that there was little deterioration of the distal phalangeal joints. This suggests some activity-related etiology was affecting that joint of the thumb specifically. The extent of the spinal osteoarthritis and scoliotic curvature of the lower spine would have produced a visible phenotype and greatly affected the individual's mobility. This pathological feature would be useful in aiding identification of the remains through interviews with known associates such as neighbors. The pathological changes observed in the skeleton present a unique pattern that would have had visible characteristics when the individual was alive.

Additionally, while there are no published sources for comparison with contemporary populations, the assessment of MSM and the contrast of the deceased's MSM scores with some prehistoric archaeological samples are of potential application. The MSM scoring patterns are not similar to prehistoric females, as expected since she lived in the Twentieth Century; however, the individual did demonstrate a high overall average score for MSM of the upper limb indicating a physically active life. In general, the osteological evidence is consistent with the suggested occupational activities of the individual as someone who used her arms and especially her hands a great deal, such as a seamstress would, but it does not definitively exclude other types of physical actions or possible occupations. The overall degree of joint deterioration and high MSM score is consistent with the suspected decedent's age at death.

While the analysis of OA is an important area of research in the modern medical field and is of interest to archaeologists studying health in ancient populations, forensic anthropologists do not frequently incorporate this data into their investigations. Observing and scoring of OA and MSM

from skeletal cases in a systematic fashion can aid future investigations not only in describing clues for positive identification based on specific pathological conditions, but also in aging the skeletons. Additionally, such investigations could provide a significant counterpoint to clinical literature where the distribution and degree of bone modification is reported only from radiographs and patient commentary. Having modern data on individuals of known age, sex and life history can enlighten other areas of research on human biology and lifestyle.

Osteological Features, Osteoarthritis, Markers of Occupational Stress

H77 Cross-Sectional Diaphyseal Geometry, Degenerative Joint Disease, and Joint Surface Area in Human Limb Bones: A Comparison of American Whites & Blacks

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The goal of this presentation is to examine the accuracy of skeletal markers of age and occupation through analysis of cross-sectional diaphyseal geometry, degenerative joint disease, and joint surface areas.

This presentation will impact the forensic community and/or humanity by adding to knowledge concerning the creation of a biological profile for an unknown victim that is based upon skeletal analysis.

Aging and physical activity are key variables affecting normal adult bone structure. Marked differences in skeletal rugosity are typically referenced in forensic anthropology cases when determining life history parameters (i.e., age, sex, occupation) necessary to establish a presumptive or positive identification as evinced by variation in (1) diaphyseal size and shape (i.e., a marker of load baring) and (2) degree of degenerative joint disease expression (i.e., DJD; marker of age). While there is no shortage of research that explores how diaphyses and joints structurally change with physical activity and age, far too little research has examined how these variables covary within the same skeletal samples. Studied separately, contradictory results suggest that neither occupation nor age have a consistent effect on long bone remodeling, which possibly leads to the creation of inaccurate biological profiles of unknown individuals. As part of a broader research study examining distinctions between the effects of age and behavior-related changes to joint surfaces by comparing samples disparate in occupation (i.e., mild, moderate, strenuous activity level) *and* age group, this study examines cross-sectional diaphyseal geometry, degenerative joint disease, and joint surface areas of bones of the shoulder, elbow, hip, and knee in African American and European American industrialists from the Robert J. Terry Anatomical Collection and William Bass Donated Collection (N=125 and N=130, respectively) to set baseline data. These data answer the following questions:

- Does the joint lipping associated with DJD increase joint surface area as a functional response to force applied to the joint surface over time (i.e., repetitive physical activity) thus making an individual appear biologically older?
- Are long bone diaphyses more accurate indicators of load history associated with repetitive activity than joint surface areas and the expression of DJD?
- Can individuals with less active lifestyles be differentiated from more active individuals based upon analysis of diaphyseal cross-sections, joint surface areas, and degenerative joint disease?

To answer these questions, the left humerus, radius, ulna, femur, and tibia of each individual were grossly and radiographically examined. Only those individuals with known age at death, weight, and occupation were included in the study sample. Individuals that were immature, underweight/overweight relative to height (i.e., below 42 kg and above 90 kg), or grossly pathological were excluded. The joint surfaces of the shoulder were grossly evaluated for DJD using a 4x hand lens and identified through the presence of lipping, bone spurs, and exostoses, porosity and eburnation using a grade based system. Additionally, joint lipping was scored as either trace, mild, moderate or severe and degree of lipping was measured using sliding calipers (mm). Joint surface areas were determined using Scion Image. Lastly, cross-sectional diaphyseal geometry was evaluated with computed tomographic (CT) scanning and subsequent biomechanical analysis (i.e., each CT image was generated using a 1.5mm thick slice with a 4 second exposure time at 170 MA and 120 kV).

All data were tested for violations for assumptions of parametric tests using the Kolmogorov-Smirnov test. These data were *not* normally distributed. Therefore, test means and standard deviations (z-scores) for each activity variable (DJD, JSA, or CSD) was determined and these data were pooled – data by sample, age and sex – to compare the arm, forearm, thigh, and leg using nonparametric tests (Mann-Whitney U and X^2 analysis of variance). The skeletal samples were also compared using MANCOVA to determine the best predictor of activity (DJD, JSA, CSD, or MSM) within samples and between samples for the upper or lower extremity. Cross-sectional geometries and joint surface contours were evaluated using elliptical Fourier coefficients which computed average distances between groups. Then, the shape-based distances between the groups were examined using principle coordinates analysis (PCO). Physical activity effects were not significantly different between these two samples; though a significant interaction between JSA, lipping, and DJD expression was indicated.

Cross-Sectional Analysis, Degenerative Joint Disease, Occupational Markers

H78 Skeletal Markers of Obesity in the Lower Leg

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After attending this presentation, attendees will understand the biomechanical effects of obesity on the bones of the lower leg and the subsequent skeletal markers, which can suggest obesity during life.

This presentation will impact the forensic community and/or humanity by providing researchers further insight into the relationship between soft tissues and skeletal tissues during life. The University of Tennessee has the unique opportunity to provide this type of research due to the large donated collection with extensive antemortem records.

Obesity in the United States is reaching epidemic proportions. More than fifty percent of all adults are overweight, with a fast growing percentage of obese children. Skeletal markers of obesity are investigated as a combination of multiple traits due to the complex nature of obesity on the human skeleton. The purpose of this study is to examine the biomechanics of obesity in the vertebral column, hip and knee and its relationship with osteoarthritis, diffuse idiopathic skeletal hyperostosis (D.I.S.H.), and the frequency of fracture. This project investigates osteoarthritis of the medial and lateral tibial plateau and proximal femur, fracture of the distal fibula and proximal femur, as well as the presence of D.I.S.H. A total of 44 skeletons from obese (n=21) and non-obese (n=23) adult individuals were analyzed, with ages ranging from 20 to 86 years. The skeletons represented in this sample are from individuals of known age, height and weight, from the donated collection of the Forensic Anthropology Research Facility at the University of Tennessee, Knoxville.

In a review of clinical literature on the biomechanics of obesity, the effects of obesity in the leg can be separated into two separate suites of traits for the two dominant types of knee malalignment associated with obesity. *Genu varum* is responsible for greater torque on the hip and knee, decreased joint space on the medial knee joint, 100% of weight bearing on the medial side and osteoarthritis of the medial tibial plateau. There are

relatively few effects of this *varus* malalignment on the foot. In contrast, *genu valgum* preserves the integrity of the knee and hip, compromising the integrity of the foot and ankle, which will be investigated in a future research project. From clinical reports, the ankle is more prone to severe lateral malleolar fracture and greater rear foot movement as a result of this condition. Obese individuals will exhibit greater asymmetry, with individuals typically favoring the right side. The findings of this skeletal analysis support some of these clinical findings. Osteoarthritis of the left lateral tibia, the right medial tibia and the right proximal femur all show fairly significant Chi-square relationships to obesity at the level $p = 0.1$, with these results being asymmetric and not completely consistent with the clinical findings. The presence of D.I.S.H. was significantly correlated with obesity at the level $p = 0.1$. There was no significant correlation between obesity and ankle fracture or between obesity and hip fracture in this skeletal sample.

As the number of obese individuals living today increases, so will the number and frequency of obese in skeletal populations. Thus it is of significant forensic concern to be able to determine whether a skeletonized individual was obese or not and whether this can be ascertained from the skeleton. This preliminary research, despite the small sample size, shows promise for the future for determining obesity in the skeleton. Skeletal markers of obesity investigated as a suite of traits could prove useful to identification in the field of forensic anthropology. Furthermore, the biomechanics of obesity need to be better understood in order to stop the cycle of obesity.

Obesity, Skeletal, Biomechanics

H79 Serial Murder With Dismemberment of Victims in an Attempt to Hinder Identification: A Case Resolved Through Multidisciplinary Collaboration

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The goal of this presentation is to illustrate the importance of collaborative forensic investigation, and highlight the specific contributions of forensic anthropology to resolving complex cases involving postmortem mutilation of bodies to conceal their identity, and cause and manner of death.

Collaboration between forensic anthropologists and other medicolegal investigators has proven increasingly important in the investigation of homicides, particularly in cases where bodies have been extensively altered postmortem in an attempt to conceal the identity of victims and the cause and manner of death. Positive identification of victims and the linking of crimes by patterns of postmortem dismemberment are increasingly recognized as areas where forensic anthropologists can make important contributions.

This paper presents a serial homicide case that was resolved through the active collaboration of homicide detectives, the District Attorney's Office, and various forensic scientists. Key to the prosecution's strategy in this case was a linking of three homicides and positive identification of the victims. While identification of the second and third victims was relatively straightforward, the first (Victim 1) was more complex, and required collaboration between the Assistant District Attorney, a local hospital, and the forensic anthropologist. Victim 1's body was intentionally mutilated and dismembered, and parts had been disposed of over a wide geographic area. Some remains (a torso and attached right arm) were subsequently found by chance, while investigators were led to others (the head, upper neck and severed left forearm) by the co-defendant in the case, whose testimony was key in revealing details of the postmortem history of Victim 1 that would otherwise have been difficult to reconstruct from the physical evidence alone. The co-defendant also led police to tools allegedly used to dismember the victim. Matching of the different parts of Victim 1's body was achieved through forensic anthropological analysis. The remains were defleshed and patterns of sharp force trauma associated with the intentional severing of the head and fingers were identified and compared. Skeletal analysis revealed that the head had been severed between the fifth and sixth cervical vertebrae by multiple blows with an edged weapon (later identified in testimony to homicide detectives as a machete). In addition to a match between chop marks on the neck vertebrae recovered from the two locations, a small portion of the transverse process of the fifth cervical vertebra was found still attached to the trunk, and was matched with the rest of the vertebra found still articulated with the neck and head. Similarities in the manner and location at which the fingers were severed linked all three victims.

Although DNA analysis was successful in demonstrating a match between Victim 1's head, left arm, trunk and bloodstains found in the defendant's apartment and storage locker, this was not sufficient for a positive identification because comparative DNA could not be obtained from living relatives. Examination of the defleshed skull, however, revealed evidence of an apparent healed gunshot wound to the left frontal and parietal bones. The injuries had not been seen at autopsy, as they were concealed by soft tissue. The forensic anthropologist requested a search for local hospital records with the hope that antemortem and postmortem comparisons of the gunshot wounds might lead to an identification. After an extensive search, both a police report and hospital records were located. Comparisons of antemortem and postmortem radiographs revealed multiple points of correspondence, allowing a positive identification. Upon reviewing the evidence against him, and facing a capital murder trial, the key defendant in the case pled guilty to the murders and is now serving three consecutive life terms in prison.

Dismemberment, Postmortem Modification, Positive Identification

H80 Fifty Years of Questions: The Re-Evaluation of a Korean War Soldier Buried in the United States

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The goal of this presentation is to inform researchers of problems and rewards associated with exhumation and reanalysis of previously identified soldiers from the Korean War era who have been returned home and buried in the United States

This presentation will impact the forensic community and/or humanity by showing that taphonomic processes can affect the DNA extraction from well-preserved bones, and that dental identification continues to be a valid tool in forensic science.

On December 2, 1950, PFC James B. Sanders, of the United States Army, Company D, 32nd Infantry Regiment, was reported missing in action while helping to secure the town of Hagaru-ri in the Chosin Reservoir of Korea. In the fall of 1953, the Sanders family received a telegram that noted there was reason to believe that Cpl Sanders (promoted to Cpl after he was missing in action) might be or might have been in communist custody. In February, 1954, the Department of the Army declared Cpl Sanders "to be dead." According to the Army's report, they based this declaration on "the lapse of time without information to support a continued presumption of survival." Following the end of the war as part of "Operation Glory," communist forces reportedly recovered ten sets of buried remains from an area within the region of the Chosin Reservoir. In the fall of 1955, the Army advised the Sanders family that they had approved the identification of one set of the remains as those of Cpl James B. Sanders. According to official government documents, "Association of Cpl Sanders ... is based on favorable dental; very favorable comparison of physical characteristics, and place of casualty in relation to recovery site of remains." Cpl Sanders'

remains were shipped home to the United States in a sealed casket. However, on May 27, 1957, Cpl Sanders' name once again appeared in a government publication entitled "Return of American Prisoners of War Who Have Not Been Accounted For by the Communists" (1).

For close to fifty years following the burial, the Sanders family felt that the remains in the casket might not be those of their son and brother. Their fears were based in part on the fact that his name continued to appear on various lists of soldiers missing in action that were published after Cpl Sanders' remains were returned home. In addition to that were the medical records associated with the recovered remains which indicated that Cpl Sanders had a healed, broken foot bone. The family knew of no broken bone. Also, Cpl Sanders' brother Lloyd, a soldier himself in that era, was not allowed a furlough to attend his brother's funeral. Sealed caskets; list after list of prisoners of war thought to be in enemy custody; ambiguous government papers; an undocumented healed, injury; and seemingly unwarranted decisions about a funeral furlough added to a grieving family's concern.

Eventually, through association with a victims' advocate group, the family contacted the Louisiana State University Forensic Anthropology and Computer Enhancement Services Laboratory (LSU FACES Lab) and asked for assistance in opening Cpl Sanders' grave, reanalyzing the remains, and sampling bone and teeth for DNA confirmation of his identity. In the summer of 2003, FACES Laboratory personnel exhumed the casket.

Unknown to surviving family members, the casket was enclosed in a metal vault. The vault, a Clark, was still sealed; so was the casket. When the casket was opened, the state of preservation of the interior casket lining, associated burial goods, and the skeletal remains themselves (which were tightly packed in a bundle) encouraged the researchers to conduct a complete skeletal analysis and to sample the remains for DNA testing. One unusual, though not totally unexpected, feature of the burial was a heavy coat of grayish-white powder covering all of the bones in the bundle. Referred to by some as "burial powder," this material was known to have been placed in soldiers' caskets at a particular mortuary in Japan. According to one researcher, this powder had affected the extraction of DNA from at least one other case from that era (personal communication).

Results of the reanalysis of the skeletal remains by anthropologists and a forensic odontologist showed congruency with the antemortem dental records for Cpl Sanders. Additionally, cranial features and other skeletal markers were consistent with the description of Cpl Sanders in life. Though no small foot bones showed any obvious, healed break, x-ray equipment used for confirmation of the old injury by the Army was not available in the embalming laboratory where the skeletal analysis took place.

Subsequent x-ray diffraction analysis of the powder from Cpl Sanders' casket showed that it is comprised mainly of inorganic calcium sulfate in varying degrees of hydration. Calcium Sulfate is the main component of Drierite, a popular desiccant. Also, after months of exhaustive efforts to extract DNA from the bone or tooth, Reliagene Laboratory in New Orleans was unable to do so. However, the biological profile and the dental profile confirm that Cpl Sanders is buried in Cpl Sanders' grave.

References:

1. Return of American Prisoners of War Who Have Not Been Accounted for by the Communists. Hearing before House of Representatives Subcommittee. U.S. Government Printing Office, May 27, 1957, p 28.

Korean War Soldier, Forensic Anthropology, Burial Powder

H81 Diagnosis of Anencephaly, a Common Lethal Neural Tube Defect, From Taphonomically Altered Fetal or Neonatal Skeletal Remains

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Attendees will learn about the prevalence and appearance of anencephaly and how it can be overlooked, or even misdiagnosed, in certain recovery contexts. Attendees will be able to implement a robust quantitative osteometric method to determine anencephaly from abandoned fetal or neonatal remains that have been scavenged or otherwise taphonomically altered.

Anencephaly is a relatively common birth defect that universally results in miscarriage or neonatal death. Establishing the cause of death is essential in cases of abandoned newborns, however, the determination of anencephaly from taphonomically altered fetal or neonatal skeletal remains can be difficult when recovery is incomplete due to scavenging animals or other taphonomic variables. A robust osteometric procedure was developed from documented cases of anencephaly which provides a probability statement that will impact the forensic community and/or humanity by assisting in the establishment of differential diagnoses of cause of death in abandoned fetal or neonatal remains.

Anencephaly is defined as the complete absence of a skull vault resulting from a failure of closure in the anterior neuropore. The prevalence of this lethal neural tube defect ranges between 1 in 1000 live births in the U.S. to between 5 to 7 in 1000 live births in some regions of Ireland and Wales. Establishing the cause of death is essential in cases of fetal or neonatal abandonment; however, the forensic anthropology and paleopathology literature displays a deficiency of diagnostic criteria to identify this relatively common defect when various taphonomic processes result in incomplete or altered fetal or newborn remains. Even fetal remains that are completely mummified can lead to initial misdiagnosis of anencephaly (Dupras *et al*., 2002).

Osteometric data was collected from 7 clinically documented anencephalic skeletons curated at the National Museum of Natural History, Smithsonian Institution, and contrasted with normal fetal database standards from Fazekas and Kosa (1978). Comparisons involving the proportions of basi-cranial elements (those most likely to be preserved in recovery contexts) yielded statistically significant differences related to the congenital abnormalities of this condition. Random sampling of the small documented anencephalic collection assisted in the creation of a suite of logistic regression models. These models were then tested on a partially preserved, archaeologically recovered, fetal skeleton that has been demonstrated to possess morphological traits strongly indicative of a profound neural tube defect involving the skull and vertebral column (Dudar, 2002). This archaeological case study was predicted to be anencephalic with a probability of $p>0.99$ with the developed logistic regression model.

This maximum likelihood-based method provides a robust procedure that will generate a probability of anencephaly that will assist in the differential diagnosis of cause of death in forensic contexts from taphonomically altered or scavenged remains.

Fetal Remains, Anencephaly, Cause of Death Diagnosis

H82 Utilizing Taphonomy and Context to Distinguish Perimortem from Postmortem Trauma in Fire Deaths

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The goals of this presentation are to demonstrate interactions of fire environments with the condition and preservation of human remains; to illustrate the importance of correlating the in situ position of burned bone with lab analysis for differentiating skeletal traumatic injury from taphonomy of heat and fire; to introduce problems of interpreting original body position in structural fires; and to discuss spatial relationship models for human remains in advanced stages of cremation for purposes of scene reconstruction.

This presentation will impact the forensic community and/or humanity by introducing benefits of experimental modeling demonstrating how soft and hard tissues of the human body are affected by heat and how these results are applicable to forensic casework dealing with extensively burned human remains. This modeling has the potential to identify features differentiating preexisting traumatic injury created in fresh bone from postmortem fractures caused by taphonomic changes to bone by fire and heat.

With the exception of crematoriums, human remains rarely burn in ideal conditions free of structural debris, dynamic environmental change, or body shifting during the reduction process. Heat alone causes muscle shrinking and dehydration, thus repositioning arms, legs, torso, and head into the flexed 'pugilistic posture.' Fire simultaneously impacts the surrounding environment, reducing construction materials and collapsing exposed spatial areas into layers of debris. Environmental changes potentially aid preservation or produce further damage by impacting and fragmenting brittle burned bone. Reduction of supporting materials of furniture, floors, or levels also contributes to fragmentation and dispersed spatial relationships of remains. Similar to decomposition, favorable conditions of ample oxygenation, circulation, and fuels accelerate soft and hard tissue destruction by fire, whereas restricted conditions impede proper combustion, thus producing visual differences in final appearances of burned human remains left for forensic analysis. Considering these taphonomic variables can assist scene reconstruction and differentiation of heat-related fractures from preexisting traumatic injuries in fragmentary burned skeletal remains.

Experimental burn research with human cadavers served as a model for observing interactions of the body, environment, and heat-related changes to known position and preexisting trauma in soft tissue and bone. Remains were photographically documented prior to, during, and following burning in conditions replicating forensic fires. Analysis began with the in situ position of remains at the scene, noting deviations from known original positions, influence and degradation of construction materials, spatial relationships of remains, relative fragment size and distance from the body, and condition of traumatic injuries in bone following incineration.

Distorted repositioning of limbs are observable heat-related changes to skin and muscles. Living skeletal tissues undergo similar dynamic transformations where heat pyrolyses and removes organic components (lipids, collagen, protein, water), producing black carbonization or charred bone. Depletion of organic materials weakens structural properties of remaining inorganic bone, appearing as white or gray calcined bone after heat drives off remaining carbon. Color changes occur simultaneously with shrinking and deformation of remaining inorganic skeletal structures, creating heat-related fractures and brittle bone. These are expected taphonomic processes for advanced stages of burned bone and are produced differently than traumatic injury in fresh bone from applied external force.

Preexisting wounds in fresh bone are vulnerable to thermal damage through accelerated exposure by penetrated tissues, abnormally positioned long bones from shrinking muscles, or exposed fracture margins, particularly in cranial bone. Exposure to heat caused soft tissue injuries, modeled by surgical incisions, to exaggerate wound morphology due to shrinking skin, muscle, and fat. Superficial soft tissue injuries were difficult to discern for advanced stages of cremation (calcination) in the absence of associated color or tool marks in bone. Skeletal fractures in long bones were overpowered by contracting muscles from heat, pulling broken margins apart like an open hinge. In thicker tissues shrinking muscles overlapped fractured ends embedding deeper into surrounding tissues, thus shortening the limb.

Evidence of preexisting skeletal fractures in long bones was best represented by correlating abnormal in situ positions with photographic images following extinguishment and skeletal analysis of reconstructed specimens. Cranial bone requires similar attention to the in situ position or distribution of fragments. Fragmentation results from biochemical reduction of organic materials from living bone (which leaves inorganic calcined bone and heat fractures), preexisting skeletal trauma, collapsed debris (walls, ceiling, roof, windshield), body shifting or falling during the fire, and/or handling and transport of fragile bone. Since traumatic fractures are produced by force impacting or penetrating fresh bone, it is possible to differentiate them from heat-related fractures produced by organic pyrolysis, shrinking, and deformation of inorganic skeletal structures. Traumatic fracture margins were eroded, weathered, and deformed from heat exposure and more noticeable in thinner cortical and cranial bone than thicker cortical structures.

Context at the scene is an invaluable source of information for investigating fire deaths. Time and intensity of heat exposure contribute to the progressive degradation of human remains. Bodies salvaged earlier sustain less tissue damage when compared to advanced or complete reduction by fire. Similar logic applies to structural materials surrounding the body. Degraded or collapsed materials can either reduce possibilities of finding intact skeletal remains because of increased impact and skeletal fragmentation, or create artificial protection with fallen debris shielding tissues of the body from heat. Documenting context and relationship of human remains within the immediate environment yields contributory information toward explaining burn patterns of the body and scene. However, caution should be given to interpreting original position or behavioral body language (protective stance) of the victim since contracting muscles alter the body's posture and throughout burning remains can shift position, become artificially restrained, fall, or become impacted and repositioned by larger debris. These factors provide challenges directly associated with their unique environments (structural, vehicular, public transportation, or mass disaster) and should be integrated with laboratory analysis of burned soft and skeletal tissues for reconstructing identity and differentiating perimortem traumatic injury from postmortem taphonomic changes to bone by fire. Examples of these differences will be illustrated with models from experimental burn research and forensic casework.

Burned Bone, Perimortem and Postmortem Trauma, Taphonomy

H83 Burned Beyond Recognition: Attempts to Destroy Evidence of Death

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The goals of this presentation are to illustrate differences among postmortem and perimortem effects of burning to osseous tissues as a means to destroy evidence of death or identity; to describe techniques for identifying signatures of perimortem trauma in extremely burned skeletal remains, especially cranial bone; to demonstrate utilities of actualistic modeling as a tool for analyzing difficult cases of burned human remains; and to provide examples of intentional attempts to destroy human remains and traumatic evidence with fire.

This presentation will impact the forensic community and/or humanity by introducing techniques for differentiating perimortem and postmortem trauma in burned human remains.

Analysis of burned human remains presents many challenges since fire alters familiar personal features of hair, skin, fingerprints, and unique facial soft tissues used for visual identification. More extreme cases require additional methods developed in anthropology and odontology to assess the biological profile, unique features of osseous and dental tissues for personal identification, and presence or absence of traumatic injury. Intentional use of fire to obscure or destroy human remains complicates these analyses but does not render them impossible. Contrary to popular belief, burning human remains whether fleshed or as dry bone, does not completely destroy all evidence. Such cases are difficult to process since heat degrades organic structures of bone, creating embrittlement, deformation, and fragmentation of bone. Accompanying dynamic changes of human tissues with heat, external factors of impacts with fallen debris or intentional reduction by the assailant further complicates analysis of surviving remains. Experienced anthropologists recognize skeletal structures of age and sex in fragmentary bone, but analyzing traumatic injury in remains intentionally burned to destroy evidence of death during the perimortem or postmortem interval presents a challenging task for reconstructing fatal events.

The authors conducted a comparative study involving cases of traumatic death and intentional burning from repatriated Guatemalan sites known for indigenous genocide by their military within the past 30 years and experimental human cadaver burn research to test identification techniques of traumatic injury in cranial and long bones. For the control sample, the researchers replicated perimortem blunt force trauma in five fleshed crania, removed soft tissue, burned specimens in a dry or partially fleshed state, and compared signatures of skeletal injury with four traumatized crania and long bones burned in the flesh to examine differences of perimortem and postmortem burn patterns.

Presence of soft tissue contributed to visual differences between fleshed perimortem burn patterns and postmortem burning of partially fleshed or dry bone. Through experimental burn research with human cadavers it is understood how different anatomical areas of the body burn predictably from known distributions of soft tissues (skin, muscle, fat) around each bone. Fleshed specimens with perimortem trauma exhibited a range of color changes to bone, showing progressive heat damage over large exposed bones of the upper face and vault versus skeletal structures deeply protected by lower facial and neck muscles that remained unburned or less severely compared to the exposed vault. Dry or partially decomposed specimens with perimortem trauma presented different burn patterns with more consistent blackening and calcination of the exposed bone and teeth lacking soft tissue protection. Color changes were valuable distinguishers of perimortem from postmortem burning episodes.

Perimortem traumatic injury was more difficult to discern in fleshed and defleshed specimens. Intact cranial bone fractured naturally from heat stress. Preexisting traumatic fractures undergoing thermal alteration appeared different than natural heat-related fractures. Disruptions or weakness in bone structure from fractures, impacts, or penetration became early failure points as bone shrinks from heat exposure, intensifying these discontinuities and producing permanent deformation. Heat causes fractures to open and remain exposed, producing an eroded, worn, weathered appearance opposed to heat-related fractures created by shrinking in dry charred and calcined bone. Characteristics of traumatic and heat-related fractures should be examined following cranial reconstruction and not on individual fragments. Perimortem fractures produced in green bone were also compared to postmortem fractures in grease-free dry bone to simulate a prolonged postmortem interval and features of non-lethal breaks in bone (environmental and taphonomic factors noncontributory to death).

Known features of traumatic injury for experimental specimens were compared to reconstructed skeletal remains of the genocide victims excavated in Guatemala. Field samples examined consisted of individuals violently murdered and burned to destroy evidence of death or identity(1). Field cases were independently analyzed to test the validity and reproducibility of traumatic signatures in experimental research as an effective tool for modeling forensic casework. Successful techniques for identifying features of preexisting trauma in burned bone will be presented for use in the forensic community. Examples of both known traumatized features and case examples will be used to demonstrate effective techniques for identifying traumatic injury in burned human remains.

References:
1. REMHI (Recovery of Historical Memory Project) and ODHAG (Human Rights Office of the Archdiocese of Guatemala) *Guatemala Never Again!* Orbis Books Maryknoll, New York. 1999.

Burned Bone, Traumatic Injury, Postmortem Burned Bone

H84 Dismembered Bodies - Who, How, and When

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Attendees will become familiar with various forensic aspects of postmortem dismemberment.

In the forensic literature there are many isolated case reports of postmortem dismemberment, this presentation will impact the forensic community and/or humanity by attempting to provide a comprehensive view of the main features common to the majority of dismemberment cases.

Close scrutiny into 14 cases of body dismemberment of homicide victims, analyzed at the National Centre of Forensic Medicine – Israel National Police (Israel) and the laboratory of Anthropology of the University of Granada (Spain), provides insight into various aspects of this type of postmortem mutilation.

The sample includes eight males and six females whose ages ranged between 12 and 67 years old. Four of the bodies are unidentified while the remaining ten were identified by means of a variety of techniques including fingerprints comparison, dental and medical data, and comparison of DNA profiles.

The investigation into these cases reveals common features regarding intent, state of mind of the perpetrator, cutting method, anatomical location of the severing cuts, and most commonly used tools to accomplish the deed.

The approach for an exhaustive analysis of all aspects of dismemberment cases requires careful handling of the remains to avoid damage during autopsy, thorough photography prior to removal of the severed parts, systematic documentation of the anatomical distribution of the cutting activity and examination of the walls of the cut-marks to expound the nature of the tool employed.

The objective of the perpetrator can be elucidated by the care or lack thereof in concealing the dismembered cadaver. In 5 cases (35%), the perpetrators cut off the hands and heads of their victims in order to hinder the identification of the deceased. This assertion is confirmed by the removal of portions of skin from the chest and back of two of the victims to eliminate tattoos that could have been conducive to positive identification of the cadavers. The disposal of the victims is a good indicator of the aim of the perpetrator; often the objective is to "send a message." In two cases the assassins decapitated their victims and left them to be found in their own homes; in five instances the mutilated body parts were left in areas of easy access to the public.

The most common reason for dismembering a body is to facilitate concealment and transportation; in 35% of the cases the taphonomic features indicated that the body parts were kept under refrigeration and were subsequently disposed of – either buried or wrapped separately and thrown in scattered garbage containers.

The state of mind of the person behind the murder can be ascertained by the number of cut marks on the cadaver. As a rule, a very high number of cuts or stabs are considered indicative of "overkill" or high disregard for the victim. This phenomenon was encountered in ~45% of the cases examined.

Oftentimes the postmortem interval precludes determining the cause of death; in six of the 14 cases, lethal stab-wounds were detected while in one case the perpetrator confessed that he had strangled the victim. For the remaining seven cases, the cause of death is undetermined.

The skills required to successfully dismember a cadaver are revealed by the neat results obtained by perpetrators somewhat proficient in human anatomy or in meat processing that cut very near or within the joints, utilizing dedicated tools like surgical scalpels or butcher knives. In six cases, the perpetrator's knowledge of anatomy was reflected in the small number of incisions and a minimum of kerf marks. In contrast, the unskilled perpetrator utilizes heavy utensils and due to his lack of knowledge in anatomy leaves many "false starts" In two cases (one from Israel and one from Spain) the perpetrator severed the body in half through the lumbar vertebrae but couldn't separate the limbs from the torso. The cut-marks left in the soft tissue in the vicinity of the axillary and inguinal areas are good indicators of the cutting sequence in these cases.

The implementation of 3-dimensional techniques including casting and photography will be illustrated. Typical marks associated with specific cutting devices will be described in detail. In 20% of the cases the perpetrators used more than one tool to accomplish the dismemberment; this information was instrumental for the police investigation.

Dismemberment, Taphonomy, Tool Marks

H85 Differential Human Decomposition in the Early Stages: An Experimental Study Comparing Sun and Shade

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The goal of this presentation is to provide information to help further the accuracy of the estimate of time since death (or postmortem interval, PMI) in cases that involve decomposition in very sunny locations such as a field, or those in very shady locations such as a dense forest.

This presentation will impact the forensic community and/or humanity by presenting research which examines the affects of sun and shade on the early stages of human decomposition. The results of this study should further the base knowledge on PMI estimation for the forensic anthropology community.

The analysis and estimation of time since death has long been a significant contribution of the forensic anthropologist to the death investigation. It is also, perhaps, the most difficult portion of data that the forensic anthropologist must analyze. It is widely known that many factors directly affect the rate of decomposition and therefore blur the actual PMI. Throughout the years many experimental studies have been conducted, attempting to generate information about decomposition. The purpose of this study was to analyze two possible extremes that arise in most casework: the affects of positioning a body in the direct sunlight or in complete shade.

To examine differences in decomposition in the early stages, a study using five human bodies that were un-autopsied, unembalmed, and had no soft tissue trauma was conducted. The study took place in 2002 at the Anthropology Research Facility in Knoxville, TN. The remains were placed out at the facility as soon as they became available during the summer months. All remains were placed in a supine position, with no clothing. During the study, data was observed, and collected daily including information on the weather, the remains and the amount of insect activity. Weather data that was collected independently at the two sites included current temperature, high and low temperature for the 24-hour period, humidity, rainfall, and sky conditions. Decomposition data that was observed included marbling, skin slippage, bloat, discoloration, desiccation, and skeletonization. In order to have data that would be relevant to actual casework, all other environmental factors were not eliminated from the study (except animals access, as scatter would have greatly detracted from the observations).

Results from the study were quite confounding but will be examined more thoroughly. The decomposition patterns of remains left in direct sunlight differed slightly from those of remains placed in complete shade. The remains in the sun progressed evenly through early decomposition but then hit a plateau during which time there were minimal changes in coloration, marbling, bloating, skeletonization, and insect activity. On the other hand, the remains in the shade maintained a constant rate of decomposition and did not run into the same type of stall in progress. Therefore, the remains in complete shade actually decomposed faster, some reaching skeletonization earlier. The weather data was more informative in terms of fieldwork. The temperature readings indicated that the sun bodies experienced highs that averaged about 10 degrees Celsius above those in the shade, where lows were very similar. In addition, the rain gauge readings indicated that remains in open, sunny locations are exposed to much higher rainfall levels. The forest canopy actually worked to block and redistribute rain limiting the amounts that reach the remains in heavily shaded areas. The data recorded daily and the photographs can serve as a great comparative sample when analyzing actual casework, weather comparisons, and fluctuation analysis.

The study was very informative, but the evaluation of the data maintains that analyzing PMI is truly an estimate. The more studies such as this, combined with actual known PMI casework can only help to increase the accuracy of the estimation that the forensic anthropologist is asked to make in death investigations.

Decomposition, Postmortem Interval (PMI), Forensic Anthropology

H86 Raccoon (*Procyon lotor*) Foraging as a Taphonomic Agent of Soft Tissue Modification and Scene Alteration

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Attendees will acquire an appreciation for the remarkable strategies employed by an opportunistic carnivore to exploit the insect species attracted to carrion.

Human medicolegal investigations increasingly rely on entomology to estimate time-since-death based on species' presence or absence, and stages of development. Estimates, however, may deviate when carrion-seeking insects are subject to predation themselves. Ants, wasps, beetles, and birds have been documented to scavenge carrion for fly eggs, larvae, or both. The authors have observed brown rats (*Rattus norvegicus*) ingest developing larvae found on human remains. These predators alter the entomological evidence which can be collected from the scene, and record of their presence must be taken into account when estimating the postmortem interval. To the authors' knowledge, there has been no prior record of mammals directing as much, if not the majority, of their efforts towards locating, and recovering, insect fauna, as they do in scavenging carrion.

This paper examines the foraging strategies of the raccoon at the University of Tennessee's Anthropological Research Facility—a 2 ½ acre plot of land set aside for human decomposition research. Prompted by the paucity of literature on small mammal scavenging behavior, multiple cameras were stationed at the Facility to record the nocturnal behavior of animals inhabiting, or frequenting, the Facility. The cameras were maintained throughout most of the September 2003 through July 2004 calendar months, after which point they were sporadically operated. Ancillary visits

in daylight enabled detailed photographic documentation of any previous night's activity.

Raccoons (*Procyon lotor*), in the order Carnivora, can be found throughout much of the United States. Although highly adaptable to diverse habitats, they prefer hardwood forests near streams, lakesides, or other bodies of water. They may establish dens in hollow trees, abandoned ground burrows, brush piles, caves or rock piles, drain pipes; and in, or under, buildings and structures. Urbanization has attracted many raccoons into metropolitan areas due to easily obtainable food, water, and shelter. Exceptionally inquisitive, their unique dexterity enables them to manipulate objects and probe crevices extracting contents within reach for examination.

Raccoons forage at night for a variety of foods including fruit, berries, nuts, fish, mollusks, snails, earthworms, insects, crayfish, clams, frogs, turtles, carrion, and small rodents and birds as well as their eggs. They may incorporate new foods into their diet – such as corn, grain, vegetables, pet food, melons, birdseed, and garbage – by watching the behavior of other raccoons. In temperate regions of the United States, they have been known to uproot lawns in urban areas while 'grubbing' for insects and their larvae. This behavior usually begins in the fall when many young raccoons are responsible for finding their own food, leading biologists to believe it may be preparation for winter when doubling their weight is required to survive into spring.

Bacteria, insects, and soil microbiota are the primary drivers of decomposition. Insects are attracted to carrion for sustenance for themselves or their offspring; whether via the corpse itself, or by other species frequenting the site. Post-feeding, the larvae of beetles and flies burrow beneath ground litter and into soil adjacent to, and underneath, the corpse, seeking protection from predators and other elements in preparation for pupation. While newly transformed beetles and flies emerge from the soil within several days, dead adult insects may remain in the soil; in some instances, many years after death. Blow fly larvae are normally found in the first three to five centimeters of soil, while larvae of some of the gnat-like flies can be found in buried remains up to depths of four feet. In temperature regions, the soil insect fauna beneath the skeletal remains at the ground surface will return to normal in approximately two years.

Recorded video and photographs visually demonstrate raccoon foraging to be an agent of soft tissue modification and scene alteration secondary to the quest for entomological nourishment. Indeed, a good deal of time and effort is spent probing for larvae feeding deep within the internal body cavities, snatching-up wriggling larvae from the body and ground, and unearthing larvae pupating within the soil.

Forensic Entomology, Animal Activity, Postmortem Interval

H87 Interdisciplinary Forensic Science Workshops: A Venue for Data Collection

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After attending this presentation, attendees will understand the need to record observations regarding the decomposition process of animals used as models for conducting forensic workshops; understand the value of such observations for the development of research objectives; and understand the value of such observations from various regions of the United States, or even the world, for future forensic investigations.

Forensic workshops are primarily conducted to educate law enforcement personnel on the novel use of various disciplines as a means to solve crime. This presentation will impact the forensic community and/or humanity by demonstrating that these workshops can also be used to record observations on insect and botanical demographics and taphonomy.

Workshops are a common vehicle for educating law enforcement personnel on the application of entomological, anthropological, and botanical techniques to gather forensically important information. From June 8 to June 11, 2004, such an interdisciplinary workshop was conducted outside of Charlotte, NC. The American Academy of Applied Forensics, under the auspice of the Central Piedmont Community College, hosted this workshop.

In preparation for this workshop, three pigs weighing individually between 40 to 60 kg were sacrificed and placed in the field on June 4, while three pigs of similar size were killed and placed in the field on June 7. The carcasses were placed at three sites. Two of the sites, separated by approximately 20m, were in a wooded lot, while the remaining site was in a sunlit area approximately 10m from the nearest wooded site. Two carcasses, one from each kill date, were placed approximately 1m apart at each site.

During the afternoon session on the last day of the workshop, participants collected three *Chrysomya rufifacies* (Macquart) (Diptera: Calliphoridae) 3rd instar maggots from one pig that was killed on June 7; these data represent the first record of this forensically important insect species in North Carolina. Furthermore, these data provide evidence of this species expansion into new geographic regions of the United States.

The interdisciplinary nature of this workshop allowed participants to understand the intersection of entomology, anthropology, and botany. The new entomological information gathered may have implications for body decomposition patterns and rates, thus leading to new research ideas to further contribute to forensic science applications.

Anthropology, Entomology, Botany

H88 Society of Forensic Anthropologists (SOFA): An Introduction

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After attending this presentation, attendees will be aware of the newly formed Society of Forensic Anthropologists (SOFA), its members' contributions to active medicolegal investigations, and professional concerns the members believe affect the evolving practice of forensic anthropology in the 21st century.

This presentation will impact the forensic community and/or humanity by introducing the Society of Forensic Anthropologists (SOFA) to the larger forensic community and invite their discussion of the group's overall mission and professional concerns affecting the discipline.

In recent years an increasing number of forensically trained anthropologists have found professional employment in the medical examiner system. Often these individuals carry a dual role within the office serving as a medicolegal death investigator and/or autopsy technician in addition to being the forensic anthropologist. Typically, they are the only forensic anthropologists practicing within their office, contrary to the academic setting where you may have several peers. This environment has led to a feeling of isolation and limited means of professional communication. As a result, several forensic anthropologists working in the medical examiner system have formed the Society of Forensic Anthropologists (SOFA). For the most part, SOFA is a web-based discussion forum enabling its members to consult on cases, discuss advances in the field, and raise concerns regarding the evolving practice of forensic anthropology in the 21st century.

SOFA formally came to be in February 2003 and is currently comprised of 20 members who work professionally throughout the United

States. Education levels of members include Masters, PhD or PhD, D-ABFA. Most lecture and train other anthropologists through various institutions. A statistical survey of SOFA members conducted in July 2004 revealed that members manage all forensic anthropology cases in areas ranging in size from a single county to a complete state. During 2003, members were assigned 628 anthropology cases and wrote 545 formal reports. Reports were filed with various legal agencies. Many of the members have testified and/or been subpoenaed to testify as expert witnesses in court. In sum, SOFA members make a large professional contribution to current medicolegal casework and thereby, the growth of forensic anthropology.

During the past year, group members have brought two professional concerns to the forefront of discussion. One concern is the lack of policy for certification of forensic anthropologists practicing within the medical examiner system; and a second is the lack of a standardized system to peer review formal reports written by isolated forensic anthropologists. The purpose of this presentation is two fold: first, to introduce SOFA to the larger forensic anthropology community; and second, to define and raise awareness of these concerns.

Forensic Anthropology, Professional Communication, Society of Forensic Anthropologists (SOFA)

H89 The Forensic Anthropology Society of Europe: An Introduction

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After attending this presentation, attendees will understand how forensic anthropology is organizing itself in Europe.

This presentation will impact the forensic community and/or humanity by improving transatlantic collaboration in forensic anthropology and the certification process in Europe in this field. This is the introduction of a European scientific association dedicated to forensic anthropology and to the development of international collaboration in this field.

The first board of FASE (Forensic Anthropology Society of Europe) was elected at the IALM (International Academy of Legal Medicine) Congress in Milan, September 2003 during a plenary session which was officially announced at a preliminary FASE meeting held during the International Academy of Forensic Sciences meeting in Montpellier in September 2002; it is made of people from five European countries.

The Board is composed of one President, two vice-Presidents, a Secretary a Treasurer, and one auditor. Offices are of the duration of three years. All Board members may be reelected for a second term of office. The newly elected Board takes over official duties on 1 January following elections.

The FASE was created to bring together anthropologists, forensic pathologists, odontologists, geneticists, and other experts in the fields of forensic medicine and forensic science, in the scientific and academic promotion and development of the discipline of forensic anthropology across Europe.

The goals of FASE are:

- To encourage the study of, improve the practice of, establish and enhance standards for, and advance the science of forensic anthropology and related disciplines; promote knowledge and research in the field
- To harmonize techniques and diagnostic procedures in forensic anthropology across Europe
- To encourage and promote adherence to high standards of ethics, conduct, and professional practice in forensic anthropology
- To promote training and certification in forensic anthropology and eventually create Boards of certificates and inform the existence of trained forensic anthropologists in order to guarantee high quality performance in the medicolegal study of human remains;
- The formation of working groups in different areas of forensic anthropology and the accreditation of protocols and laboratories.

Membership: In order to become a member of FASE one must be a member of the International Academy of Legal Medicine (IALM). Applications for membership must therefore be made to IALM, according to the statutes of the Academy, specifying that he/she also wants to become a FASE member.

Board and General Assemblies: The General Assembly will elect members of the FASE Board, decide on congresses and meetings, on rules/statutes, and other matters dealing with the aims of the Society. The General Assembly will meet once every year, at FASE or IALM meetings. The Secretary of the Board will forward invitations to the meeting together with the Agenda of meetings six weeks before the date of the meeting.

Yearly assessment: One year after its creation, FASE has officially 30 registered members (16 MD, anthropologists, dentists, etc.,) coming from eight different countries (2 non-Europeans). A one week workshop in forensic anthropology (the 7th) was given in Milan from June 28 to July 2 to 10 students. The first yearly meeting of FASE was held in Frankfurt on the 22nd an 23rd of October (more than 20 oral presentations); next year it will be held in Monastir during the 2nd Mediterranean Academy of Forensic Sciences Biennial meeting (June 22-25, 2005) and in Budapest in 2006 (IALM meeting). Two newsletters were written (one published in the International Journal of Legal Medicine). More up to date information will be provided on February 2005.

Forensic Anthropology, Europe, Organization

H90 The Louisiana Identification Data Analysis Project (IDA): A Comprehensive Analysis of Missing and Unidentified Cases

H. Beth Bassett, MA, and Mary H. Manhein, MA, Forensic Anthropology and Computer Enhancement Services Laboratory, Department of Geography and Anthropology, Louisiana State University, Baton Rouge, LA 70803*

The goal of this presentation is to present the forensic community with information about an effort to solve long-term, unresolved cases. The outcome of the presentation includes the potential for cooperative efforts among forensic scientists to share resources and methods that may assist with such cases.

This presentation will impact the forensic community and/or humanity by providing information about the Louisiana IDA project, a method for establishing a central location for identification data (including both missing persons and unidentified remains). The Louisiana IDA project may be used as a template for forensic scientists in other areas of the country who are addressing the same identification issues. Finally, the IDA project has potential for providing the public with resolution of unidentified and missing persons cases.

Thus far, the focus of research in the field of forensic anthropology has included the proliferation of principles and methodologies whose applications result in the successful resolution of cases of unidentified remains (Krogman and Iscan 1986). Additionally, many authors have presented case studies which highlight unusual techniques and/or applications that have led to identifications (Bennett and Benedix 1999 and Walsh-Haney *et al*. 1999). Yet, unresolved missing persons and unidentified remains cases

are rarely discussed in presentations and literature (Grisbaum and Ubelacker 2001 and Marks 1995). Additionally, many states lack a centralized location for information on missing people and unidentified remains. This results in a breakdown of communication among different agencies that deal with these types of cases and ultimately leaves unresolved cases open for long periods of time.

The Louisiana Identification Data Analysis Project (IDA) initiated at the Louisiana State University Forensic Anthropology and Computer Enhancement Services Laboratory (LSU FACES Lab) involves the systematic collection and storage of traditional identification profile information along with DNA profile data on Louisiana's cases of missing persons and unidentified remains. Throughout the history of the LSU FACES Lab there have been 91 cases of unidentified remains (with varying degrees of completeness) that have been analyzed to an exhaustive degree yet have never been identified. These unidentified individuals are from many locations across the state of Louisiana and from other states as well. Many of them have unique characteristics (such as tattoos, healed skeletal fractures, and dental restorations/features) that could corroborate or negate their potential identity when compared with information about missing people. Also, some Louisiana agencies have retained or buried unidentified remains that have never been evaluated by an anthropologist and/or odontologist.

To initiate the IDA project, data on approximately 400 missing persons and unidentified remains cases from across Louisiana and the country was collected. This number represents only a fraction of these types of cases from Louisiana and the nation. Through the IDA project, the Forensic Anthropology and Computer Enhancement Services Laboratory is becoming the central location for data on Louisiana's missing and unidentified people. It is hypothesized that some identifications could be resolved by providing a centralized location for the information on these cases. Currently, the researchers are continuing to compare the data on missing people from across the state and country with known cases that have been found but are unresolved. The systematic data collection on Louisiana's missing people and unidentified remains has begun using the WINID3 software package, a Windows-based dental and demographic program. Additionally, bone, hair, and tooth samples are being provided to the North Louisiana Criminalistics Laboratory for DNA profiling of the unidentified remains. Concurrent with the analysis of accessible cases, the database is being built by gathering additional information on other missing persons from across Louisiana. Finally, the authors aim to collect biological and DNA profile information of all people missing from Louisiana.

The goal is to resolve as many of these cases of unidentified remains and missing persons as possible. As the Louisiana database continues to build, the authors wish to invite other anthropologists to consider this model and join in this substantial effort.

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Forensic Anthropology, Unidentified Remains, Missing Persons

H91 FAD - A Database Application for Forensic Anthropology in Human Rights

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The goal of this presentation is to introduce the forensic community to a new database application as a tool for forensic anthropology and to show the advantage of using such an application in the practice of forensic exhumations, examinations, and identifications.

This presentation will impact the forensic community and/or humanity by presenting a new tool to facilitate and standardize Forensic anthropological work in a human rights context.

In order to support forensic anthropologists working in a human rights related field, the authors, in cooperation with the Argentine Forensic Anthropology Team (Equipo Argentino de Antropologia Forense – EAAF) created a special database application for exhumation and identification of human remains. The Forensic Anthropological Database (FAD) facilitates the process of identification of skeletal remains and has been instrumental in assisting the EAAF in organizing and processing their world-wide case load. It features modules on exhumation, anthropological analysis, sorting, and re-association of commingled remains, and antemortem information on missing persons that can be matched with the postmortem data obtained from anthropological analysis. In addition, the database supports general conclusions and statistical analysis from examined cases, such as biological and traumatic profile of skeletal populations. In this electronic format, the data also remains available for further scientific research. As such, the FAD is the first system of its kind and, being easy to use and based on easily accessible software, constitutes an important contribution to the forensic anthropological investigation of human rights violations and the identification of the victims.

Forensic Anthropology, Forensic Archaeology, Database

H92 New Tools for the Processing of Human Remains From Mass Graves: Spatial Analysis and Skeletal Inventory Computer Programs Developed for an Inter-Disciplinary Approach to the Re-association of Commingled, Disarticulated and Incomplete Human Remains

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The goal of this presentation is the introduction of two computer programs that can potentially assist mortuary personnel in the re-association of numerous disarticulated body parts through inter and intra-site analysis for purposes of facilitating identification and increasing efficiency of a large scale DNA identification process.

This presentation will impact the forensic community and/or humanity by demonstrating the use of computer database programs by all professions involved in the identification of human remains from mass graves.

The means of deposition of human remains within mass graves often leads to a large amount of disarticulation, commingling and incomplete bodies. While 'routine' cases are usually processed in stages by separate

forensic disciplines, often in separate locations, the simultaneous processing of hundreds to thousands of human remains from mass graves can be overwhelming if a similar system is employed. The complexities of recovery, recording, and processing large amounts of disarticulated remains require innovative solutions that integrate several disciplines. This panel wishes to present to the forensic community a process by which data recorded during the recovery and examination of remains from mass graves may be used to assist in the re-association of disarticulated human remains.

The first database application involves spatial analysis of commingled, disarticulated and incomplete bodies. Contemporary methods of mass grave recovery operations often include the electronic three-dimensional recording of bodies, body parts, artifacts, and related feature location and position. From these locational points, maps can be created to represent the crime scene or to reconstruct the sequence of events, including separate depositions of remains from a number of primary graves. However, the use of the data points does not have to end with map making. These locational points may also be extremely useful in guiding re-association efforts of disarticulated remains on the large scale needed at mass graves. The electronic survey data can be queried to generate a list of a particular body part, in order of distance, which may belong to a specific body missing that element. The premise is that the closest disarticulated body part to a body missing that particular part has a higher probability of being the correct match than all other same body parts at the site that are further away. The resulting list has the potential to save hours of work by providing mortuary personnel with an inventory of the nearest targeted body part to aid in re-association with a body. Instead of having to randomly search through all potential body part matches the mortuary worker can use the generated list as a starting point in their search for the most likely match.

The second application involves a comprehensive visual skeletal inventory that again can be queried for purposes of re-association. During initial examination of remains mortuary personnel can record all present body elements for each case they work on in the skeletal database. After all cases have been recorded the mortuary worker can then query the database for all the potential matches to a particular body part or body missing that element. Combined, the spatial analysis and the visual skeletal database may prove to be important tools in strengthening the efficiency of re-association and identification of complex and large scale sets of human remains.

With the success of mass scale DNA testing, DNA analysis of all elements recovered is possible. The unfortunate down side of DNA analysis is the cost of the process. While recovery and identification missions of mass disasters in the United States and other developed nations are usually well enough funded to cover the cost of such testing, this is not true of most less developed or post-conflict countries. The desired effect of such databases is a decrease in unnecessary DNA sampling and analysis, and an increase in overall processual efficiency.

The presenting panel made up of Recovery, Mortuary, DNA, and Database personnel will provide examples of the use of spatial analysis and skeletal inventory database programs with remains recovered from mass graves. Each panelist will describe his or her role in the processing of the remains and how the programs integrate into their work.

Database, Commingled Remains, Re-association

Psychiatry & Behavioral Science

I1 Violence Risk Assessment in the Workplace

William Cardasis, MD, 202 East Washington Street, Suite 208, Ann Arbor, MI 48104; and Harley V. Stock, PhD*, 10097 Cleary Boulevard, PMB 300, Plantation, FL 33324*

After attending this presentation, attendees will understand how the implementation of a model protocol for the evaluation and management of qualifying problematic situations in the workplace can assist to mitigate risk in a cost effective manner.

This presentation will impact the forensic community and/or humanity by demonstrating deriving a better method of forensic psychiatric consultation and evaluation in training management and employees in the framework of the model in order to take a proactive stance in this area to ensure safety in the workplace.

For many years employees in certain fields have faced a significant risk of job related violence. Assaults and threatening or other inappropriate behavior represent a serious safety and health hazard for these employees and interfere with the operation of business. Organizations experience instances of perceived risk from employees, recipients of services, and/or third parties. Most of the time, instances of perceived risk are managed on an ad hoc basis triaged by present management staff that may not possess specialized training or experience in the area of violence prevention and risk management. Similarly, these instances have been addressed in the context of the present hierarchical structure of the organization without the benefit of a defined process or model to respond consistently and comprehensively. The model protocol is designed to address the specific violence prevention and risk management needs unique to the individual organization.

Within the proposed model, instances of perceived risk and other problematic issues, which qualify for specialized intervention and management, may include threatening behavior, violence, concerning or threatening communication, and/or crisis management. Referrals generated from such situations would most often involve assessment of the risk of violence posed, management of the case, and appropriate disposition. Subjects of interest could be employees, staff, students, customers/clients, or unrelated third parties. The proposed model protocol involves: 1) development and maintenance of a violence prevention program, 2) implementation of a specialized response team in the workplace to address qualifying incidents, 3) provision of specialized forensic psychiatric consultation services and risk assessment, and 4) performing specialized forensic psychiatric assessments and conducting fitness for duty evaluations.

In summary, the specialized model progresses from: an initial phase of development; institution of policies and procedures; development of procedures for employees to report incidents to the response team; consultation by the forensic psychiatric consultant on qualifying cases; invocation of the response team; evaluation process of cases; incident response; and post-incident or crisis management response.

Violence, Risk Assessment, Forensic Psychiatry Evaluation

I2 Stalking as a Risk Factor in Domestic Violence Finale

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The goal of this presentation is to present a typology for assessing domestic violence stalking and risk factors for assessing violence within domestic violence stalking campaigns.

This presentation will impact the forensic community and/or humanity by providing understanding of the prevalence, purpose, and implications of stalking behaviors in domestically violent relationships, as well as methods for assessing violence risk within this population.

This paper is a follow-up to the presentations from AAFS 2001 (Stalking as a Risk Factor in Domestic Violence) and AAFS 2003 (Stalking as a Risk Factor in Domestic Violence Revisited). This presentation will cover the final results of a several-year study on stalking behaviors perpetrated by domestic violence offenders. Eighty-five participants who were referred to a community domestic violence/anger control treatment program were assessed for stalking and abuse within their intimate relationships. Their reported motives for conducting the stalking behaviors varied from apologizing, to showing their love, to intimidating their partner, and to gaining access to property and children. A factor analysis of the stalking behaviors, motives, and associated characteristics revealed a three-factor typology: *Apologetic & Hostile*, *Malicious*, and *Business-like*. A second factor analysis on the stalking and partner abuse behaviors also revealed a three-factor typology: *Assaulters*, *Pursuers*, and *Coercers*. Path analysis between the participant historical variables, partner violence, and stalking behaviors revealed that sexual coercion, psychological aggression, and negotiation tactics were more indicative of the perpetration of stalking behaviors than physical violence against the partner. The findings suggest that rather than considering stalking and domestic violence as different constructs, stalking behaviors may be better conceptualized as an extension of the physical and psychological abuse against the partner, with more severe forms of stalking being used by more severe domestic violence perpetrators. The implications for assessment of violence risk, law enforcement intervention, and legal/policy issues will be discussed.

Stalking, Domestic Violence, Threat Assessment

I3 Assessing Increases in Violence: An Analysis of Homicide Cases From Orleans Parish, Louisiana

Helen V. Bouzon, MA, 4444 Tigerland Avenue, Apartment 4, Baton Rouge, LA 70820*

The goal of this presentation is to present the trends in homicide cases occurring in Orleans Parish, Louisiana. Research indicates that homicides in Orleans Parish are becoming more violent.

This presentation will impact the forensic community and/or humanity by offering a research method, which can be applied to a study of homicide in any city. Such research can be used to implement measures to decrease the rates of homicide in any area.

This study is an analysis of homicide cases from the Orleans Parish coroner's office. Research was performed from June of 2003 until January of 2004. A total of 1,334 homicide cases were reviewed. Autopsy, police, and toxicology reports were assessed for each case. The first goal of the research was to determine trends in homicide cases in Orleans Parish. To establish changes over time, the years 1980, 1985, 1990, 1995, and 2000 were reviewed. A total of 21 variables were considered to determine trends in victim profiles and in the homicide incident itself.

The results of this study indicate that African American males aged 21 to 30 are the primary victims of homicide in Orleans Parish. Homicides were more likely to occur in the beginning of the year and during the summer months. Homicides were also more likely to occur on weekends and during the late evening and early morning hours. Certain police districts were found to consistently be more dangerous than others. Homicide cases were also analyzed based on the type of weapons used. Gun related homicides were consistently in the majority.

The second goal was to determine whether the amount of violence in homicide cases has increased over time. All homicides are violent in nature. However, the amount of violence can differ from case to case. The goal of this research was to determine whether overkill has become more common in recent years. When overall violence was analyzed, the results indicated that homicides in Orleans Parish have become more violent in recent years. Both the number of overly violent cases per year and the average number of wounds per victim increased over the years under study. These results indicate that today perpetrators are more likely to cause excessive wounding to their victims than they were in the past.

Homicide cases determined to be more violent were analyzed separately to analyze trends. For this analysis, only nine of the previously used variables were considered. Again, the results indicated that the victims of overly violent homicides in Orleans Parish were principally African American males aged 21 to 30. Many of the trends in overly violent homicides were similar to those found when all of the cases were analyzed.

Analysis of homicide cases in different cities can provide valuable research information. The information gathered from such an analysis can be used to aid those who are the primary targets of homicide. Such studies can also be used to understand the nature of homicide and what measures can be taken to decrease the rates of homicide in any given area. An analysis of this kind can inspire future research into why homicides are becoming more violent, information about the perpetrators of violent crime, and why people commit murder.

Homicide, Trends, Violence

I4 Psychophamacology of Aggression: An Update

Adam M. Estevez, MD, 27 West 72nd Street, Suite 302, New York, NY 10023*

Attendees of this presentation will be provided with the most current information for the psychopharmacologic treatment of aggression.

This presentation will impact the forensic community and/or humanity by demonstrating astute clinicians can significantly reduce aggression in society and correctional settings with appropriate and judicious use of selected medications and new treatments.

Introduction: Both for the general psychiatric clinician and for the forensic psychiatrist treating in correctional settings, recent research findings in the psychopharmacology of aggression is important.

History of Treatment of Aggression: Dangerous behavior has long been a focus of society and psychiatry. The asylums of the past were created to protect the chronically ill mentally from abuse by the public, but also to protect the public from the dangerous sequelae of severe mental illness. With the advent of modern psychopharmacology, it has been possible to discharge many chronically ill patients with a history of violence from the large long-term hospitals. The early neuroleptics had unfortunate side effects in maintenance treatment, such as tardive dyskinesia.

Newer Treatments: Newer treatments have a better safety profile and have greater specificity in targeting symptoms. Recent research shows variable success in alleviating aggression with different medications. Mood stabilizers are used extensively both as a primary treatment and as adjunctive treatment. Other treatments including benzodiazepines, SSRIs, atypical antipsychotics, and beta-blockers have been used with some variable success on certain populations. Although psychotherapeutic programs and other non-pharmacologic approaches *have been used to reduce* aggression, this paper will focus primarily on psychopharmacologic *approaches to the treatment of aggression.*

Conclusion: Astute clinicians can significantly reduce aggression in society and correctional settings with appropriate and judicious use of selected medications and new treatments.

Psychopharmacology, Aggression, Treatment

I5 These Women Who Kill Their Children

Clotilde G. Rougé-Maillart, MD, Arnaud Gaudin, MD, Nathalie Jousset, MD, Brigitte Bouju, MD, and Michel Penneau, MD, PhD, Service de Médecine Légale, Centre Hospitalier Universitaire, 4 rue Larrey, Angers, 49100, France*

Mothers who are charged with the murder of a child between the ages of 1 through 16 are expected to come from a slightly different population than the mothers of neanaticide. The purpose of this study is to contribute to the basic knowledge about these filicides and determine the characteristics of these mothers.

This presentation will impact the forensic community and/or humanity by individualizing some characteristics concerning the mothers who are charged with the murder of a child aged 1 through 16 years. A variety of psychosocial stresses appear to be a major factor. Prevention begins with the identification of potential perpetrators.

The killing of a neonate on the day of its birth is known as neonaticide. The murder of a child aged 1 through 16, after its entry in the family is different. It is expected that mothers charged with filicide come from a slightly different population than other child-killing mothers.

Method: The study was conducted at the Institute of Forensic Medicine of Angers over a ten-year period. All the victims were autopsied at the institute. Information was collected from forensic medical files, police reports, and judicial files. It was possible to review the interrogations and the forensic psychiatric examinations.

Result: The study involved 17 observations. The mean age was 3.5 years for the victims and 29.5 years for the women. Most women were married or did not live alone. They often had an occupation. Generally the economic status was average. Head trauma, strangulation, suffocation, and drowning were the most frequent means of filicide. However, some mothers used more aggressive methods such as striking, and shooting. Disturbed or disturbing behavior was documented for 15 perpetrators. Six women tried commit suicide. It was often possible to identify the apparent motivation for the offense.

Discussion: In this study, two types of mothers-killers can be identified. Five women killed their children in a general context of abused children and present similarities with the mothers of neonaticide (young, immature). The other group of filicide mother is different. They are generally older, married, and employed. The crime is usually premeditated, committed with the direct use of hands, and sometimes very violent. To understand the motives or the source of the impulse to kill, like Resnick's classification can be used: altruistic filicides (8 cases), accidental filicides (5 cases), spouse revenge filicides (2 cases). The fact that 15 of the 17 perpetrators had disturbed behavior is remarkable. Many women showed signs of suicidal tendencies prior to the event, aggressive and angry behavior. In general, suicidal attempts tend to prevail. These offenders act out of an acute sensitivity to social regulation. A variety of psychosocial stresses appear to have been a major factor. These stresses include lack of social or spouse support, economic difficulties, family stress, and unrealistic expectations of motherhood. The precipitating stress may be disputed.

The prevention begins with the identification of potential perpetrators. Therefore, medical doctors have a significant role in relation to the prevention of child murder.

Homicide, Filicide, Child Abuse

I6 The Youth of AOT: Evaluating the Demographic and Clinical Characteristics of the Young Adult Population of a New York City Outpatient Commitment Program

Eraka Bath, 440 East 23rd Street, #4E, New York, NY 10010; and Suma Gona, MD, Bellevue Hospital, AOT Program, 550 First Avenue, 21W-15, New York, NY 10016*

Attendees of this presentation will learn about the demographic and clinical characteristics of young adults committed to outpatient psychiatric treatment and hopefully will be better able to serve their needs.

This presentation will impact the forensic community and/or humanity by developing interventional strategies to reduce recidivism and re-hospitalization.

The authors' hypothesis is that the young adult population of the Manhattan based Assisted Outpatient Program (AOT) is more likely to have substance abuse related disorders, histories of violence and arrest or incarceration as compared with the general population of AOT. Also hypothesized is that these young adults are more likely to have more frequent psychiatric hospitalizations prior to age 18 and prior to their outpatient commitment. Additionally the authors hypothesize that this group will be disproportionately male and have minority backgrounds.

This will be a descriptive study using the methodology of a retrospective chart review of files on all patients who are between the ages of 18-24 who have had at least one AOT order since the inception of the Manhattan based AOT Program (*4years). Charts will be screened for a variety of demographic data including but not limited to the following: 1) type of psychopathology, 2) presence or absence of substance abuse, 3) history of child abuse, 4) family history, 5) educational attainment, 6) types of medication ordered, 7) number of orders issued, 8) history of violence, arrest, and incarceration.

Medical records provided for the AOT referral process as well as the evaluations conducted by the forensic psychiatrists involved in the commitment process will be examined.

Currently there have been approximately 150 AOT participants who are between the ages of 18-24 through the Bellevue Hospital AOT program out of 1,000 total AOT clients in the history of the Manhattan program. This group represents 15% of the total population and examining their clinical and demographic qualities could have significant implication for treatment outcome. There are very few studies on young adults who are court mandated to psychiatric treatment. As the juvenile justice system expands to become a locus of primary psychiatric care for adolescents with severe psychopathology because of the lack of other care options, their interface with the judicial system becomes more pronounced and intractable. It is important to gather knowledge about this group who are likely to have long term and frequent utilization of mental health services and the criminal justice system.

Young Adults, Outpatient Commitment, Mental Illness

I7 Are Drug Related Deaths Avoidable? An Analysis From Vienna, Austria

Daniele U. Risser, MD, I. Czarnowska, A. Eisenkolbl, K. Haunold, T. Jasek, J. Maresch, M. Meier, A. Rosenzopf, M. Scharrer, A. Scheed, and D. Wolf, Department of Forensic Medicine, Sensengasse 2, Vienna, 1090, Austria*

After attending this presentation, attendees will recognize the patterns of drug related deaths in Vienna, Austria and will understand the prevalence of avoidable death in this population.

This presentation will impact the forensic community by demonstrating the existence of avoidable factors in the overdose deaths of drug-addicted individuals in Austria.

Introduction: Drug abuse is a worldwide problem. It is estimated that in Vienna, the capital of Austria, with a total population of 1.6 million inhabitants, there are between 10,000 and 15,000 heroin users. Since the end of the 1980's the number of officially registered drug related deaths has increased in Vienna. The aim of this survey was to find out if at least part of the drug related deaths could have been avoided.

Methods: Police records of drug related deaths in Vienna in the year 2002 have been analysed regarding place, sex, age at death, and if witnesses were present.

Results: In 2002 a total of 95 drug related deaths were investigated at the Institute of Forensic Medicine in Vienna. Of the drug related deaths 75% happened in private flats. In 39% of these cases other people were present. Of the victims 76% were male. The proportion between sexes was 3:1. The average age was 33, ranging from 17 to 47 years. Female drug users were younger than males.

Discussion: Based on the results of this study – three quarters of drug related deaths have happened in flats, mostly in the presence of other persons – it may be assumed that at least some of these deaths would have been avoidable if first aid measures would have been applied in time.

Drug Abuse, Drug Related Deaths, Epidemiology

I8 Relapse Prevention for Adolescent Substance Abusers

Richard Rosner, MD, Forensic Psychiatry Clinic, 100 Centre Street, Suite 500, New York, NY 10013*

The goal of this presentation is to introduce relapse prevention as an essential part of the treatment of adolescent substance abusers.

This presentation will impact the forensic community and/or humanity by assisting in planning realistically for the treatment and rehabilitation of adolescent substance abusers.

OUTCOME: Understanding the components of an effective Relapse Prevention program with adolescent substance abusers.

This is a presentation of the American Society for Adolescent Psychiatry's Liaison with the AAFS Psychiatry & Behavioral Science Section.

Adolescent substance abuse is endemic in our society. Adolescent substance abusers frequently enter the juvenile justice system and the adult criminal justice system. In order to realistically reduce recidivism among adolescent offenders, an understanding of relapse prevention treatment for adolescent substance abusers is essential.

This presentation will consider relapse as part of the phenomenon of addiction. It will review the two models of relapse prevention developed by T.T. Gorski and by G.A. Marlatt, with special consideration of their application to adolescent substance abusers.

Adolescents, Substance Abuse, Relapse Prevention

I9 Recent Scientific Advances in the Understanding of Adolescent Brain Development and Its Forensic Applications: An Update

Daphne Dorce, MD, 8027 250th Street, Bellerose, NY 11426*

Upon completion of this presentation, attendees will have a clearer understanding between the physiological difference between the adolescent and adult brain; understand forensic implications of recent research findings on adolescent brain development; and understand risk factors that contribute to adolescent violent crimes.

This presentation will impact the forensic community and/or humanity by providing a better understanding of the legal issues regarding juveniles and the need for revised legislation with regards to punishment.

Introduction: Society has long struggled with the question of when do people become competent and responsible for their actions warranting certain punishments. Recent research findings have illuminated understanding of adolescent brain development and its immaturity in comparison to adults.

History of Adolescents: The concept of adolescence emerged in the 1900s. Prior to this time children and adolescents were treated as adults. The juvenile justice system in 1899 was created in order to handle youth separate and distinct from adults, preventing penalization of juveniles for their immature minds. With the advent of drugs. gangs, and the increase of violent crimes committed by juveniles, particularly in the schools, society has reacted by demanding harsher punishments and adult penalties including the death penalty for juveniles. The death penalty, the maximum punishment for adults is society's exaggerated response to a complex problem without full understanding of adolescents and their behaviors.

Recent Research Findings: Functional MRI has allowed researchers to study and demonstrate the differences between the developing adolescent brain and the fully developed adult brain. The prefrontal cortex, the area of the frontal lobe, the largest part of the brain associated with rational thinking, impulse control, judgment, planning for the future, and understanding of consequences does not fully develop adult capacities *until* the early twenties. In addition to physical changes of the brain, adolescence is a time of significant hormonal and emotional change. Testosterone, which is closely associated with aggression, increases tenfold in adolescent boys. Furthermore, pediatricians have identified risk factors such as witness to domestic violence, substance abuse, and victim of physical and sexual assault as triggers to violent behaviors in adolescents. On the basis of the aforementioned scientific findings it becomes apparent that a grave injustice is done in treating juveniles as adults. These developments have implications in the legal process, the principles surrounding punishment and the culpability of the offender and their appropriate punishment. This paper will discuss all these issues.

Conclusions: With these recent research findings perhaps it would be important for society to reexamine its enthusiasm in ascribing too many adult characteristics to adolescents. The research makes clear that adolescents do not think and behave the same way as adults, and therefore, should not be legally treated the same way.

Adolescent, Brain, Development

I10 Intellectual Deficits Detected by Psychometric Testing (WISC-IV) in Fifty Adolescents Referred, for a Pre-pleading Evaluation, to the New York Criminal Court's Forensic Psychiatry Clinic After Committing a Violent Crime

Richard Rosner, MD, and Manuel Lopez-Leon, MD, New York University School of Medicine, Department of Forensic Psychiatry, Forensic Psychiatry Clinic, 100 Center Street, Suite 500, New York, NY 10013*

After attending this presentation, attendees will learn that intellectual functioning is a major risk factor in adolescents who commit violent crimes. The attendees will consider screening for cognitive deficits (i.e., low I.Q.) in this population in hopes of preventing future violent crimes by referring them to appropriate treatment.

This presentation will impact the forensic community and/or humanity by making forensic scientists who deal with adolescents and their behaviors more mindful about cognitive deficits as a predisposing factor in teenage-violence. The presentation may motivate the audience to consider testing the cognitive functioning of this population, and by doing so, appropriate treatment can be recommended and future violent acts avoided.

Deficient intellectual functioning plays a major role in teenagers who are involved in violent crimes. The purpose of this study is to analyze the data provided by psychometric testing (WISCIV) done in adolescents who committed violent crimes. In general, standardize psychometric testing, specifically testing that yields an intellectual coefficient (i.e. WISC IV) is not routinely performed as part of the initial forensic evaluation in juveniles who commit violent crimes. If teenagers are identified with borderline cognitive limitations, mild retardation, and perhaps even, subtle intellectual deficits, in this population, future violence may be avoided. The method used for this study is a retrospective chart revision of 50 patients between the ages of 15 and 17 who were referred by a single judge from the New York City Criminal Court to the Forensic Psychiatry Clinic for a forensic evaluation to determine fitness to stand trial, and who received the WISC-IV as part of the evaluation. The data is currently in the process of being collected and analyzed. Once the data is obtained and results produced, we might conclude that psychometric testing should be routinely administered to juveniles who committed violent crimes.

Cognitive Deficits, Adolescents, Violent Crimes

I11 Minimizing Detrimental Effects of Child Custody Litigation on Children

Julie Y. Low, MD, St. Vincents Hospital/NY Medical College, 144 West 12th Street, Reiss 175, New York, NY 10011-8202*

After attending this presentation, attendees will be able to identify, isolate, and counteract specific negative effects of custody litigation on the children involved.

This presentation will impact the forensic community and/or humanity by helping the forensic examiners to be sensitive to the needs of the innocent children caught between two warring parents and their lawyers. With the learned material, the examiner will help the children weather the adversarial atmosphere in an optimal way and thrive in the new circummstances of their lives.

Child custody litigation can often be a process fraught with tension, resentment, and conflict. Therefore, this type of litigation has the potential to create deleterious psychological effects not only on the parents involved in the custody dispute, but also on their children. It is not automatic, however, that the psychological ramifications of custody proceedings must be negative. The forensic examiner can take positive steps towards facilitating and optimizing the outcome of this complex proceeding. The primary intervention is to encourage the parents' understanding of the crucial difference between their marital dispute and their mutual obligation and responsibility towards their children. Once that is achieved, the forensic examiner must also evaluate and understand the children's perspective of the divorce, and then he or she must principally act to protect and promote the best interests of the children. The forensic examiner has the unique opportunity to help forge a new relationship between the parents, one that can potentially ease the transition and future effects of the divorce on the entire family. In this article, potential detrimental effects and ways to minimize their impact will be comprehensively discussed.

Child Custody, Child Psychopathology, Forensic Neutrality

I12 Juvenile Sexual Offenders of Minors

Giuseppe Troccoli, Alexsandra Stramaglia, and Roberto Catanesi, MD, PhD, Criminology and Forensic Psychiatry Section, Policlinico - Piazza Giulio Cesare, Bari, 70100, Italy*

After attending this presentation, attendees will understand some useful data on socio-demographic and psychopathological characteristics of the juvenile offenders

This presentation will impact the forensic community by presenting a demographic, psychological, and criminal behavioral profile of juveniles arrested for sexual offenses against other minors, and comparing these findings to the known literature on this population.

This study examined the files from the Bari (Italy) Juvenile Court trials against minors who committed sexual offences against other minors between 1990 and 2000. Forty-six cases were selected. For each case, information was collected on the offenders' education, occupation, criminal records, social and family background, together with psychological profiles and assessments, relationship with the victims, type of abuse, crime scene, and the way the offence was perpetrated. Moreover, the results shown in this study also take into account the specialized literature on this subject.

Sexual Offense, Minors, Court Files

I13 Video Games and Violence: Is There a Connection?

Gagan Dhaliwal, MD, 1110 Montlimar Drive, Suite 560, Mobile, AL 36609*

After attending this presentation, attendees will gain knowledge of violence depicted in popular video games by learning the impact of violence on children and juveniles exposed to video games, the use of exposure to violence in video games as a defense in criminal responsibility cases, and the liability of the video game industry in civil cases in context of certain violent incidents.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of considering impact of violence in video games in context of violent incidents, reviewing the legal issues related to use of violence in video game as defense in criminal cases, and studying the liability of video game industry in civil cases.

Some attorneys have tried to use impact of violence in media to excuse criminal responsibility in cases of murder and other crimes. In a similar vein, recently, violence in video games has raised the possibility of using it as the cause of a certain violent acts.

The school killings at Columbine brought this issue to the forefront when the two shooters, were found to be obsessed with a violent video game called "Doom." Some speculated that this obsession with video games was responsible for the shootings.

Recently Britain's biggest electronics chain, Dixons, has pulled the violent video game "Manhunt" from its shops after claims that it sparked the murder of a 14-year-old boy by a friend. Censorship officials in New Zealand banned the game six months prior. This has sparked debate throughout Britain's press as to whether violent video games can influence behavior, and thus whether they should be controlled, or even banned.

To this day, academicians and researchers debate about whether video games make children and adolescents more aggressive. The debate reflects a divide in the way people perceive games. Are games harmless, perhaps even cathartic, as many people who grew up playing them believe? Or are they teaching kids to be more aggressive, and in extreme cases, to kill?

The presentation will include depiction of violence in video games and its impact on adolescents and young children. Various aspects of psychiatric evaluation in a forensic setting of an individual with exposure to violent video games will be delineated.

It will discuss the available data including recent studies that found that video games can increase aggressive thoughts, feelings, and behavior because they are interactive and engrossing. Additionally, other contradicting theories including that these studies confuse cause with effect and that aggressive children may simply prefer violent games. Furthermore, research that these games are beneficial in increasing hand-eye coordination, faster reflexes, and learning skills will be reviewed.

It will try to answer the following questions: Do these games which reward points for brutally murdering their victims send the wrong message and desensitizes them to violence? Does it suggest that violent behavior is acceptable and reinforces evil killings? Are these beneficial in venting out some anger and aggression in a harmless way and preventing real violent acts?

The presentation will also include the description of the video game industry's five ratings for games - adult only, mature, teen, everyone, and early childhood and how a psychiatrist in clinical settings can educate parents and young patients to find games with suitable content.

Finally, it will address whether the age of the child matters when considering the impact of the violence in video games. Research has shown that younger children are more suggestible and impressionable.

The presentation will end with a conclusion whether these can be solely responsible for a criminal act or these should be considered as a part of a violent society where aggression is so commonplace we don't even think about it any more.

Video Games, Violence, Juvenile

I14 Physician Participation in Executions

Abraham L. Halpern, MD, 720 The Parkway, Mamaroneck, NY 10543; and John H. Halpern, MD, Alcohol & Drug Abuse Research Center, McLean Hospital, 115 Mill Street, Bellmont, MA 02478-9106*

After attending this presentation, attendees will know what actions are prohibited and what actions are allowed by the code of medical ethics in connection with the execution of death row inmates.

This presentation will impact the forensic community and/or humanity by helping physicians in death penalty jurisdictions adhere to the code of medical ethics' canon against participation in executions.

More than 740 persons have been executed in the United States by lethal injection over the past 25 years. Notwithstanding the codes of ethics of the American Medical Association and the American Psychiatric Association prohibiting participation in legal executions, physicians have indeed participated, in one way or another, in most, if not all, of these cases. Actions not allowed, i.e., actions that constitute participation in executions are: 1) selecting fatal injection sites; 2) rendering of technical advice regarding executions; 3) starting intravenous lines as a port of a lethal injection device; 4) prescribing or administering pre-execution injection drugs or their doses or types; 5) inspecting, testing, or maintaining lethal injection devices; consulting with or supervising lethal injection personnel; 6) monitoring vital signs on site or remotely (including monitoring of electrocardiograms); 7) performing medical examinations during the execution to determine whether or not the prisoner is dead; 8) attending, observing or witnessing executions as a physician; and 9) treating an incompetent-to-be-executed death row inmate to render him competent unless a commutation order is issued before treatment begins.

Given that many state laws preclude the disciplining of participating physicians on the grounds that participation in executions is not considered the practice of medicine and that in no instance has a participating physician been disciplined by a medical society, it is the view of the presenters that nothing less than abolition of capital punishment can bring to an end the unethical participation of physicians in executions. Nevertheless, since it is incumbent on all physicians to abide by the code of medical ethics, they should be knowledgeable about the canon against participation in legally authorized executions and the specific prohibited actions that constitute participation.

Death Penalty, Physician Participation, Legal Executions

I15 Ethical Consideration in Working with the Capital Murder Defendants: Perspective from the Defense Lawyer, Forensic Evaluator, and the Bench

Scott A. Bresler, PhD, Bridgewater State Hospital, 20 Administration Road, Bridgewater, MA 02324; Joseph P. Raspanti, JD, 3900 North Causeway Boulevard, Suite 1470, Metairie, LA 70002; and Leon A. Cannizzaro, JD, 4th Circuit Court of Appeal, 410 Royal Street, 3rd Floor, New Orleans, LA 70130-2199*

After attending this presentation, attendees will understand the ethical ramifications and pitfalls of working as an expert witness in a capital murder case, and will understand the nature of working collaboratively with a defense attorney as a mental health expert (sometimes both parties have competing agendas).

This presentation will impact the forensic community and/or humanity by proving to be a fascinating presentation and discussion about death penalties cases and the challenges of working with defendants who may be fully invested in using the State as a proxy for their own death.

The goal of this presentation is to present to the forensic community through case example the complex considerations and dynamics between defense attorney and expert witness, in this case, a forensic psychologist hired by the defense attorney

This presentation will begin with a description of an actual legal case; a quadruple homicide perpetrated in Louisiana, a capital murder case with possible (and likely) death penalty implications. It is the case of familicide resulting in the death of 3 children and the female spouse, perpetrated by the biological father/husband. The defendant insisting that his legal defense attorney do everything possible to ensure that he gets a death penalty conviction makes legal representation difficult. That is, the defendant is fully committed to dying and wants the state to be his proxy for his own death. The defense attorney struggles with his mandate to defend his client while the defendant has no vested interest in his own defense. A defense expert, forensic psychologist, is called in to evaluate the defendant's competence to stand trial, mental state at the time of the alleged killings, and any other relevant mitigating factors. "What kind of a defendant would want no defense at all, possibly leading to the death penalty," the defense attorney asked; the defense attorney questioned his own client's adjudicative competence. From the outset, the forensic evaluator must be vigilant for signs of malingering. However, this kind of malingering is quite different from that normally encountered in ordinary forensic evaluations of criminal defendants. In this case, it is suspected that the defendant was purposefully "faking good," that is, trying to look "quite normal" so that a mental health defense (e.g., insanity) would not be a viable defense strategy. The insanity defense would keep him from dying, contrary to his wishes. Yet, the defendant also appeared to simultaneously present as "faking bad." That is, he appeared to exaggerate psychopathic characteristics so that he would look like a "cold blooded killer" making it more likely that the state would fulfill his stated aims, killing him by lethal injection.

The defendant begrudgingly agreed to a forensic psychological evaluation. When the evaluation was completed, the results were presented to the defense attorney who, upon great deliberation, decided not to use the defense expert's findings. Then another unusual set of circumstances arose posing difficult ethical issues for the forensic psychologist and a legal challenge for the defense attorney. Specifically, the prosecution insisted that since the state helped pay for the defense expert's evaluation (the defendant was seen as partially indigent), they were entitled to the defense expert's findings. The defense attorney argued against this citing "no legal precedent." However, the Judge ruled that the results of the evaluation should be handed over to the prosecution. The forensic psychologist consulted with colleagues, and then wrote a letter of protest to the defense attorney, which was forwarded to the judge. In turn, a whole new set of ethical issues emerged including limitations of confidentiality and privilege, and concerns about how such information (the forensic evaluator's findings) may be misused.

Following the case presentation from both a legal defense attorney's perspective and forensic psychologist (the defense expert witness), a panel discussion will ensue with an added view from the judiciary. The Honorable Leon Cannizzaro, Judge in the Louisiana Fourth Circuit of Appeal (with many years of experience on the bench in Orleans Parish as a criminal court judge) will facilitate a follow-up discussion with emphasis on Louisiana law, its uniqueness, and how a judge steers through a minefield of potential legal and ethical quandaries in a case such as this.

Ethics, Capital Murder, Forensic Psychological Evaluation

I16 Post-Doctoral Training in Criminal and Investigative Psychology: Developing a Structured Curriculum

Linda S. Estes, PhD, Nancy A. Slicner, PhD, and James K. Poorman, MFS, Air Force Office of Special Investigations, AFOSI HQ/DOOG Criminal Investigations, 1535 Command Drive, Suite AB 309, Andrews AFB, MD 20762*

Attendees will learn about the unique training requirements for psychologists functioning primarily as consultants to law enforcement, and will be presented with a proposed curriculum for training criminal and investigative psychologists at the post-doctoral level.

This presentation will impact the forensic community and/or humanity by highlighting the emerging subspecialty of criminal and investigative psychology and the unique skills and experiences required to serve as psychological consultants to law enforcement. The outlined post-doctoral curriculum can serve as a springboard for further discussion and development of advanced training to prepare psychologists to serve as consultants to law enforcement.

Most forensic psychology programs, although providing excellent training, are focused on conducting research and preparing psychologists to function as expert witnesses in the courts. Increasingly, psychologists and other behavioral specialists are serving in a different forensic capacity - as consultants to law enforcement in the conduct of investigations. This consultation encompasses much more than the popularized notion of "criminal profiling," and includes advising on interview strategies, dealing with victims and families, and assisting in generation of leads for challenging cases. To distinguish this role from "traditional" forensic psychology, the terms "criminal psychologist" and/or "investigative psychologist" have been coined. To function adequately as a criminal and investigative psychologist requires understanding the roles, responsibilities, and limitations of law enforcement, the techniques and investigative strategies used by law enforcement agents, and the ways in which psychological techniques and research can be integrated into investigations. Furthermore, the psychologist needs to understand the specific culture of the law enforcement agency to which s/he is consulting, and must gain acceptance as a member of the law enforcement team.

The Air Force Office of Special Investigations (AFOSI) is a military law enforcement agency with multiple missions, including felony-level criminal investigations. Historically, AFOSI has utilized criminal and investigative psychologists to consult on cases, provide agent training, and assist command with personnel issues. For a time, AFOSI policy provided for the selection of a few AFOSI agents to attend graduate programs in psychology and then return to the organization as criminal and investigative psychologists. The main advantages of this process consisted of having psychologists who were also experienced law enforcement agents and who were known and accepted by AFOSI agents in the field. The disadvantages, however, included large investments of time and money to send individuals through lengthy graduate programs, only to have them serve the organization for a few years before separating from service or moving to other assignments. In 2000, the Air Force and AFOSI instituted a new process: a two-year Post-Doctoral Fellowship in Forensic Psychology, aimed at training a few Air Force clinical psychologists to serve as

consultants to AFOSI. The first post-doctoral fellow completed training in 2002 and continues to serve as a consultant to AFOSI; the second post-doctoral fellow began training in August 2004. This presentation will summarize the AFOSI post-doctoral training program, which seeks to combine selected courses from law enforcement training with supervised case consultation and grounding in theory and research drawn from forensic psychology and other forensic sciences. The challenges of creating an adequate curriculum will be discussed, including identifying the appropriate areas of emphasis and devising means to measure learning and performance to optimize the educational experience.

(Disclaimer: The opinions expressed are those of the authors and do not reflect official views or policy of the United States Air Force or the Department of Defense.)

Criminal/Investigative Psychology, Forensic Psychology, Post-Doctoral Training

I17 Malingering Mental Illness: Barriers to Detecting Feigned Symptoms

Jason E. Hershberger, MD, and Steven Ciric, MD*, New York University School of Medicine, 15 West 12th Street, #1C, New York, NY 10011*

After attending this presentation, attendees will be able to appreciate the factors that lead to the under-diagnosis of malingered mental illness in forensic examinations.

This presentation will impact the forensic community by describing the challenges for mental health experts in making the diagnosis of malingered mental illness.

The talk will outline the basic fundamentals of malingering and its detection. There will be presentations of malingering patients from civil and criminal settings and an explanation of how the diagnosis of Malingering was made. Finally the presentation will discuss motivations of evaluated persons, advocates, custodians, and even forensic psychiatric experts themselves that can become barriers to the correct diagnosis of the forensic evaluation.

Malingering, Diagnosis, Motivation

I18 The Forensic Neuropsychiatric Developmental Analysis of Spy Robert Hanssen

Mohan Nair, MD, 5212 Katella, Suite 106, Los Alamitos, CA 90720, and J. Arturo Silva, MD*, PO Box 20928, San Jose, CA 95160*

After attending this presentation, attendees will learn about a neuro-psychiatric developmental approach developed to optimize understanding of serial criminal behaviors from a comprehensive biopsychosocial perspective. The case of Robert Hanssen will be presented to highlight this approach.

This presentation will impact the forensic community and/or humanity by assisting forensic mental health professionals, law enforcement, and attorneys/judges to understand serial criminal behaviors from a psychiatric-legal as well as a neuro-psychiatric developmental perspective.

In 2001, 57-year-old Robert Hanssen, former FBI counterintelligence agent, pleaded guilty to espionage and was eventually sentenced to life in prison. He had a long history of spying for the Soviet Union and later the Russian government. His spying activities are considered amongst the most damaging sustained by the United States in modern history. He was a politically and religiously conservative man, and apparently a devoted father and husband.

Both psychiatrists and members of the intelligence community examined Robert Hanssen, but no credible diagnosis has publicly emerged. Hanson has been described as eccentric, aloof and rigid, as well as a "loner" who was possessed of a rich and unusual fantasy life. In his childhood and adolescent years he was described as, oddly dressed, odd looking, intolerant of change and, secretive. He was generally seen as a high school student with poorly developed social skills but proficient in science and math. Hansen had an obsessive-like interest in ham radios, the 50's equivalent of computers. In his later college and adult years he was described as brilliant, aloof, socially inept with noticeable oddness of clothing and demeanor.

He is reported to have had an excellent memory and an obsession for detail and precision. His speech is reported as pedantic, monotone, and narrowly focused in content. He reports dealing with social situations with rehearsed stories and conversations. Hanssen sought to be in secretive organizations such as the FBI and the Catholic Opus Dei but remained noticeably marginal in his interpersonal connections within these organizations. He developed highly compartmentalized repetitive and intense interests that included computers, espionage, religion, and unusual sexual interests.

Some observers have suggested that Hanssen suffered from antisocial and narcissistic character pathology. Other suggested diagnoses have included dissociative identity disorder, obsessive-compulsive disorder and impulse control disorder. In this presentation, information on Robert Hanssen will be explored that is currently available in published sources including information on the Internet. The authors propose that none of the will elaborate on why most of the previously considered diagnoses can adequately explain Robert Hansen's psychopathology and subsequent spying activities.

In this presentation the Neuropsychiatric Developmental Model will be used a paradigm that evaluates serial offensive behavior from a biopsychosocial perspective. The Neuropsychiatric Developmental Model consists of five parts of which its neuro-psychiatric developmental/neuropsychiatric component is its most important aspect. The other components of the Neuropsychiatric Developmental Model are sexual psychopathology, aggressive psychopathology, and psychopathy and ecological factors, especially stress. Available published information will be used in order to arrive at a tentative multi-axial DSM-IV-TR diagnosis and will attempt to link his psychopathology to the origin of his spying behavior. Lastly we will briefly address the issue whether Hanson could have been detected earlier. First, the authors will focus on the question of whether the intelligence community should be able to prescreen or identify vulnerable individuals within their ranks. Second, they will briefly discuss if 21st century espionage, with its increasing reliance on technology, is more likely to draw individuals such as Robert Hanssen. Third, the role of psychological, neuropsychological and neuro-psychiatric techniques to help identify vulnerable individuals in potentially sensitive positions will be briefly covered.

Forensic Neuropsychiatry, Developmental Disorders, Espionage/National Security

I19 Did Robert Stroud Suffer From Asperger's Disorder?

J. Arturo Silva, MD, PO Box 20928, San Jose, CA 95160; Gregory B. Leong, MD, Center for Forensic Services, Western State Hospital, 9601 Steilacoom Boulevard, SW, Tacoma, WA 98498-721; and Michelle M. Ferrari, MD, Division of Child and Adolescent Psychiatry, Kaiser Permanente, Santa Clara, CA 95110*

After attending this presentation, attendees will learn the basic diagnostic characteristics of Asperger's Disorder; and will also learn about the potential relation between autism spectrum psychopathology and criminal violent behavior.

This presentation will impact the forensic community and/or humanity by introducing neuro-psychiatric-developmental approaches in the evaluation of individuals who present with high functioning autism associated with serious violent behaviors.

Robert Stroud, better known as "the Birdman of Alcatraz," became one of the most famous prison inmates in the United States during the twentieth century. He was initially incarcerated when he was 19 years of age after killing a man. He remained incarcerated for the rest of his life. In 1962, one year before his death, the major motion picture "Birdman of Alcatraz" helped consolidate his image as a man whose life and personality highlighted the evolution, complexities, and contradictions of the penal system in the United States. However, the portrayal of Stroud by the media and the justice system and psychiatry has led to a confusing and distorted appreciation of this complex, enigmatic, and tragic figure. Psychiatrists have fared no better in this regard by providing conflicting diagnoses ranging from psychosis to a psychopathic personality. Even the term "Birdman of Alcatraz" has unfortunately served to further confuse Stroud's life. In fact, most of Stroud's work in the field of ornithology took place during his stay in the federal penitentiary at Leavenworth, Kansas.

In this presentation, a psychiatric diagnostic analysis of Robert Stroud will be provided by using information limited to published sources of information, including internet based information. In this presentation the authors will use a neuro-psychiatric developmental model, a paradigm that takes into account five areas. These components include the following: 1) neuro-psychiatric developmental components, 2) psychopathy, 3) psychopathological aggression, 4) sexual psychopathology, and 5) lifetime stressors. With regard to the neuro-psychiatric developmental component, Stroud qualified for DSM-IV-TR Asperger's Disorder, a form of high functioning Autism Spectrum Disorder. Autism Spectrum Disorders have strong neuro-psychiatric and genetic bases.

With regard to qualitative impairments in social interaction, Stroud manifested a serious failure to develop peer relationships appropriate to developmental level. While he had a well-developed capacity to approach others, his interactions with them were superficial and often manipulative in nature. His conversations with others were strongly characterized by one-way communication in which Stroud engaged in a monologue and the other person was for the most part relegated to listening. Essentially, he was not interested in the other person's mental life unless it directly related to his own immediate experience. Therefore, he manifested a serious lack of social and emotional reciprocity.

With respect to restricted, repetitive, and stereotyped patterns of behavior, interests, or activities, he manifested an encompassing preoccupation with several highly restricted patterns of interest that were abnormal either in both intensity and focus. This is highlighted by his interest in avian biology and medicine, an interest that brought him fame and lasting recognition. However, this very same interest came with a level of pathological rigidity and difficulties in recognizing his limitations. Moreover, this interest was associated with a lack of care for his own self and a disregard for the humanity of others. He recognized that he had a great appreciation for birds but not for humankind. He displayed hypochondriacal symptoms. For example, he adhered to unusual diets and demanded bizarre treatments for imagined illnesses. At the same time, he had little respect for the medical background of the prison medical staff. He manifested an impressive ability to deconstruct physical objects for which he had a focused interest. This gift brought a remarkable ability to describe avian anatomy. His explorations of the gross anatomy of canaries and similar birds continue to command the respect of contemporary ornithological experts. He had an impressive aptitude in the mathematical and engineering areas. He was mechanically gifted.

His autistic disturbance caused clinically significant impairment in social areas primarily because he was unable to interact with other human beings in a balanced give-and-take manner, and because he gravitated to interactions with birds or felt most comfortable with subjects that involved analytic precision and description and that did not tax his serious deficits with empathy when dealing with others. His inability to accept other points of view led to serious interpersonal conflicts and may have been partially responsible for his lethal attack on a prison guard. There was no clinically significant general delay in language abilities. His cognitive development was associated with age-appropriate self-help skills, adaptive behavior and substantial curiosity with his environment. Although Stroud once pled not guilty by reason of insanity in the homicide case involving the prison guard, there was little evidence that he ever suffered from a major mental disorder.

On Axis II of his psychiatric diagnosis, Stroud qualified for a Personality Disorder NOS (not otherwise specified) with Schizoid, Schizotypal and Narcissistic Personality Disorder traits. Schizoid Personality Disorder is often indistinguishable from Asperger's Disorder. He also qualified for a Paranoid Personality Disorder. Since childhood, he had displayed a significant number of psychopathic traits. He tended to be rigid as well as persistent in his thinking and behavior and frequently could not discern at what point his relentless persistence had ceased to be of any value in coping with life's challenges. Rather, he would frequently retaliate against those who disagreed with him by becoming verbally hostile, manipulative and even violent when his world view was challenged. In addition, he had a longstanding sexual attraction to prepubescent and barely pubescent males. There is also evidence that he enjoyed a life of coercive sexual fantasies. However, there is no evidence that he ever sexually attacked other people. He was the victim of sexual abuse when he was a child, though when asked he denied that this experience had been stressful or otherwise negative. His life in prison was, not surprisingly, associated with numerous serious stressors. However, both his personality and the prison system, contributed to his highly stressful life experiences. A neuro-psychiatric developmental analysis of Robert Stroud reveals that optimal understanding of his crimes and intellectual accomplishments must take into account his autistic as well as his psychopathic psychopathology.

Autism, Violence, Forensic Psychiatry

I20 Pure Persecutory Delusions and the Law

Alan R. Felthous, MD, and Angeline Stanislaus, MD, SIU School of Medicine, Chester Mental Health Center, PO Box 31, 1315 Lehmen Drive, Chester, IL 62233-0031; James K. Wolfson, MD*, U.S. Medical Center for Federal Prisoners, Mental Health, 1900 West Sunshine, Springfield, MO 65807; and William H. Reid, MD*, PO Box 4015, Horseshoe Bay, TX 78657*

The goal of this presentation is to outline critical issues that arise with defendants who suffer from pure persecutory delusions; to summarize the views of courts and amici organizations with respect to these issues; to provide an update on recent developments in the *Sell v. United States* landmark case; and to offer practical guidance on conducting risk assessments for individuals with pure persecutory delusions.

This presentation will impact the forensic community and/or humanity by bringing greater understanding regarding individuals who present some of the most compelling challenges for the mental health system and the criminal justice system. It will bring critical issues into focus and then address them by analyzing the views of courts and amicus organizations and by providing guidance on assessing the risk of violence in this significant, but ill understood population of afflicted individuals. Hopefully, the presentation will advance the discussion in these areas, leading eventually to greater, rational consistency in clinical and legal applications.

Dr. Felthous will provide an overview of critical issues presented by criminal defendants who suffer from pure persecutory delusions. Although psychotic, such individuals may successfully conceal their delusional thinking from the fact finder. The range of paranoid disorders: paranoid personality disorder to delusional disorder, persecutory type, to schizophrenia, paranoid type is a spectrum wherein the specific disorders are not always crisply distinguishable. The individual who is exceedingly vexatious and litigious by nature can appear remarkably similar to an individual with a delusional disorder, persecutory type, yet the clinical difference is one of psychotic dimensions. There is a dearth of clinical research on the

nature of such disorders and their most effective treatments. The jurisprudence is ambiguous and self-contradictory regarding issues such as when individuals with delusional disorder can be forcibly medicated to restore their competence to stand trial. Because the purely deluded individual's intellect is otherwise intact, he or she will demonstrate a sufficient understanding of the proceedings and may even be able to present a semblance of rationality while his behavior is driven by the irrationality of his delusions.

Dr. Stanislaus will summarize the views of the United States Supreme Court, other courts and amicus organizations regarding the nature of pure persecutory delusions and their amenability to psychotherapeutic and pharmacotherapeutic treatments respectively.

Dr. Stanislaus will also explain the differences in emphasis on various interests involved in enforced medication for restoration of competency and the substantially different procedures and criteria recommended by these amici. She will discuss how courts consider these factors when deciding whether to support enforced treatment for restoration of competence. Interestingly the amicus briefs to the United States Supreme Court regarding *Sell* by the American Psychiatric Association and by the American Psychological Association respectively came to opposite positions with regard to the therapeutic efficacy of psychotherapy and of pharmacotherapy for delusional disorder.

Dr. Wolfson, who has been involved with the *Sell* case from the beginning, will provide an update on the outcome of Dr. Sell since the landmark case *Sell v. United States*, wherein the United States Supreme Court provided guidelines for determining whether a patient's treatment refusal should be overridden to enforce treatment for restoration of competence. Since the *Sell* decision, the legal and clinical case of Dr. Sell has undergone further unexpected twists and turns, the details of which should be instructive. Dr. Wolfson will also describe how the *Sell* decision affected the treatment of other similar defendants found incompetent to stand trial who have been sent to the United States Medical Center for Federal Prisoners in Springfield, MO.

The assessment of dangerousness is relevant to several legal issues, including civil and criminal commitment, punishment, and court-enforced medication. Although violence risk assessment has been studied in many settings, empirical research on violence associated with delusional disorders per se is virtually nonexistent.

Dr. Reid will suggest practical approaches for conducting risk assessments in individuals who suffer from relatively pure persecutory, grandiose, or religions delusions, carefully separating behavioral prediction from risk. He will discuss the likelihood of associations between delusional content and violence risk, and how other factors - such as frank psychosis, recognition of delusions by others, delusion-congruent social or religious setting, additional psychiatric or substance abuse problems, or psychiatric treatment - may increase or decrease risk.

Paranoid Disorders, Persecutory Delusions, Competence to Stand Trial

Questioned Documents

J1 The Copying and Replication of Original Wet Seal Stamps

Robert G. Gohl, MFS, and Troy Eberhardt, BS*, Forensic Document Laboratory of Immigration & Customs Enforcement, 8000 Westpark Drive, Suite 325, McLean, VA 22102*

After attending this presentation, attendees will understand the difficulties in identifying copied genuine wet seal impressions from the genuine impressions being copied.

This presentation will impact the forensic community and/or humanity by pointing to the difficulties associated with identifying wet seal impressions even if the document examiner has the original stamp that made the impression.

The purpose of this presentation is to illustrate the difficulties and limitations associated with the examination and authentication of wet seal impressions. Document examiners are already being challenged to differentiate between original and counterfeit wet seal impressions due to the variety and lack of unique detail associated with the manufacturing process of wet seal impressions.

Wet seal impressions are still being widely used and affixed to numerous official government travel documents around the world. In the United States new technological enhancements of security features have largely replaced wet seal impressions as an authenticating device.

This paper will try to demonstrate, through the use of simple and inexpensive methods, that original wet seal impressions can be copied and then replicated with enough unique detail so that they cannot be differentiated from the original wet seal impression.

Replication, Copying, Wet Seals

J2 Warning Statement on Plastic Bags: A Useful Characteristic During the Examination

Lorie L. Gottesman, MSFS, and Meredith A. DeKalb, MFS, Federal Bureau of Investigation, Laboratory Division, 2501 Investigation Parkway, Quantico, VA 22135*

Attendees will learn how to use this class characteristic found on many plastic bags to streamline the examination and comparison process.

This presentation will impact the forensic community and/or humanity by providing forensic examiners with a class characteristic to streamline the examinations and comparisons of plastic bags.

In October 2002, a triple homicide and robbery occurred in Georgia. Early in the investigation, seven trash bags were recovered from a dumpster that contained personal property of the victims that was believed to have been taken during the commission of the crime. Shortly thereafter, a suspect was apprehended and during the search of his vehicle, a box of trash bags was located.

An examiner at the FBI Laboratory was requested to compare the bags from the dumpster to the box of bags recovered from the suspect's vehicle. During this examination, the examiner was able to streamline the examination and comparison by utilizing the cautionary statement stamped on the bags. In the past, this feature was only seen occasionally, but in this day and age, this class characteristic is becoming more and more prevalent.

Plastic Bag, Warning Statement, Class Characteristic

J3 Fragment Stack Analysis Techniques for Efficient Reconstruction of Ripped-Up Documents

Patrick De Smet, PhD, Ghent University, Department TELIN/TW07, Sint-Pietersnieuwstraat 41, Ghent, B-9000, Belgium*

This presentation will demonstrate several guidelines and (computer-assisted) techniques that can enable a more efficient reassembly procedure for recomposing multiple stacks of recovered ripped-up document fragments.

This presentation will impact the forensic community and/or humanity by developing and discussing formal guidelines that can aid in faster reassemby of ripped-up documents.

When ripped-up documents are recovered at a crime scene, manual reassembly of the fragments can be a very time consuming task. Automatic and semi-automatic techniques have been and are being studied in order to reduce the complexity of this "jigsaw puzzle" problem, but currently such an automated reassembly process often still needs manual intervention and correction.

Hence, recent research has explored other possibilities for deducing more structured procedures and guidelines for reassembling recovered stacks of ripped-up document fragments. More specifically, the authors have investigated how a piece of paper is typically ripped-up and how this process can be reversed by discovering the subsequent ripping steps that were used. Obviously, it is assume that the stacks of fragments have been collected without disturbing their original and relative ordering or positioning relationships.

As it turns out, (sets of) fragments are often stacked on top of each other while a document is being ripped-up. Hence, by using a formal search procedure for matching fragments from the different substacks back together, ripped-up documents can be quickly reassembled. Obviously, the numbering indexes that separate the different substacks are unknown when the matching process is initiated, but after successfully matching some of the fragments together, the substack boundaries can easily be deduced and the subsequent matching process can be speeded-up further. The approach turns out to be quite efficient when compared to an often random search procedure as would typically be used by any inexperienced person reassembling a ripped-up document.

First, researchers studied the analysis and the reconstruction of several real but "ideal" stacks of fragments. As an example the following case can be considered. Suppose a person decides to rip-up a single page of a document. This person first rips the page in half. The two resulting fragments are stacked on top of each other and the stack is then torn in two again. This stacking and ripping process is repeated until either the fragments become too small or the physical thickness of the stack inhibits further iterations. Clearly, the final stack will contain 2^i fragments, for i ripping iterations. If a theoretical and small scale example is considered, e.g. for i=3, a binary ripping sequence would yield a stack sequence "1,2" for iteration 1, "1a,2a,1b,2b" for iteration 2, and "1aA,2aA,1bA,2bA,1aB,2aB,1bB,2bB" for the last iteration. The reassembly problem will need to rearrange the fragments "1,2,3,4,5,6,7,8" that are individually positioned on top of a reassembly working surface or desk; the fragments are labeled consecutively here since the ripping sequences, e.g. the a/b and A/B labeling, are still unknown at the start of the reassembly process. The first matching experiment in the proposed reassembly procedure is given by (1,5). Since this would yield a valid matching result, the two fragments can be recomposed into a new fragment "I" that is put on top of a second reassembly desk. Next, researchers match and recompose the subsequent pairs of fragments, i.e. (2,6), (3,7), and (4,8). This yields the new fragments II, III and IV that are also put on top of the second reassembly surface. The entire procedure can now be repeated for the new set of fragments, etc.

Next, more complex reassembly and matching processes were reviewed by considering and introducing real-life problems such as: (i) uncertainty of the ordering of *multiple* substacks that could possibly be recovered independently at a crime-scene: what if one stack of three fragments and one stack of five fragments were recovered at different locations, should the first stack be labeled "1,2,3" or rather "6,7,8," (ii) compensating for missing or (temporarily) unmatchable fragments: what if only seven fragments from the scene were recovered or if a certain fragment would not display any distinctive color, text or shape features, (iii) non-binary ripping iterations: what if a ripping sequence "1,2,3," "1a,2a,3a,1b,2b,3b,1c,2c,3c" would be used, etc. Some of these more specific problems are still being studied further, but researchers believe the most important complications have already been resolved successfully.

Finally, researchers have developed an interactive computer program that helps its user to follow the formal matching rules and guidelines studied and developed. This enables the user not having to memorize or study all the properties and guidelines related to the authors' formal reassembly process.

An important goal of this abstract is to discuss and further interact with other forensic investigators and scientist in order to have research and results evaluated and commented on.

Reconstruction, Ripped-Up Documents, Fragment Matching

J4 Automated Reconstruction of Strip Shredded Documents

Patrick De Smet, PhD, Ghent University, Department TELIN/TW07, Sint-Pietersnieuwstraat 41, Ghent, B-9000, Belgium*

The goal of this presentation is to present an overview on recent research regarding several semi-automatic reconstruction methods for recomposing strip-shredded documents.

This presentation will impact the forensic community and/or humanity by providing more detailed and objective information about automated reconstruction of strip-shredded documents, creating an incentive for further discussion and research

Up until recently, the forensic or investigative reconstruction of shredded documents has always been dismissed as an important but unsolvable problem. Manual reassembly of the physical shreds could always be considered, but for large amounts of shreds this problem would quickly become an intangible task, requiring vast amounts of time and/or personnel. Automated reconstruction methods have recently been studied, but little objective information about these techniques and the results that can be obtained with them, has been made available.

In this research several image processing and computer vision techniques that can be used to reconstruct strip-shredded documents contained within a digital image database are reviewed, proposed, and discussed.

As already indicated above, an important problem for reconstructing a digital database of document shreds is given by the computational burden of the shred matching process that has a complexity order of O(N^2) (with N the number of shreds). Hence, in order to reduce this complexity researchers have investigated the use of several feature based classification and matching steps.

The first processing step was designed to detect and eliminate document shreds that do not contain any valuable feature information; such shreds typically are the result of shredding (partially) blank pages or page margin areas. Additionally, each shred side is examined separately for determining if any reliable cross-shred features can be found; if not, that side of the shred does not need to be considered for further matching.

Next, a single binary feature vector for each shred is determined. These feature vectors contain a binary flag for each horizontal line of pixels on the surface of the shred image, indicating if any foreground colors can be found on that line of pixels. Thus, the feature vector encodes the detection of printed or written character lines and white space areas found within the shredded documents. The information contained within these feature vectors can be stored efficiently using a run length encoding method, and also allows efficient computation of the shred matching costs. This also allows classification of shreds e.g., based on their upper and lower page margins (header and footer detection).

So, by using these and other characteristics the shreds can pre-sorted after which they can be matched more quickly and more accurately using the pre-sorted classification data of the shreds. To determine these last sets of accurate matching costs, color based feature vectors are used that are computed for each pixel along each side of the full-length contours of the shreds.

The last step that discussed is the actual reassembly of the different shred images on top of a common image canvas. This requires an accurate determination of the translational and rotational repositioning parameters of all the shreds.

Obviously, the proposed algorithms are discussed with several matching and reconstruction results obtained for a real shred database containing various types of shredded document pages.

Finally, the impact of these findings on secure document management strategies and the possibilities for applying these techniques within the context of forensic and investigative applications are briefly discussed.

Reconstruction, Shredded Documents, Digital Image Processing

J5 A Study of Business Letter Features

Sandra Ramsey Lines, BA, 6200 East Cholla Lane, Paradise Valley, AZ 85253; and Randy Carodine, BA, Houston Police Department, 1200 Travis, 1011A, Houston, TX 77002*

The goal of this presentation is to assist the Forensic Document Examiner community with identifying features in word processed letters that are common and sometimes rare.

A literature review found no research that dealt with specific features in word processed letters that were considered common (class characteristics) or uncommon (individual characteristics) by the forensic document examiners. This presentation will impact the forensic community by providing a basis for making such determinations.

As part of their work, forensic document examiners examine word processed letters. The purpose of this study, the first of its kind, was to determine how common or rare certain features are in word processed business letters and if any of these features could determine the author or source. Initially 114 original business letters were obtained that were dated from 1999 through 2003. The letters originated from 22 different states and the District of Columbia. Specific features of the letters were selected for examination. These features were letter format, type style, the point size of the font, margin spacing to ascertain the use or nonuse of the default margins for Word (1.25 inches non-justified) and the default margins for WordPerfect (1 inch non-justified). In addition, the research involved the examination of the right margins to determine if they were justified or not and the use of the comma or colon in the salutation of the letter. No two letters were from the same source or entity.

The features of each letter were independently examined by the authors and the findings documented. Any differences in findings were discussed and a consensus reached. As expected, several features were found to be very common. For example, full block format was used on 48 percent of the letters followed by the semi-block with 39 percent. The Times Family of Fonts was used on 67 percent of the letters. Font point size 12 was the most popular with 70 percent. The non-justified default margins were widespread with 67 percent and the colon was the overwhelming favorite in the salutation with 79 percent. There were some unexpected findings. The default margins for Microsoft® Word and Novell WordPerfect are 1.25 inches and 1 inch respectively. However, neither was used on 33 percent of the letters and in this 33 percent, the margin spacing

varied dramatically. Other examples of unexpected findings include the use of the space bar 4 times after each period in a sentence on one letter and the use of 16 spaces for indenting paragraphs on another. Indentations on some of the letters did not follow generally accepted format practices or defaults and could be considered unusual. Only one letter contained a semi-colon in the salutation, while two letters were typed using a 13 point font. Some of the unexpected findings could possibly lead to the identification of a source or typist.

Future studies in this area may involve the common or uncommon use of paper and watermarks found in business letters.

Questioned Documents, Business Letter Format, Word Processing

J6 Characterizing Inks From Documents Using HPLC/MS

Roger W. Jones, PhD, Anthony J. Wagner, PhD, and John F. McClelland, PhD, Iowa State University, 107 Spedding Hall, Ames Laboratory, Ames, IA 50011-3020*

The goal of this presentation is to provide details on how liquid chromatography-mass spectrometry may be used to differentiate individual inks of all types (i.e., ballpoint, liquid, and gel) extracted from documents.

Ink analysis within the forensic community is largely limited to imaging under a variety of lighting and filtering settings, and thin layer chromatography. Although these are often sufficient in specific cases, substantially more analytical information is available by HPLC/MS. This presentation will impact the forensic community and/or humanity by discussing the increased information and announcing the start of a library of HPLC/MS data on inks that will be available to the forensic community.

Inks are complex mixtures of dyes, pigments, resins, surfactants, and other additives in a volatile vehicle. Nevertheless, most forensic ink analysis is based principally on the dyes and pigments they contain. This ignores the additional information and the potentially greater power to distinguish one ink from another that the colorless ink components afford. Methods are under development for reliably acquiring high performance liquid chromatography-mass spectrometry (HPLC/MS) data on inks extracted from documents, with the ultimate goal of producing a library of such data so that unknown ink samples may be identified as to manufacturer and pen model by comparison with the library data. HPLC/MS data provide an inventory of both colored and colorless components and their relative abundances in a given ink, so it should be superior to thin layer chromatography in differentiating inks.

A single, 1-mm plug punched from a document is sufficient for extraction and injection onto a column for analysis. Acetonitrile works well for extracting ballpoint inks, but a mixture of dimethylformamide and water is necessary for fluid and gel inks. A C18 microbore column has provided good separation for all ink types when used with a mobile phase consisting of a mixture of water and a 50%/50% (v/v) blend of acetonitrile and methanol at a 5 □L/min flow rate. Formic acid and ammonium acetate are added as a pH stabilizer and as an ion-pairing agent, respectively. A gradient running from 30% to 90% acetonitrile/methanol is used during each run. The HPLC eluent is introduced into a single-quadrupole mass spectrometer by electrospray ionization. This interface results in little or no molecular fragmentation, so the mass spectrometer principally provides the mass of the parent molecule for each component.

Many inks contain similar dyes. For example, the only dyes many black ballpoint inks contain are crystal violet (and its byproducts, methyl violet and tetramethyl para rosaniline) and metanil yellow. Nevertheless, these inks can be differentiated by HPLC/MS both because of the differing relative amounts of crystal violet and its byproducts and because of the colorless components. Colorless components play an essential role in distinguishing pigment-containing inks. Because pigments are particulate in nature, they do not pass through the HPLC column and hence do not contribute to the HPLC/MS results. Such inks can be characterized solely by their colorless components. Resins are particularly helpful components because they generally consist of not just one molecule, but a distinctive series of species with different, equally spaced masses that elute serially from the column. A small library of data on black and blue inks is being built up as a test of the power of HPLC/MS data to differentiate ink formulas. The thirty inks tested as of this writing are all easily distinguishable from one another.

High performance liquid chromatography-Fourier transform infrared spectroscopy (HPLC/FT-IR) is another potential method for distinguishing inks. It is planned that HPLC/FT-IR will be studied. Infrared spectroscopy provides more information on the identity of a pure component than electrospray mass spectrometry does, so HPLC/FT-IR may be a useful complementary technique. A brief comparison of the two approaches will be presented.

Ink, HPLC/MS, Documents

J7 Freeze-Drying Documents Revisited

Gerhard W. Wendt, MS, Pennsylvania State Police, 1800 Elmerton Avenue, Harrisburg, PA 17112*

Attendees will gain an expanded knowledge on the use of freeze-drying as a resource for preserving evidential documents.

This presentation will impact the forensic community and/or humanity by reinforcing the use of freeze-drying as an option for preserving damaged documents.

Despite being a rarely submitted case to the Questioned Documents Section, examiners should still be familiar with the proper preservation and recovery methods for water-soaked documents. In July of 2003, an object appearing to be a checkbook and containing various slips of paper, was submitted to the Pennsylvania State Police Questioned Documents Section for examination in relation to a homicide investigation. The challenge posed by this case involved locating the proper instrument to "freeze-dry" the checkbook and recover its contents for examination purposes. This presentation will review the methods used to successfully recover numerous documents from the checkbook.

Lyophilizer, Freeze-Drying, Water-soaked

J8 Update on a Report Prepared by the American Academy of Forensic Sciences Relative to Needs of Crime Lab and Medical Examiner Community Beyond the "DNA Initiative" in the Field of Questioned Documents

John L. Sang, MS, Sang Forensic Document Laboratory, One Harbor Lane, Glen Head, NY 11545*

The goal of this presentation is to present the status of the "180 Day Study."

This presentation will impact the forensic community and/or humanity by providing the forensic community with information to judge the progress of the "180 Day Study" for funding Forensic Laboratories and Medical Examiners.

The United States Department of Justice, National Institute of Justice, at the direction of the U.S. Senate Appropriations Committee, requested four forensic science organizations: the American Academy of Forensic Sciences, the American Society of Crime Laboratory Directors, the International Association for Identification and the National Association of Medical Examiners to each nominate three persons to assist in developing a plan which will address the needs of the crime labs and medical examiner

community beyond the "DNA Initiative" and report back to the Committees on Appropriations no later that 180 days from the date of enactment of this Act. The report should address the following: (1) manpower and equipment needs, (2) continuing education policies, (3) professionalism and accreditation standards, and (4) the level of collaboration needed between Federal forensic science labs and State/local forensic science labs for the administration of justice.

The nominees from the American Academy of Forensic Sciences are: Ronald L. Singer, MS, President; Edmund R. Donoghue, MD, President-Elect; Barry A. J. Fisher, MS, MBA, Past President, 1998-99.

In response to the request, Barry Fisher prepared an e-mail survey request form title "180 Day Study Questionnaire" and with the assistance of Questioned Document Section Chairman, the questionnaire respondents and other key members of forensic science community data was collected for the report. A report was prepared by the American Academy of Forensic Sciences. This presentation will elaborate on the progress of the study.

Crime Laboratory Needs, Medical Examiner, Funding

J9 Quality-Control Issues in the Production of Travel and Identity Documents: The "Grey Area" of Document Authentication

John J. Ross, MFS, U.S. Immigration & Customs Enforcement, Forensic Document Laboratory, 8000 Westpark Drive, Suite 325, McLean, VA 22102*

Attendees will gain a heightened awareness of quality-control issues and the importance of understanding and identifying these issues when authenticating travel and identity documents.

This presentation will impact the forensic community and/or humanity by heightening awareness of quality-control issues and the importance of understanding and identifying these issues when authenticating travel and identity documents will be addressed.

It has often been stated that the identification of handwriting is not always "black and white." The subjective aspects of handwriting examination result in a "grey area" that is more difficult to discern. A similar grey area can be encountered when examining security documents such as travel and identity documents. This grey area includes quality-control issues in the production of security documents. Awareness of quality-control issues and the importance of understanding and identifying these issues when authenticating travel and identity documents will be addressed. Case studies involving quality-control problems will be examined and lessons learned will be discussed.

Quality-Control, Security Documents, Authentication

J10 The Edge of Light Scanner

Linton A. Mohammed, BSc, San Diego Sheriff's Crime Laboratory, 5255 Mount Etna Drive, San Diego, CA 92117*

After attending this presentation, attendees will be aware of a possible new source of detection of indented impressions of handwriting and sequencing of entries.

This presentation will impact the forensic community and/or humanity by introducing new technology in the area of Forensic Document Examination.

The Edge of Light (EOL) Scanner has been used to look at defects in aircraft wings and bodies. This paper explores the use of the scanner as a possible new tool in Forensic Document Examination for the detection of indented impressions of writing and sequencing of writing impressions and ink strokes.

Document Examination, Indented Impressions, Sequence of Strokes

J11 The Examination of Inkjet Printed Documents—What's on the Frontier

Gerry M. LaPorte, MSFS, United States Secret Service, 950 H Street NW, Washington, DC 20223*

After attending this presentation, attendees will understand current approaches to examining inkjet printed documents by utilizing physical and chemical examinations; and become aware of new technologies that are on the horizon for the analysis of inkjet printed documents.

This presentation will impact the forensic community and/or humanity by demonstrating the practices incorporated at the U.S. Secret Service Forensic Laboratory for the examination of inkjet printed documents and serving as a platform for the introduction and discussion of some new techniques.

With the tremendous popularity of inkjet printers, forensic document examiners are encountering these types of questioned documents more often. The physical and chemical examination of inkjet printed documents can help to associate multiple documents to each other and/or to a suspect printer(s), determine the brand of printer(s), and possibly determine if a document is legitimate with respect to date. The objective of this presentation is to emphasize the importance of conducting examinations using microscopy, the video spectral comparator (VSC), an electrostatic detection device (EDD), and/or thin layer chromatography (TLC). As well, some new ideas will be proposed with the intention of providing forensic document examiners insight into the future of inkjet analyses. These will include instrumental methods such as spectrophotometry, mass spectrometry, and the use of imaging analysis equipment and software.

Inkjet, Printers, Ink Analysis

J12 Passport Examination by a Confocal Type Laser Profile Microscope

Shigeru Sugawara, MS, Takahiko Izuno, MS, and Yoko Seki, MS, National Research Institute of Police Science, 6-3-1 Kshiwanoha, Kashiwa City, Chiba 2770882, Japan*

The goal of this presentation is to measure the film thickness on the paper using a confocal type laser profile microscope, which is nondestructive and precise. The authors will demonstrate usefulness of the confocal type laser profile microscope for passport examination.

The film thickness on the paper using a confocal type laser profile microscope is measured, which is nondestructive and precise. The usefulness of the confocal type laser profile microscope for passport examination is demonstrated.

Three genuine Japanese passports and 26 counterfeit Japanese passports were used. Genuine passports were numbered from 1 to 3. Counterfeit passports were numbered from 4 to 29. The materials of the films on the samples were examined by the ATR-FTIR method. Polyethylene terephthalate (PET) film was used for all genuine passports and 9 counterfeit passports. Polypropylene film was used for 6 counterfeit passports. Polyvinyl chloride (PVC) film was used for 11 counterfeit passports.

The film thickness was derived from the surface profile of the film and the interface profile between the film and the paper measured by the confocal type laser profile microscope (Keyence Co.VF-7500). The surface and interface profiles were measured at four different places for one sample and measured twice at each place.

The thickness was derived by the algorithm that was made with the technical computing language "Matlab." The linear lines were fitted to the profiles by least square methods. The outliers in the profiles were removed iteratively in the program. The distance between the fitted lines to the surface profile and the fitted lines to the interface profiles was regarded as the thickness of the film.

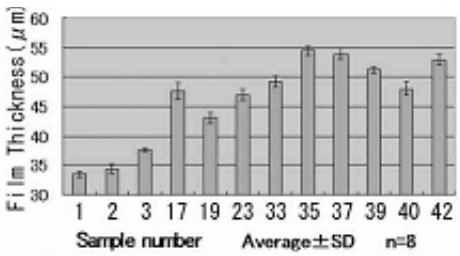

Fig. 1 Thickness of PET films

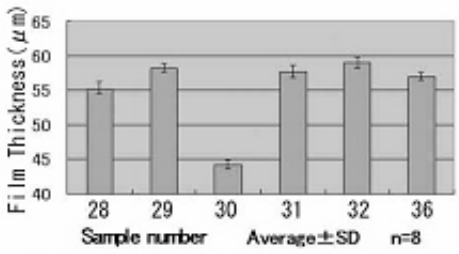

Fig. 2 Thickness of polypropylene films

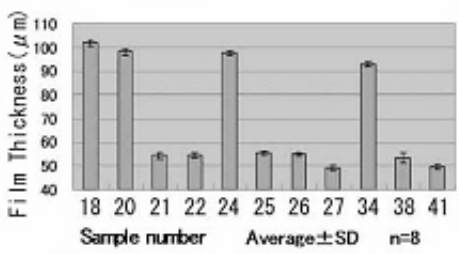

Fig. 3 Thickness of PVC films

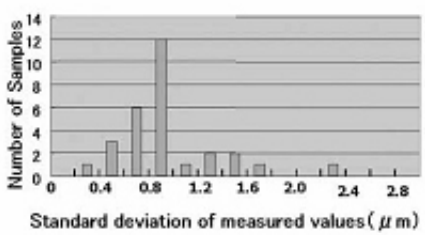

Fig. 4 The accuracy of thickness measurements

Average :0.96μm Maximum:2.28μm

Fig.1 shows thickness of PET films that were used on both genuine and counterfeit passports derived by this method. Error bar shows the standard deviation of eight measurements. Genuine passports and counterfeit passports definitely differ in their films' thickness. It is supposed that this is because thin films are more difficult to be laminated without wrinkles than thick films. The genuine passports and the counterfeit passports that cannot be distinguished by the ATR-FTIR method are briefly discussed. Fig.2 and Fig.3 show thickness of polypropylene films and PVC films that were used on the counterfeit passports. Researchers can find the differences among the counterfeit passports that cannot be found by the ATR-FTIR method. Fig.4 shows a histogram of the standard deviation of eight measurements giving the accuracy of thickness measurements. Most samples could be measured with the standard deviation less than 1?m. The average of the standard deviation was 0.96μm. The maximum value of the standard deviation was 2.28μm.

Tthe film thickness was undesrtuctively measured without peeling the film from the paper by the confocal type laser profile microscope. The thickness of films on Japanese passports with the preciseness about 1μm are briefly discussed. It is concluded that thickness measurement by the confocal type laser profile microscope is useful for passport examination.

Passport Examination, Confocal Type Laser Profile Microscope, Film Thickness

J13 Diary of an Astronaut: Examination of the Remains of the Late Israeli Astronaut Ilan Ramon's Crew Notebook Recovered After the Loss of NASA's Space Shuttle Columbia

Sharon Brown, MS, Questioned Documents Laboratory; and Laser Sin-David, PE, Photography Laboratory, Division of Identification and Forensic Science, Israel Police National Headquarters, Jerusalem, 91906, Israel*

The goal of this presentation is to reconstruct and visualize the handwriting, some completely erased and some visible but fragmented, on a series of highly traumatized documents, using classic and modern document examination methods.

Two months after the fatal re-entering into the Earth's atmosphere of Columbia flight STS-107, remains of Israeli astronaut Ilan Ramon's Crew Notebook were found strewn in a field in San Augustine County, Texas.

The random pile of papers was found to have survived the calamity of the Shuttle's disintegration remarkably well. Most of the papers recovered were only mildly charred around the edges but were torn and/or washed out to varying degrees.

The sheets of paper could be categorized into four groups:

1. Ilan's personal diary, written while in space in black ink and in pencil; the writing on these eight sides of paper survived well and is only missing where the pages were torn. Small fragments found in the field were physically matched to holes in the pages thus locating their original positions in the text.
2. Six sheets of technical preparation notes written by Ilan prior to the mission; the writing on these pages was washed out entirely but much of it was visualized using infrared luminescence.
3. Eight pages of personal notes prepared by Ilan prior to the mission written in blue ink; the writing on these pages was barely visible to the naked eye and not visualized by infrared luminescence, but was made largely legible by digital enhancement photography.
4. A few sides of printed technical information. The paper from these pages will be researched in order to learn how exactly the papers' fibres and makeup were affected by the explosion of the Shuttle.

With the conclusion of examination of the diary from the aspect of reconstruction and deciphering its contents at the Questioned Document Lab, it was transferred to the Paper Conservation Department of the Israel Museum for preservation and strengthening treatments.

Introduction: NASA's Space Shuttle Columbia, flight STS-107, took off from the Kennedy Space Center on January 16th 2003 for a 16-day mission. While orbiting the earth, the seven-man crew conducted a wide variety of experiments and intermittently stayed in contact with earth through email and carefully timed public announcement broadcasts.

On re-entering the Earth's atmosphere on February 1st, the Space Shuttle broke up, most likely as a result of damage inflicted to the space-craft soon after takeoff; all seven crewmembers tragically perished. Two months after the disaster, during extensive searches to recover any material that may have survived the crash, a pile of papers containing Hebrew writing was found in a field in San Augustine County, Texas. Once it had been verified that the pages were relevant to the Shuttle debris, the papers were collected and transported to a storage hangar in Florida before being returned to Ilan Ramon's family. Ilan Ramon's wife decided to bring the papers to Israel for deciphering and ultimately, conservation.

Although the whole pile of paper had presumably suffered the same traumatic conditions of highly elevated temperatures when the Shuttle exploded, plus the approximately -60°C atmospheric temperature at the altitude where it broke up and then at least several days of wet weather during February and March, the papers showed a diversity of damage and could be split into four groups.

The first group comprising eight sides of paper (four pages written in black fluid ink and four sides of paper in pencil) were torn to varying degrees but were barely charred and did not show any signs of water damage to the writing although the ruled lines on the first three pages were totally washed out. These pages constituted Ilan's personal diary, written while in space and were readily legible where not torn.

The second group consisted of six pages of water-damaged paper – the blue ruled lines were very blurred and no writing remnants were visible to the naked eye; the paper was slightly charred along the edges, but not torn to the extent of the first group.

The third group had very faintly visible remnants of writing in blue ink – enough to tease the eye in seeing that something had been written there, but nowhere near clear enough to decipher the content. The paper was slightly charred along the edges, slightly torn, and slightly water damaged.

The fourth group of pages contained printed technical information. No reconstruction work was required here in order to read their content but these pages will be examined to learn more about the effects of the explosion of the Shuttle on the papers' makeup.

Remarkably, the writing on the first three groups of paper was ultimately visualized using three different methods commonly used for questioned document examination. In other words, what worked well for one group was ineffective for another.

It should be noted that there is no information available as to where the pages of the Crew Notebook were situated during reentry, for example if they were in a pocket of Ilan's spacesuit or in a padded, heat resistant container or simply held under his leg (as suggested by one astronaut).

Examination: When the diary was handed over for examination, it was stressed that its contents were to be kept well guarded and secret, as they were the personal property of Ilan's family. In order to conform to this wish, the author had hoped to delve as little as possible into the content of the diary and stick to piecing together the fragments like a puzzle. However, it was soon realized that in order to attain any measure of success, it would be necessary to become totally familiar with Ilan's handwriting style and become immersed in the content of the diary so as to be able to anticipate the words or letters that were missing in the hope of finding them amongst the ink deposits on the curled and twisted fragments.

All of the handwritten pages received for examination had three punched holes along the margin and were of similar size. Several of the pages were still "bound" by three partially melted plastic-coated rings. A sample "Crew Notebook" received from NASA was found to match most of the pages received for examination both in size and format. Some larger folded pages were also found amongst the pile of papers containing Ilan's handwriting.

The first group of papers consisted of eight sides of clearly visible handwriting. The first four pages were written with black fluid ink that penetrated to the reverse side of the paper, most probably from a Sharpie® extra fine marker.[1] The last two pages were written on both sides of the paper, in pencil. These were the pages of Ilan's personal diary, written in space. The chronology of the diary's pages was determined by their content. The paper of the diary's pages was quite badly torn in places; some areas had been pierced by foreign objects and the writing in those areas physically removed. The writing that had not been torn away was easily legible, although there were several segments across tears in the paper where the writing was more difficult to decipher. Furthermore, some of the pages were tightly stuck together and had to be pried apart carefully. At the same time, the pages were very fragile and along with the main body of paper there were several twisted or tightly curled fragments that had either broken off during the straightening process or were received separately from the rest of the pages. When straightened out, it was a challenge to correctly place those fragments that contained remnants of writing, in their original locations.

The entire diary covers the period from liftoff to flight day six (FD 6). It is not known if there were more pages of the diary that were not found or if Ilan stopped writing at this point. There were other pages of the notebook among the pile received for examination on which no writing was found, but there is no way of knowing if these belonged to a different section of the Notebook earmarked for another purpose, or if Ilan simply chose not to use them for continuing his diary.

It is important to point out that when deciphering the contents of the diary, an educated guess was most valuable. fter deliberating over certain entries for quite some time, a member of the Israel Air Force who had been involved in the Israeli experiments on board the Shuttle read those entries quite effortlessly.

The first page of the diary was received in relatively excellent condition, a remarkable fact in and of itself considering the heat of the explosion, the altitude from which it had fallen, and the weather conditions to which it had been exposed. The bottom left hand side of the paper had been burned away, leaving a gray-tinged charred edge. Pages two and three of the diary were received completely stuck together, including several twisted and 'traumatized' areas. Page two had been the most exposed to the elements and the face of the page was dotted all over with a yellow powder-like substance, actually fungus spores; likewise on the reverse side of the third page. The face of the third page was remarkably white, as it had been protected from external sources. These two pages had the most internal tearing and indeed most of the fragments were found to belong to them.

The fourth page was only partially intact and its outer edges had been torn away more than any of the others. The fifth and sixth pages were written on both sides in pencil and suffered from the same random tears as the other pages written in black ink.

After all the curled edges of the pages and their torn areas had been straightened out as much as possible, their contents were copied out in the lab file. Where possible letters or words that could be guessed, even though they had been torn away, were written with a dotted line. In this way, it was possible to search for parts of certain letters or words among the paper fragments.

The different papers also had varying colorations depending on exactly what they had been directly exposed to before they were found. Thus, as mentioned above, the face of page two had patches of a yellow powder like substance and page three being well protected was particularly white. The first page was hardly discolored but the left hand margin that had been burnt at the edge had a gray tone not seen on the other pages. The third indication of where a fragment might fit was its size, shape, contours and its remnants of ink deposits. It has to be remembered that the papers had undergone seriously traumatic conditions and tears in the paper could not be expected to show perfect physical matches as for paper torn under laboratory conditions.

On the face of one of the fragments were several lines that could not be recognized as belonging to any specific letters. The black ink of these lines had penetrated to the reverse side of the fragment and in addition to them another letter was visible in its entirety in a tone of gray on the reverse of the fragment. On closer examination it was found that the back of the second page showed signs of both the black ink that had penetrated from the face of the paper plus a gray 'shadow' resulting from transfer of a component of the black ink from the face of page three remembering that these two pages were received completely stuck together. The shape of the full letter on the reverse side of the fragment was matched to its source on the face of page three, and thus a site found for it on page two. The proper placement of the fragments made several words of the diary legible, whereas beforehand one could only guess what those words may have been. One of the most interesting discoveries resulted from positioning a rather large fragment on the first page of the diary.

With placement of the fragment the passage reads as follows:

"The last traditional breakfast on Earth,

Get dressed in spacesuits, play the traditional card game till the last few seconds, go down in the elevator, out to the astrovan with the last hand waves, the way to" ...

It seemed somewhat strange that the astronauts played cards after they had put on their bulky spacesuits and it was wondered if the fragment had been placed correctly, although its contours and ink deposits matched the gap in the page very well. Two NASA astronauts were asked if they knew anything about the card game, but both replied that as they had yet to take

part in an actual space flight, they did not know of any such tradition. Ilan Ramon's family and friends also had no light to shed on the question.

Three weeks later a reply was received from one of the NASA astronauts who had asked around and learned that some crews did have a tradition to play a game of cards before the launch, believing it would bring them luck. This information would have been lost without the correct placement of this particular fragment. All in all, approximately ten fragments were returned to their original locations.

The second group of six pages appeared totally washed out with no plainly visible remnants of any form of writing. The pages were viewed with various light wavelengths, from the ultraviolet to the infrared using the VSC-1, Foster + Freeman, England.

With infrared luminescence, it was found that the pages contained technical lists made in preparation for the mission including lists of NASA personnel, lists of medicines for different medical conditions relevant to space flight and various safety and operating procedures. Although the luminescence in the central areas of the pages was strong enough to "blind" the camera, a good part of the writing was deciphered.

The third group of eight pages proved to be the most challenging. The first page had clear remnants of a washed-out blue ink, showing that the whole page had once been full of writing. Although several individual letters could be discerned, hardly one complete word was clearly legible. The other pages were even more affected and hardly any letters could be read. In the infrared region, the pages were very highly luminescent, completely blinding the camera. Ultraviolet light and reflectance in the infrared did not help to view the writing any clearer than regular white light. It was decided to try digital enhancement photography in an attempt to enhance the contrast of the traces of pale blue writing.

As a first step the pages were individually scanned using a flatbed professional scanner at 600 dpi and then processed using Adobe® Photoshop® and Image-Pro Plus®, increasing the saturation of the blue component. After trial and error the best results were obtained by converting to the CIE L*a*b* color mode, choosing one channel and using the "equalize" function with one of the software programs mentioned. Small areas of the resultant image were "burned" and "dodged," bit by bit. This process increased the local contrast of the traces of writing against the background. At the same time as the contrast of the writing is increased, the "noise" from the background also rises and so has to be subdued accordingly. This was done using a median filter or a "Dust & Scratches" filter. These filters also cause blurring of the writing and therefore one must carefully control the extent of their use. Some of the pages were processed with the "Channel Mixer" function in order to differentiate between the writing and the background.

Although these applications are summarized here in a few lines, they took many hours of work to reach optimal results. Amazingly, after processing the first almost blank page, a whole side of writing, a good percentage of it readily legible, was visualized on the computer screen, and printed out on high quality photographic paper.

The page seemed to contain a list of topics that Ilan had prepared before the mission intending to talk about them during one of the public announcement broadcasts from space. The second page showed slight traces of blue ink all over, but where on the first page several letters were legible, here only one square bracket could be made out.

Once again, after processing with Photoshop®, a complete page of writing was visualized. The content was in Hebrew like in all the other pages examined so far, but in contrast to them, this writing was punctuated with vowels. On close examination several key words were recognized that led to deciphering the entire page – Ilan had copied out the special Sabbath blessing for wine, "Kiddush." He had intended to say the "Kiddush" blessing on Friday night (sunset on Friday marks the beginning of the Jewish Sabbath), and had prepared the cup and the blessing accordingly.

Two of the pages contain handwritten notes in Hebrew that have yet to be deciphered. As in examination of all the pages that were found, an educated guess is better than a random one, so that where there is no clue as to what the writing may contain it is very difficult to make head or tail of the content.

Conclusion: The examination of Ilan Ramon's Crew Notebook proved to be a fascinating case. Everyone had heavily felt the tragic loss of the Shuttle's seven astronauts. Over two months after the accident the discovery of the Notebook provided the chance to learn more about the mission through the diary written by Ilan Ramon, Israel's first astronaut.

From the first moment when researchers heard that the Notebook had survived the explosion of the Shuttle and that it had been found in the vast expanse of Texas, it was realized that this was no ordinary case. Indeed, the variety of techniques used to ultimately visualize the writing in the various pages of the Crew Notebook, covered a good range of techniques used in questioned document examination.

It is important to realize that despite the availability of wonderful digital enhancement technology, the forensic photographer spent many "human" hours in order to achieve the very best results. This was by no means a case of scan, apply software and see the results. Each area of the pages in question was treated individually, sharpening contrast in some places and reducing background glare in others. The results obtained way surpassed expectations and the contents that they revealed made every bit of effort well worthwhile.

With the conclusion of examination of the Crew Notebook, it was transferred to the Paper Conservation Laboratory of the Israel Museum. Although work has just started on fixing the diary fragments in place, it has been decided to protect the integrity of the pages as much as possible. Therefore only a minimum amount of restoration will actually be done even though it is within their capability to restore the Notebook to "look like new." The pages of the diary and the Crew Notebook have a story to tell, through the writing contained within and no less by the very fact that they survived the tragic loss of flight STS-107.

[1] As verified during a visit of a NASA astronaut to the QD Lab

Document Reconstruction, Infrared Luminescence, Digital Enhancement Photography

J14 Leopold-Loeb Revisited: Document Examiners Help Unravel "The Perfect Crime"

Larry A. Olson, MFS, IRS National Forensic Laboratory, 29 North Wacker Drive, 3rd Floor, Chicago, IL 60606*

The goal of this presentation is to acquaint modern examiners with the facts of this historic case, from the forensic document examiner's point of view.

This presentation will impact the forensic community and/or humanity by presenting a summary of the case and what he learned about the experts involved in conjunction with a poster session that displays the documentary evidence.

The year 2004 marked the 80th anniversary of the thrill-killing of Bobby Franks by Nathan F. Leopold, Jr., and Richard A. Loeb, two wealthy teenaged geniuses in Chicago.

Due to the sensational elements of the crime and the presence of Clarence Darrow, opponent of the death penalty, for the defense, it was perhaps the first case to be dubbed "the Crime of the Century" and "the Trial of the Century." The story has been told and retold in works of fiction as well as nonfiction.

The physical evidence in the case included handwritten, hand printed, and typewritten documents. According to newspaper accounts, as many as nine "experts" in handwriting and typewriting may have been consulted at the behest of various parties, although only two questioned document examiners testified at trial. Who all of these persons were and the role they played has been ignored in virtually all modern published accounts of the case.

Questioned Documents, Handwriting, Typewriting

J15 Inkjet or Offset? Proceed With Caution

Machelle A. Reid, MFS, Federal Bureau of Investigation, Laboratory Division, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, forensic document examiners will be made aware that single, solid-color inkjet printing is available and be able to view available images and/or samples.

This presentation will impact the forensic community and/or humanity by making many forensic document examiners aware that single, solid-color inkjet printing is available and to consider this fact when examining solid, single-color printing.

The forensic document community has exercised skill and knowledge in determining whether documents are prepared using an inkjet or offset printing process for years. However, newer and better printing technology makes this task more challenging. Traditionally, inkjet printers have combined cyan, yellow, and magenta as the only means to produce other colors. Due to this fact, it was commonplace to discount the idea that an inkjet printer could produce solid, single-color images. These flat or even surface images were typically produced by an offset or even flexographic (which exhibits very little, if any, embossing) printing process. Now, in this day of advanced printing technology, forensic document examiners need to be aware that inkjet printers can produce solid, single colors.

Hewlett-Packard Company, Specialty Printing Systems, is one company, among possibly others, that has developed single-color thermal inkjet print cartridges that use fast-drying, water resistant ink available in black, red, green, and blue. With this new single-color print cartridge, wasted ink will be a thing of the past. Right now this licensed technology is only made available to companies that qualify.

How will this affect the forensic document examiner who has to make the determination as to the printing process on a document? Some of the characteristics observed when examining samples of the single-color inkjet were jagged edges, some overspray, linear non-inked areas indicating some nozzles were not releasing ink, and brightly colored ink which was really absorbed into the paper.

The characteristics forensic document examiners would expect to see with offset printing are vibrant ink colors, smooth edges, no overspray, and ink absorbed into the paper. However, if the image that is used for offset printing is poor in nature or of a digital or inkjet process, could this exhibit other characteristics than those traditionally observed in offset printing? Hence, there is a need for extreme caution when making these determinations regarding flat, single-color images.

Offset Printing, Inkjet Printing, Solid Color Processes

J16 The Use of Fiber Analysis When Examining Questioned Documents

Walter J. Rantanen, BS, Integrated Paper Services, 101 West Edison Avenue, Suite 250, Appleton, WI 54915*

The goal of this presentation is to assist document analysts and criminalists in learning what information can be derived from examining the fiber types in paper. The attendee will better understand the possibilities and limitations in using a paper fiber analysis.

This presentation will impact the forensic community and/or humanity by showing examples of fiber analysis techniques will allow the document analyst to have additional useful methods in evaluating paper.

When examining questioned documents, it may be advantageous to examine the fiber types that make up the papers. The use of Fiber Analysis can provide information to show a document is consistent with or significantly different from other paper. These identifications of certain papermaking fibers can be used in some situations for the dating of the documents or for comparison with other associated papers.

The examination of the fibers is a destructive test, but can be done after most or all of the other forensic tests have been completed. Only a relatively small area of a document or a paper in question needs to be examined to determine the fiber types. Usually several paper punch-sized pieces can be used for the examination. The required equipment is a transmitted light compound microscope with objectives of 4X, 10X, and 40X magnification. Any magnifications close to these are also acceptable. Other equipment to enhance the analysis may involve a stereoscope, an ultra violet light source, a light box, and chemical reagents for spot staining.

This presentation will feature some of the methods used to examine the fibers present in questioned documents and other paper based products. Examples of fiber differences in papers will be viewed under the microscope. Some examples of how Fiber Analysis examinations have been used to compare and evaluate documents will be discussed. Researchers will also discuss some of the limitations associated with this type of analysis, as well.

Fiber Analysis, Paper, Microscope

J17 A Qualitative Analysis of Modem Standard Arabic Handwriting for the Purpose of Document Examination

James L. Hayes, BA, Hayes & Associates, 221 North LaSalle Street, Suite 1254, Chicago, IL 60601*

After attending this presentation, attendees will understand research which incorporated the known theories used in document examination and utilizes the phenomenon uncovered in the interviewing technique of qualitative research methods.

This presentation will impact the forensic community and/or humanity by providing relevant information to law officials who look to forensic document examination to provide aid in distinguishing the author of known exemplars.

Motivated by the terrorist attacks of September 11, 2001 and the "Anthrax Letters" of less than one year later, U.S. law officials look to forensic document examination to provide relevant information that aid in distinguishing the author of known exemplars. Recognizing that document examination requires the ability to examine discrete units of handwriting and the skill to evaluate the specimen as a whole, the researcher conducted a one on one interview with a person of Arabic heritage to uncover the cultural implications involved with their style of handwriting. Then 30 sets of handwriting samples were taken for evaluation. Forensic Document Examiners marry the art and science in their examinations. This research incorporated the known theories used in document examination and utilizes the phenomenon uncovered in the interviewing technique of qualitative research methods.

Forensic Science, Document Examination, Modern Standard Arabic Language

J18 Examination of Line Crossings by Infrared Chemical Imaging

Katherine Flynn, BSc, Brian Reedy, PhD, and Claude Roux, PhD, University of Technology, Sydney, Centre for Forensic Science, PO Box 123, Broadway, NSW 2007, Australia; Chris Lennard, PhD, Australian Federal Police, Forensic Services, GPO Box 401, Canberra, ACT 2601, Australia*

Attendees will gain an understanding of the application of infrared chemical imaging in determining the sequence of intersecting lines on questioned documents.

With technology continuously evolving, this presentation will impact the forensic community and/or humanity by exploring new developments that may prove to be superior to techniques currently in use in forensic laboratories. Infrared Chemical Imaging has been demonstrated to be effective for the examination of intersecting lines on questioned documents.

This poster focuses on a preliminary examination of infrared imaging as an objective, non-destructive technique for examining line crossings.

Determining the sequence of intersecting lines is still a problem faced by forensic document examiners. Many of the techniques used are either subjective in nature, or are partially destructive. FTIR spectroscopy, using an ATR accessory, is a non-destructive method that can be used to analyse ink and toner in situ on documents. However, until recently, FTIR spectroscopy has been limited to single-point analysis only.

Recent advancements in technology have led to the development of FTIR imaging, a powerful new technique, which is capable of simultaneously obtaining both spectral and spatial information. FTIR imaging uses a Focal Plane Array (FPA) detector, which can be thought of as 64 x 64 discrete detectors (or pixels) laid out in a grid pattern. This detector simultaneously collects 4096 spectra in a single image with a spatial resolution of approximately 5 - 10 microns using the microscope or around 50 microns using the Large Sampling Accessory. In the latter case (used in this study), the image size is approximately 3 x 3 mm.

The advantages of infrared chemical imaging include its ability to provide both spatial and spectral information. In approximately the same amount of time taken by a conventional spectrometer to collect a single spectrum, this new technology can simultaneously collect thousands of spectra using an array detector and thus map the spatial distribution of chemical species across a sample. The ability to image ink and toner in situ, without the need to remove the material by a destructive means such as lifting and cutting, means that the technique is suitable for the non-destructive analysis of the sequence of intersecting lines. An important advantage of infrared imaging over visible light chemical imaging is the greater number of spectral bands that can be used to characterize or identify a given molecule. Another advantage is that it produces visually appealing displays that can be useful in demonstrating results to the layperson, such as a jury member.

Currently there is an extremely limited amount of research published on forensic applications of FTIR imaging. Therefore the benefits provided by FTIR imaging have yet to be fully explored, and it holds enormous potential for forensic analysis. FTIR imaging may have numerous applications in questioned document examination. This poster focuses primarily on the study of infrared imaging as a technique to determine the sequence of intersecting lines. For this preliminary examination, intersecting line samples that were prepared using a wide range of writing media were studied in order to determine the capability of the technique. Writing materials examined included various pens (including ballpoint and gel pens), and laser and ink-jet printing. Samples were prepared using a range of pressures, from light to heavy, and also over varying time intervals. Samples were imaged using the Digilab Stingray IR imaging system with zinc selenide and germanium FastIR ATR accessories (Harrick Scientific).

Preliminary results demonstrated that infrared chemical imaging was able to successfully image toner and ballpoint ink in situ. By imaging on an infrared band (peak) present in only the toner or ink spectrum, chemical images showing the spatial distribution of these materials could be obtained. Using the ink chemical images, it was possible to determine the sequence of intersecting lines. To test the validity of the technique, blind testing was conducted. Results demonstrating the advantages and disadvantages of infrared imaging as a technique for examining intersecting lines will be presented.

Questioned Documents, Line Crossings, Infrared Chemical Imaging

J19 Pad Printing: A Forensic Analysis

Gabriel D. Watts, BA, and Peter J. Belcastro, Jr., MFS*, FBI Laboratory, Questioned Documents Unit, 2501 Investigation Parkway, Quantico, VA 22193*

After attending this presentation, attendees will gain an understanding of the subtle, yet distinguishing print characteristics of pad printing.

Classifying a print process can be exceedingly difficult in such a fast paced industry. With the apparent popularity and widespread use of pad printing, this presentation will impact the forensic community and/or humanity by accentuating the necessity of the forensic document examiner to be thoroughly educated in its subtle distinguishing characteristics.

The 2004 East Pack packaging show in New York City showcased the latest trends and technology in the packaging and product printing industry. As the largest packaging event on the east coast, the event represented a reasonable indication of popular packaging and product printing methods and technologies. The dominant product in printing technology represented at the show was pad printing. Pad printing, like the name implies, employs an intermediary pad to transfer a positive (or right reading) image on to a substrate. The technique is especially designed to print information on non-flat surfaces, such as golf balls or pens (a technique that has historically been preceded by screen printing).

Print process characteristics are often forensically evaluated when attempting to determine the authenticity or origin of an item in question. Various print processes can sometimes resemble one another, even under microscopic examination. However, each process may exhibit subtle characteristics which may enable an examiner to distinguish them from one another. Factors to consider when distinguishing pad printing include the type of substrate, the detail and colors in the image, the apparent consistency of the ink, and the plate making process. Pad printing machines are capable of producing multicolor images in a manner that can appear similar to that of offset lithography and can leave a spattered edge comparable to the serrated edge characteristics of screen printing. This presentation will explain the pad printing process from plate creation to application of the final image on a product. Similarities and differences with respect to other commercial printing processes, which may assist in the examination and recognition of the pad printing process, will be addressed.

Pad Printing, Print Characteristics, Graphic Arts

J20 Analysis of Kinds of Black Signing Inks

Shuxia Lui, BS, College of Police of Liaoning, P.R., 116033, China*

The College of Police of Liaoning carries out the analysis of 15 types of black signing inks from different factories utilizing thin-lawyer chromatography and ultraviolet-visible spectrophotometry (UV-Vis).

Thin-layer chromatography was used in the analysis of black signing inks, N.N-dymethyl formamide (DMF) was used as the abstraction reagent and a solution of acetone, ethyl alcohol, and water in the proportions of 8:19:6 was used as the spreading reagent. Paper thin-layer produced better results than using silica thin-layer. Inks containing carbon was difficult to dissolve.

Another method of analysis of the inks was the use of ultraviolet visual spectrophotometry. There were three color marks to show strong absorption at 596nm, 481nm, 537nm, 444nm, and 445nm as their peak values were obviously different. There were various diagrams and features in each type so as to achieve the distinguishing characteristics of the inks examined.

The objective of the experiment shows that paper does not interfere in obtaining the distinguishing results. To sum up, this study is to establish writing time on signing inks.

Black Signing Inks, Analysis of Thin-Layer, Ultraviolet-Visual Spectrophotometry

J21 Leopold-Loeb Revisited: The Documents in the Case

Larry A. Olson, MFS, IRS National Forensic Laboratory, 29 North Wacker Drive, 3rd Floor, Chicago, IL 60606*

The goal of this presentation is to display photographs and charts prepared by two documents examiners who testified as expert witnesses in this historic case.

The year 2004 marked the 80th anniversary of the thrill-killing of Bobby Franks by Nathan F. Leopold, Jr., and Richard A. Loeb, two wealthy teenaged geniuses in Chicago.

The physical evidence in the case included handwritten, hand printed, and typewritten documents. According to newspaper accounts, as many as nine "experts" in handwriting and typewriting may have been consulted at the behest of various parties, although only two questioned document examiners testified at trial in July of 1924.

The author will display charts and photographs from the two examiners' files that were presented as evidence in court.

Questioned Documents, Photography, Court Testimony

Toxicology

K1 Determination of Toxins and Alkaloids Markers of the Toxic Plant, *Ricinus communis Linn* by New Complimentary Technique

Arvind K. Sharma, MS, Andaman & Nicobar Islands Forensic Science Laboratory, CID Complex, Abeerden Bazar, Port Blair, c/o Rajveer Sharma, Laton Wali, Kankhal, Haridwar, Uttaranchal 249408, India*

Attendees will be briefed on the tentative identification of an unknown toxin protein in trace amounts by the presented identification scheme. The method is quick and efficient, especially for forensic samples.

Bioterrorism is a global threat. The appearance of some plant toxins in the terrorism literature has diverted the attention of the forensic science community to study these plant toxins, which are potential mass homicide agents. The author's research findings will impact the forensic community and/or humanity by helping forensic science and law enforcement agencies in the rapid identification and characterization of suspected plant toxin proteins.

The present paper describes the toxicological aspect of a plant having active principles in the form of alkaloids, glycoprotein's, etc. The toxicological study of this plant is very important for forensic science due to its appearance in terrorism literature and its potential for use as a mass homicide agent.

Goal: To develop a new complementary technique and protocol for the general protein and the identification of toxins derived from the seeds of plant r*icinus communis Linn.*

Method: The author used boiling methanol for the extraction of the active principles from a forensic sample suspected to contain caster seeds along with a reference sample of caster seeds collected from trans Himalayan and Himalayan region. Extracted residue was tested for its greatest solubility in different solvents. The author experimented with different percentages of SDS page and finally approved 12.5% SDS page for isolation, characterization, and tentative identification of the unknown toxin protein.

Results: The study reveals that the suspected samples and reference sample exhibits 8 different bands, visualized by using the Coomassie bright blue. The molecular weight of 8 protein bands was determined by using molecular dynamic image quant and the molecular mass of different 8 bands is started from 13 kd to 44 kd. The molecular weight of the three major bands no. 6, 7, & 8 is 23 kd, 20 & 18 kd. Bands no. 6, 7, & 8 is 23 kd, 20 & 18 kd, exhibits the agglutination & haemolysis activity in red blood of corpuscles.

Conclusion: The tentative identification of unknown toxin protein in trace amounts is possible by the presented identification scheme. The present method is quick and efficient especially, for the determination, identification, and characterization of plant toxin proteins in forensic samples.

Ricin, Toxin, Protein

K2 Mepivacaine Fatality Occurring After Local Anesthesia Was Administered Intravascularly During a Pre-Operative Procedure

Michael Wagner, MS, PA, Harold E. Schueler, PhD, and Linda Rush O'Neil, MD, Broward County Medical Examiner & Trauma Services, 5301 Southwest 31st Avenue, Ft. Lauderdale, FL 33312*

After attending this presentation, attendees will understand why qualified anaesthesiologists should administer the drug mepivacaine in order to avoid accidental death following intravascular infusion of the drug.

This presentation will impact the forensic community and/or humanity by showing the forensic community how fatal a local anaesthetic block of mepivacaine could be when accidentally administered intravascularly.

This is the case of a 92-year-old woman who was scheduled for surgery after falling at her residence and being diagnosed as having a left hip fracture. She had a recorded history of chronic pulmonary emphysema, congestive heart failure, coronary artery disease and glaucoma. While being prepared for surgery, she received an L3 in one block with 35 ml of 1.5% mepivacaine and sedation with midazolam. Five minutes thereafter, she had a witnessed cardiac arrest. Advanced Cardiac Life Support (ACLS) protocol was initiated with no success. At the autopsy, the descendent appeared relatively healthy and no trauma was found to have caused her death. Biological fluids and tissues were tested for basic, acidic, and neutral drugs using GC/MS.

In the postmortem heart blood, toxicological analyses identified *mepivacaine* at a concentration of 9.50mg/L, which is consistent with an intravascular administration. Vitreous humor, bile, liver, and brain specimens contained: 0.96mg/L, 0.46mg/L, 14.58mg/kg, and 2.18mg/kg mepivacaine, respectively. Atropine, levorphanol, pseudo/ephedrine, citalopram, dextromethorphan, lidocaine and midazolam were also present.

Administration of an appropriate dose of local anesthetic appears to be the single most important factor in preventing catastrophic reactions (*New England Journal of Medicine*, 295, 1397-1399, 1976).

The medical examiner ruled that the cause of death was mepivacaine toxicity and the manner of death was determined to be accidental.

Mepivacaine, Intravascular, Gas Chromatography/Mass Spectroscopy

K3 Plasma and Urine Amphetamine Levels Following Administration of Dexedrine®

John T. Cody, PhD, Academy of Health Sciences, 3151 Scott Road, Ft. Sam Houston, TX 78234; Sandra Valtier, MS, Wilford Hall Medical Center, Clinical Research, Lackland AFB, TX 78236; and Kerri McHugh, MD, Emergency Medicine, Wilford Hall Medical Center, Lackland AFB, TX 78236*

Attendees will gain knowledge of the absorption and excretion profile of amphetamine following administration of a typical dose of Dexedrine®.

This presentation will impact the forensic community and/or humanity by showing the plasma and urine concentrations following administration of 10 mg of Dexedrine®, a commonly used treatment for ADHD. This information will allow members of the community to assess unknown samples in light of these to help interpret findings.

Dexedrine® (d-amphetamine) has been used for many years for a number of clinical indications including narcolepsy, attention deficient disorder with hyperactivity (ADHD), and as a short term adjunct to a weight reduction program. It also has a long history of abuse. Use of stimulant medications for the treatment of ADHD has increased dramatically in the last few years as the number of patients diagnosed with this disorder increased and those diagnosed during childhood continued treatment well into their adult lives. Evaluation of urine concentrations of amphetamine following administration of Adderall® (another commonly prescribed form of amphetamine used for the treatment of ADHD) has previously been reported. No data currently exists on the excretion profile and plasma concentrations of amphetamine following typical therapeutic doses of Dexedrine®, thus the current study was initiated to describe urine and plasma profiles.

Subjects were administered 10 mg of d-amphetamine in the form of two 5 mg Dexedrine® tablets. Blood samples were collected in lithium heparin tubes prior to administration of the drug and at 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 24, 36, and 48 hours following drug administration. Plasma was then separated from the sample and stored at ? 20ºC prior to analysis. Urine samples were collected in standard urine containers and stored at ? 20ºC prior to analysis. Samples were collected ad lib from each of the subjects prior to administration of the drug and at each urination for five days following initiation of the study.

Samples were analyzed using GC-MS following extraction of the analytes and derivatization with heptafluorobutyric anhydride (HFBA). Plasma samples were extracted using solid phase extraction of a 1 mL aliquot with United Chemical Technologies (UCT) XTRACKT, XRDAH203 high-flow 200 mg columns using a Zymark RapidTrace®. Urine samples were extracted using liquid-liquid extraction of 2 mL sample aliquots.

Urine samples were positive (≥ 500 ng/mL) for no more than 48 hours following administration of the drug. The peak concentration of amphetamine seen in urine was 6,373 ng/mL. Plasma samples showed a peak concentration of 28 ng/mL and no samples contained detectable amphetamine (LOD 4 ng/mL) at 48 hours post dose. Amphetamine was detectable (LOD 5 ng/mL) in the urine up to 118 hours post dose.

Amphetamine, Plasma, Urine

K4 Quantitation of Propane in Biological Materials by Headspace GC

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Attendees will be briefed on an important technique to quantify propane and various information about propane poisoning.

This presentation will impact the forensic community and/or humanity by demonstrating one of the most difficult methods to confirm and quantify propane. The authors tried to determine the propane in biological samples.

Two persons died from a LPG explosion in an apartment and forensic quantification of propane, the predominant component of LPG, in the biological materials of the deceased was performed using headspace-GC/FID. Because of the variation of instrument performance and sample injection, the internal standard method was adopted. The stability, retention profile, xenobiotic, and similarity of partition coefficient were considered to select the appropriate internal standard and pentane in iso-butanol was chosen. Injecting a calculated volume of pure propane gas into a capped vial containing 2 mL of blood and 5 uL of internal standard created calibration standards. The calibration curve was linear from 0.09 ug/mL to at least 90.0 ug/mL. The method validation data of repeatability, recovery and linearity were also determined. The propane quantities in blood, fat, and brain tissue were calculated between 0.27 and 70.91 ug/mL (ug/g), and the maximal value was observed in fat. The confirmation of propane was conducted by solid phase micro-extraction followed by mass spectrometry.

Propane, Quantification, SPME GC-MS

K5 A Quetiapine-Linked Fatality

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The goal of this presentation is to present a case of quetiapine overdose which resulted in a fatality and review the pharmacokinetics and adverse reactions to this drug, which has been assumed to be relatively non-toxic.

Few case reports of fatalities involving this drug have been published. This report will impact the forensic community and/or humanity by adding to the literature, and may assist forensic toxicologists and others in interpreting similar findings.

A 37-year-old white male with a history of depression was found dead at home. His current medications were listed as quetiapine, buspirone, and sertraline. Investigators estimated that approximately 96 quetiapine tablets were not accounted for, including one new bottle of 30 (300 mg) tablets. The older bottles contained 200 mg tablets. The Forensic Toxicology Laboratory received urine, blood, and vitreous humor. Cocaine and its metabolites, quetiapine metabolite, and nicotine were detected in the urine by GC-FID/NPD and by ion-trap GC-MS. Ethanol was also found in the urine by an ADH enzymatic assay. Blood ethanol was 0.029 g/dL. In the heart blood, quetiapine was 32,100 ng/mL, cocaine was 53 ng/mL, and benzoylecgonine was 819 ng/mL. The quetiapine and cocaine quantitations were performed at MedTox Laboratories.

Quetiapine (Seroquel) is classified as an "atypical" antipsychotic drug. Baselt (1) describes it as "a dibenzothiazepine derivative developed in 1993 for use as a neuroleptic agent." Its defined daily dose is 400 mg/d, has a half-life of 5-8 hours and is typically found in blood in the range of 195-632 ng/mL when used therapeutically (1).

The metabolite found in the decedent's urine is only one of approximately 20 metabolites of the parent drug. Metabolic pathways include sulfoxidation, carboxylic acid formation on the ethoxyethyl side chain, as well as hydroxylation in the 7 position. The 7-hydroxy metabolite does not apparently have significant pharmacologic activity.

According to the PDR (2), the clinical trial databases reported 6 overdoses with ingestions ranging from 1200–9600 mg with no fatalities. The 9600 mg overdose was associated with hypokalemia and first-degree heart block. Mortality cited for overdose of hospitalized patients is cited as 0.5% for the neuroleptic class of drugs (3). Overdose of these drugs is cited as similar to TCA overdose, but less toxic. So-called 'atypical' agents cause ECG abnormalities, but other case reports allege that quetiapine was less toxic than other atypical antipsychotic drugs. One series reports seizures, hypotension, QTc prolongation, and sedation to the point of requiring mechanical ventilation, similar to those effects seen with clozapine and olanzapine overdose (4).

Plasma concentrations, unhelpful in clinical management, may be useful in postmortem considerations. Dart (3) cites typical therapeutic concentrations of quetiapine of 190-630 ng/mL overlapping considerably with lethal blood concentrations of 240-4000 ng/mL. Postmortem redistribution, if any, remains unreported at this time for quetiapine.

References:

1) Baselt, R.C., Disposition of Toxic Drugs and Chemicals in Man, 6th edition, Foster City, CA; Chemical Toxicology Institute, 2002.

2) Physicians' Desk Reference, 53rd edition, Montvale, NJ, Medical Economics Co., 1999.

3) Dart, Richard C., editor, Medical Toxicology, 3rd edition, Philadelphia, PA, Lippincott, Williams & Wilkins, 2004.

4) Trenton, A, Currier, G, Zwemer, F., Fatalities Associated with therapeutic use and overdose of atypical antipsychotics, CNS Drugs, 2003; 17(5): 307-324.

Quetiapine, Fatality, Overdose

K6 Relationship of Methamphetamine (MAP) Levels to Causes and Manners of Death in MAP-Related Casualties

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Diverse psychotic behaviors induced by MAP could be recognized by the MAP level in blood and urine by pharmacokinetics and manners of death so as to predict the psychotic behaviors before casualty. The goal of this presentation is to present a pilot designed to determine whether

toxicological profiles of the decedents' body fluids could be used to implicate the status of mood at the moment of death.

This presentation will impact the forensic community and/or humanity by presenting results, which suggest that the toxicological profiles are better related to patterns of death than manner of death. The findings may enable better utilization of the toxicological profiles in future judgment of forensic parameters including the cause and time of death.

Illicit drug abuse of MAP is a worldwide problem, and has caused a serious social crisis in the Taiwan community. MAP-induced fatalities with a high homicide rate (20-30%) are much higher in comparison with opiate-related fatalities' low homicide rate (0-5%). MAP is a psychostimulant and long-term MAP abusers may become addicts demonstrating psychosis, self-destructive behaviors, emotional disturbances, and schizophrenia-like behavior (MAP psychosis). MAP can induce long-lasting deficits of the innervations in the striatum from dopamine neurons of the substantia nigra. Diverse psychotic behaviors induced by MAP could be recognized by MAP level in blood and urine by pharmacokinetics and manners of death so as to predict the psychotic behaviors before the casualty. A pilot study was designed to determine whether toxicological profiles of decedents' body fluids could be used to implicate the status of mood at the moment of death. High blood/urine ratios can be associated with acute MAP use, a short period of time after MAP intake, and a manic emotional status. In comparison, a low blood/urine ratio can be associated with chronic MAP use, a longer period of time after MAP intake, and a depressive emotional status. A retrospective review of 586-MAP related fatalities collected from Forensic Medicine Center and Institute of Forensic Medicine in Taiwan, which had MAP levels in either blood or urine that were greater than 0.10 mg/L, found 88 cases with positive impressions of the causes and manners of death (3 unknown manner of death are excluded). Distinct patterns of MAP levels were found to be associated with a unique manner of death. Higher MAP concentrations were found in blood than in urine when death occurred shortly after an overdose of MAP that was linked either to accidental overdose (7.75 ± 1.99 μg/ml blood, 17.24 ± 4.27 μg/ml urine and 2.77±1.04 blood/urine ratio; n=27) or to intentional suicide (15.71 ± 7.23 μg/ml blood, 13.86 ± 1.6 μg/ml urine and 1.23±0.62 blood/urine ratio; n=4). Lower MAP blood levels and blood/urine ratios were found in cases of deaths by accidents (0.33 ± 0.09 μg/ml blood, 4.83 ± 1.89 μg/ml urine and 1.64±1.05 blood/urine ratio; n=13) and suicides (0.77 ± 0.49 μg/ml blood, 6.02 ± 1.83 μg/ml urine and 0.43±0.19 blood/urine ratio; n=9) not by caused MAP toxicity, making an influence of MAP mediated through depression and psychotic behaviors highly suspect. Much lower MAP blood/urine ratios were found among casualties of natural (0.40 ± 0.13 μg/ml blood, 18.56 ± 6.73 μg/ml urine and 0.38 ± 0.23 blood/urine ratio; n=12) or homicidal causes (1.07 ± 0.24 μg/ml blood, 10.56 ± 1.96 μg/ml urine and 0.14±0.03 blood/urine ratio; n=23), suggesting that these deaths were relatively unaffected by the lower blood level of MAP. Chronic MAP abusers with low blood and high urine MAP levels appear to provoke violent behaviors resulting in the homicidal fatalities, and a relationship to amphetamine (AMP)-like psychosis is postulated. These results suggest that the toxicological profiles are related better to patterns of death than manner of death. The findings may enable better utilization of the toxicological profiles in future judgment of forensic parameters including the cause and time of death. (Supported by NSC 82-0412-B-016-075; 83-6016-F-096).

Methamphetamine, Manner of Death, Drug Concentrations

K7 Illicit Drug Related Fatalities in Taiwan During 1991-2003

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The goal of this presentation is to understand the epidemiology of illicit drug abuse in Taiwan during 1991-2003.

This presentation will impact the forensic community and/or humanity by providing data which supports that MAP-induced toxicity is closely related to the violent and destructive behaviors of MAP abusers.

Methamphetamine (MAP) and narcotics are considered two major illicit drugs that have resulted in serious social problems in Taiwan and other parts of the world. In addition to illicit drugs of narcotics-related substances (57.8% including opiate, morphine, and heroin), MAP constitutes the majority (41.8% including MAP semifinished material, MDMA and cannabis) of illicit drugs seized by the Investigation Bureau, Ministry of Justice and the National Police Administration (Taiwan 2003). By the end of 2003, violation of the Laws for the Control of Narcotics and the Laws for the Control of Illicit Substance constituted 16,013 cases in prison, which represented 39% of the 41,245 prisoners in Taiwan. This retrospective study of illicit drug-related decedents is proposed to understand the characteristics of MAP-related and narcotics-related fatalities by analyzing toxicological profiles, sex, age, and manners of death. During 1991 to 2003, illicit drug-related cases compromise 1,145 out of 14,887 forensic autopsy cases (7.7%) collected from the Institute of Forensic Medicine (Taiwan). MAP-related, narcotics-related, and multi-drug-related fatalities (constitute both MAP and narcotics-related substance in blood fluid) represent 371 (44%), 295 (35%) and 175 (21%) of the forensic autopsy cases, respectively. The mean age (average 30.1±1.7 years old) of MAP-related, narcotics-related, and multi-drug-related was 32.1±2.0, 30.2±1.5 and 28.1±1.7 years old. Males predominated (average 75%), MAP-related (73%), narcotics-related (78%), and multi-drug related (74%) fatalities. Manners of death of 371 MAP-related fatalities during 1991-2003 of natural, accidental, homicidal, suicidal, and unknown cause are 13%, 46%, 20%, 15%, and 6%, respectively. Manners of death of 295 narcotics-related fatalities during 1991-2003 of natural, accidental, homicidal, suicidal cause and unknown cause are 9%, 76%, 5%, 6%, and 4%, respectively. Mean concentration of MAP in blood and urine of MAP-related fatalities are 4.75±0.73 mg/L and 17.38±2.81 mg/L, respectively. Mean concentration of morphine in blood and urine of narcotics-related fatalities are 0.50±0.06 mg/L and 8.39±1.45 mg/L, respectively. Whereas higher and lower than 3 mg/L MAP concentration of blood indicated an over-dosage of illicit drug directly related to the accidental and suicidal causes of death and homicidal cause, respectively. The percentage of homicidal cause of MAP-related fatalities (20%) is higher than that of narcotics-related fatalities (5%). In conclusion, this data supports that the MAP-induced toxicity is closely related to the violent and destructive behaviors of MAP abusers.

Illicit Drug, Methamphetamine, Narcotics

K8 A Postmortem Distribution in a Fatal Case of *o*-Dichlorobenzene Poisoning

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After attending this presentation, attendees will have information about the distribution of *o*-dichlorobenzene and its metabolites 2,3-dichlorophenol, and 3,4-dichlorophenol in biological fluid and several tissues in a case of fatality due to *o*-dichlorobenzene.

This presentation will impact the forensic community and/or humanity by showing an unusual dichlorobenzene poisoning case and the distribution in various tissues.

O-dichlorobenzene has been used as a solvent, insecticide, and a degreasing agent. An accurate and simple method was developed to determine dichlorobenzene and its metabolites, dichlorophenols, in biological fluid and tissues by using gas chromatography/mass spectrometry (GC/MS) with solid phase microextraction (SPME). For analysis of dichlorobenzene, an assembly of SPME with a replaceable extraction fiber, coated with 100mm polydimethylsiloxane, was used with a headspace technique. SPME fiber, coated with 85mm polyacrylate, was used to analyze dichlorophenols with an immersion technique. The calibration curves showed good linearity at 0.99 in the range of 20 to 400mg/mL for both techniques.

A male age 34 with schizophrenia was found dead. Toxicological analyses to identify and quantify *o*-dichlorobenzene and dichlorophenols were performed on blood and tissues taken at autopsy. The concentrations of *o*-dichlorobenzene were 39.9mg/mL (blood), 89.3mg/g (spleen), 63.1mg/g (lung), 50.6mg/g (kidney), 90.6mg/g (brain), 298.5mg/g (heart), and 101.4mg/g (liver). Its metabolites, 2,3-dichlorophenol and 3,4-dichlorophenol concentrations were 2.09 and 1.65mg/mL (blood), 3.53 and 2.69mg/g (spleen), 3.30 and 3.33mg/g (lung), 7.41 and 8.02mg/g (kidney), 1.13 and 0.73mg/g (brain), 1.81 and 1.38mg/g (heart), 6.44 and 4.78mg/g (liver), respectively.

***o*-Dichlorobenzene, SPME, Dichlorophenol**

K9 MDMA in Four Medical Examiner's Cases in the City and County of San Francisco

Nikolas P. Lemos, PhD, Steven B. Karch, MD, Elin Lin, MS, Glenn Nazareno, MD, Venus Azar, MD, Jon Smith, MD, Amy P. Hart, MD, and Boyd G. Stephens, MD, Office of Chief Medical Examiner, Hall of Justice, North Terrace, 850 Bryant Street, San Francisco, CA 94103*

The goal of this presentation is to alert the general community on the apparent risks of MDMA use and will also aid forensic toxicologists in the interpretation of postmortem and antemortem MDMA levels.

This presentation will impact the forensic community and/or humanity by alerting the general community of the apparent risks of MDMA use and will also aid forensic toxicologists in the interpretation of postmortem and antemortem MDMA levels.

3,4-methylenedioxymethamphetamine (MDMA or 'ecstasy') is a 'psychedelic amphetamine' tied to the underground rave and dance club scenes throughout the world, but is also being considered for use by therapists as an adjunct agent. The Office of the Chief Medical Examiner for the City and County of San Francisco serves a population of approximately 750,000 and this number has remained stable for several decades. In 2002, 1,463 cases came under the jurisdiction of the SFOCME; MDMA was detected in blood, urine, and/or tissue of four cases, giving an incidence of 0.5 per 100,000 people. The data presented herein is the result of a retrospective analysis of all death investigations carried out by the SFOCME, from January 1, 2002 until December 31, 2002. The median age of decedents was 22 years (SD=3, range 18-25 years). Decedents were overwhelmingly male (75%) and mostly black (50%). Gunshot wound was the cause of death in two cases, and asphyxia due to hanging in one. In only one instance, a case of anoxic-ischemic encephalopathy secondary to acute MDMA intoxication was MDMA actually considered the cause of death. Benzoylecgonine was detected in the urine of one, and dextromethorphan was detected in the blood and urine of the second of the two decedents who died due to gunshot wounds. Amphetamines were screened in the biological specimens of these cases using EMIT. MDMA and other amphetamines were then extracted from biological specimens using liquid-liquid extraction for alkaline drugs using reconstitution in chloroform, derivatization with acetic anhydride, and reconstitution in methanol prior to identification and confirmation/quantitation by gas chromatography–mass spectrometry (GC-MS) in the electron impact ionization mode. In three of the four cases, where death was immediate (i.e. gunshot wounds and asphyxia due to hanging) the mean MDMA postmortem femoral blood concentration was 0.30 ± 0.07□g/mL and the mean postmortem urine concentration was 13.1 ± 7.6 □g/mL. In the case where death was actually due to MDMA intoxication, the antemortem serum MDMA concentration was 0.7 □g/mL near the time of admission, falling to 0.3 □g/mL seven and a half hours later; the respective antemortem serum MDA concentrations were 0.02 □g/mL, and 0.01 □g/mg. Both MDMA and MDA were present in the antemortem urine specimen (at concentrations of 10.4 and 0.45 □g/mL, respectively). For comparison, a review from another Medical Examiner's Department where a 24-year-old white male died of acute polysubstance toxicity involving alcohol, cocaine, heroin, and MDMA, where the postmortem MDMA blood concentration was 1.7 □g/mL and the postmortem MDA blood concentration was 0.14 □g/mL. The expectation is that this study will alert the general community on the apparent risks of MDMA use and will also aid forensic toxicologists in the interpretation of postmortem and antemortem MDMA levels.

MDMA, Ecstasy, Postmortem

K10 Methadone Related Deaths in the City and County of San Francisco

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The goal of this study was undertaken to determine whether there had been any change in the incidence of methadone related deaths, as either the principal cause of death, or as a contributing factor, since the publication of an earlier report in 1999.

This presentation will impact the forensic community and/or humanity by demonstrating that despite a continuing increase in the amount of methadone prescribed, and increased concerns about methadone diversion and toxicity, neither the demographic profile, nor the rate of methadone related deaths in the City and County of San Francisco have changed since 1997. Whether this is due to changes in either prescribing and clinical care or other unique features of drug takers in San Francisco is, at this time, impossible to say.

Goal: Public concern about methadone diversion and the accidental fatalities that may result is a cause of great concern. In spite of extensive media attention, however, the true magnitude of the problem is not known with any certainty, and the frequency of the problem seems to vary widely from city to city. The SFOCME serves a population of approximately 750,000, and this number has been stable for several decades. In 1999

records were reviewed for all deaths occurring in the City of San Francisco, from 1997 through 1998, where methadone was detected in blood or urine samples (West J Med. 2000 Jan;172(1):11-14). This new study was undertaken to determine whether there had been any change in the incidence of methadone related deaths, as either the principal cause of death, or as a contributing factor, since the publication of an earlier report.

Design: Retrospective analysis of all death investigations carried out by the San Francisco Office of the Chief Medical Examiner, from January 1, 2002 until December 31, 2002.

Findings: In 2002, 1,463 cases came under the jurisdiction of the SFOCME office; methadone was detected in blood or urine of 35 cases, giving an incidence of 4.4 per 100,000 compared to a rate of 5.0 per 100,000 in the 1997-1998 study (presuming a constant population base of 750,000). The median age of decedents was 44.9 years (SD=10.4, SE = 1.8, range 23-61 years). Decedents were overwhelmingly male (85%), and predominantly white (66%). In 2002, death was attributed to trauma or underlying medical disorder in 24 (72%) of cases. In the remaining nine cases the diagnosis was given as poly-drug abuse (6), or methadone. Cocaine was present in five of the nine cases, methamphetamine in two, and morphine in three. In each of the three cases where morphine was detected, cocaine was also present. The rate for co-abuse of cocaine was slightly higher than in an earlier study, and the rate for morphine use was slightly lower, but the small sample size precludes definite conclusions. Individuals dying of methadone toxicity were significantly younger than individuals where presence of the drug was an incidental finding (42.0 vs. 45.8 years vs. 48.3 and 46.3 years in the first study), and suffered from fewer underlying disorders. Chronic illnesses, including alcoholism, HIV, and Hepatitis B and C infection, were common in the group where methadone was an incidental finding. The mean methadone blood concentration was 835 ± 170 ng/mL compared with a mean of 957± 140 ng/mL in the earlier study.

Conclusion: Despite a continuing increase in the amount of methadone prescribed, and increased concerns about methadone diversion and toxicity, neither the demographic profile, nor the rate of methadone related deaths in the City and County of San Francisco have changed since 1997. Whether this is due to changes in either prescribing and clinical care or other unique features of drug takers in San Francisco is, at this time, impossible to say.

Methadone, Epidemiology, San Francisco

K11 Analysis of Amphetamine and Methamphetamine in Whole Blood by Solid Phase Extraction and Gas Chromatography - Mass Spectrometry

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Attendees will learn an acceptable method for the solid-phase extraction of amphetamine and methamphetamine from blood matrix as an alternative to liquid/liquid extraction methods.

This presentation will impact the forensic community and/or humanity by demonstrating a solid-phase extraction procedure, which yields acceptable results, is time efficient (taking an average of 2.5 hours from start to completion), and requires a small amount of sample and limited amounts of organic solvents.

The purpose of this study was to demonstrate that the Cerex Polycrom Clin II solid-phase extraction column (SPEware, San Pedro, CA) provides acceptable extraction of amphetamine (AMP) and methamphetamine (MAMP) from whole blood. The Cerex Polycrom Clin II solid phase extraction (SPE) column is packed with a patented divinylbenzene polymer that is highly cross-linked and functionalized to perform in dual mode utilizing hydrophobic and cation exchange mechanisms.

The procedure requires pre-treatment of the blood samples (1 mL) with 2 mL of a phosphate buffer (pH 6), vortex mixing for 30 seconds, followed by sonication for 10 minutes, and then centrifugation for 6 minutes. Samples were then added to the SPE columns and washed with deionized water, pH 6-phosphate buffer, methanol, and ethyl acetate. During the wash procedures, the samples were vacuumed at 2-5 psi. The columns were dried at full vacuum for 3 minutes and then eluted with ethyl acetate containing 2% concentrated ammonium hydroxide. A solution of 1% HCl in methanol was added to the extracts, vortex mixed, and evaporated to dryness. The dried residues were derivatized with acetic anhydride and transferred to auto-sampler vials and analyzed by GC/MS (HP6890 GC, HP5973 MS) utilizing selected ion monitoring. Deuterated internal standards were used for the quantitation of AMP and MAMP. Ions monitored for the acetyl derivatives were (underlined ions are used for quantitation): AMP: 118, 44, 177; d_{11}-AMP: 128, 48, 188; MAMP: 100, 58, 191: d_{14}-MAMP: 107, 65, 205.

The linearity study exhibited an upper limit of linearity at 4000 ng/mL, and lower limit of detection and quantitation at 10 ng/mL for both analytes. Correlation coefficients were 0.9994 and 0.9993 for AMP and METH, respectively. Daily linear regression calibration curves for each analyte yielded correlation coefficients of 0.9995 or greater along the dynamic range. Carryover was not observed at 10,000 ng/mL. Extraction efficiencies at 100 ng/mL averaged 92% and 91% for AMP and MAMP, respectively. Precision was evaluated on three separate days at 50 ng/mL and 200 ng/mL with 5 replicates at each concentration. The within-run precision yielded average responses from 47 – 51 ng/mL (%CV 1.1 – 5.8) and 202 – 207 ng/mL (%CV 3.9 – 8.6) for AMP, and 47 – 55 ng/mL (%CV 1.3 – 4.6) and 199 – 205 ng/mL (%CV 3.8 – 8.7) for MAMP. The between-run precision for AMP produced CV results of 5.5% and 6.0% at the 50 ng/mL and 200 ng/mL levels respectively. The between-run precision for MAMP produced CV results of 7.3% and 6.1% at the 50 ng/mL and 200 ng/mL levels, respectively.

A small comparative study was conducted using this SPE procedure on preserved whole blood samples that had been previously analyzed by a liquid-liquid extraction method. Good agreement was observed between these two procedures. Correlation studies yielded correlation coefficients of 0.9732 for AMP and 0.9966 for MAMP. The results of the comparative study were analyzed statistically using a two-tailed Student's t-test. The calculated t values were 1.714 for AMP and 0.5068 for MAMP and the critical t values were 2.086 for AMP and 2.048 for MAMP at the 95% confidence level. The t-test indicates there is no significant statistical difference between the results from the two methods.

An interference study was conducted using a blank control and spiked blood samples at 50 ng/mL of AMP and MAMP. The following drugs were added to these controls at a concentration of 10,000 ng/mL: 3,4-methylenedioxymethamphetamine, 3,4-methylenedioxyamphetamine, 3,4-methylenedioxy-N-ethyl-amphetamine, phenylpropanolamine, ephedrine, pseudoephedrine, propylhexadrine, fenfluramine, mecathinone, and p-methoxymethamphetamine. Phentermine, propylhexadrine, and fenfluramine were found to cause interferences with chromatography of the target analytes. If these drugs are anticipated, an alternative derivatization process, such as a fluorinated derivative, can be used to resolve these interferences.

This solid-phase extraction procedure yields acceptable results, is time efficient (taking an average of 2.5 hours from start to completion), and requires a small amount of sample and limited amounts of organic solvents.

Solid Phase Extraction, GC/MS, Methamphetamine

K12 The Death Pattern and Distribution of Toluene in Blood of Glue Sniffers

Nam Yee Kim, PhD, Geum Moon Nam, and Jong Shin Park, PhD, National Institute of Scientific Investigation, Western District Office, 111 Daeduk-li Seosam-myun, Changsung-gun, Chunnam 515-820, Korea; and Eun Ho Kim, and Sung-Woo Park, PhD, National Institute of Scientific Investigation, 331-1 Shinwol-dong Yangchun-gu, Seoul, 158-707, Korea*

After attending this presentation, attendees will have information about the types of death and the distribution of toluene following intoxication from inhalants.

This presentation will impact the forensic community and/or humanity by showing the death pattern and toluene blood concentration following intoxication from inhalants.

The blood toluene concentration was determined by using GC/MS with HS-SPME of postmortem blood, quantitatively. Fuel gases were analyzed using GC/FID with headspace technique in postmortem blood, qualitatively. Seventy-five cases of death associated with the inhalation of glue or fuel gases was reported in Korea over three years (1996-1998). In twenty-seven of the cases of death due to glue sniffing, nine persons died as a result of a fall while intoxicated and their blood toluene concentration was fairly high in the range of 1.3~21.6mg/mL (average 10.4mg/mL). However, nine persons who died suddenly due to glue sniffing showed low toluene blood concentration in the range of 0.5~22.6μg/mL (average 4.0mg/mL, only one case showed 22.6mg/mL, seven cases were below 2.0mg/mL). In cases of death due to fuel gas sniffing, fifty-four persons died of acute fuel gas inhalation or suffocation and six people who died due to sniffing fuel gases as well as glue.

Inhalation, Death Pattern, Glue-Sniffing

K13 A Suicide By Brake Fluid Ingestion

Michael E. Frontz, MSFS, and Diane K. Molina, MD, Bexar County Medical Examiner's Office, 7337 Louis Pasteur, San Antonio, TX 78229*

The goal of this presentation is to present a case report on brake fluid intoxication and resulting death.

This presentation will impact the forensic community and/or humanity by demonstrating a rarely reported manner of death where the only significant toxicological findings were easily made using routine alkaline drug screen methods and instruments.

Ingestion of brake fluid is a rarely reported phenomenon; in fact, no case reports are present within the English literature. Numerous case reports of ingestion of antifreeze (ethylene glycol) and glass cleaner (ethylene glycol butyl ether) are present within the literature, which are similar chemical compounds to the glycol ethers present within brake fluid.

Both ethylene glycol and EGBE poisoning cause metabolic acidosis. In addition, EGBE causes central nervous system depression and hemolysis. Ethylene glycol causes oxalate crystal formation within the renal tubules and renal failure. Ethylene glycol and EGBE poisonings have been successfully treated with hemodialysis and ethanol infusion.

The authors report a case in which brake fluid ingestion was the MO in a suicide. The decedent was a 38-year-old Caucasian male who drank an unidentified amount of *Snap® Heavy Duty Brake Fluid* an unknown time before his death. The decedent had a previous history of suicide attempts, including a self-inflicted gunshot wound.

An autopsy was performed at the Bexar County Medical Examiner's Office. The autopsy revealed a normally developed, well-nourished, adult Caucasian male, 67 inches tall and weighing 154 pounds. There was no evidence of trauma. The internal autopsy was remarkable for 300 cc of malodorous oily fluid within the stomach, consistent with the brake fluid submitted with the body, marked pulmonary edema and mild hepatic steatosis. A full microscopic examination was performed and showed no abnormalities. Specifically, crystal formation within the renal tubules was not present.

Remarkable toxicology included the presence of several related glycol ethers in the blood and gastric contents. These compounds manifested in an alkaline drug extraction analyzed by GC flame ionization and subsequent GC/MS with electron impact ionization. They may include triethylene glycol monobutyl ether, diethylene glycol monobutyl ether, triethylene glycol monoethyl ether, and diethylene glycol monoethyl ether. Among others, the trade name Dowanol®, a product of the Dow Chemical company, is associated with these compounds. EI fragmentation patterns were confirmed by matching with similar eluting peaks from the remnants of the actual brake fluid container. Verification with pure standards was not pursued, as they are difficult to obtain. Ethylene glycol was notable by its absence in the blood.

Brake Fluid, Suicide, Gas Chromatography

K14 Fatal Chloroquine Intoxication in a 2-Year-Old Child

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After attending this presentation, attendees will have a better understanding of the signs and symptoms of chloroquine intoxication and the distribution of chloroquine in postmortem specimens from a child fatality.

This presentation will impact the forensic community and/or humanity by assisting forensic toxicologists and medical personnel to consider the possibility of chloroquine intoxication in a child with a previous history of malaria presenting with symptoms of uncontrollable shaking, profuse sweating, bradycardia, and diffuse cerebral edema.

The authors present the case history and toxicology findings of a child fatality involving chloroquine. A 2-year-old male was found shaking, gasping for air, and complaining of feeling hot shortly after eating his dinner. The child lost consciousness and was taken to the emergency room. Observed symptoms in the hospital included bradycardia, sweating, hypoxia, and diffuse cerebral edema. He died the following day. Few details regarding the case history were known at the time. The child had been previously treated for malaria in Africa before his family migrated to the U.S. less than a year prior. However, there was no recent history of illness or allergies, and prior to this incident the child had been described as a normal healthy 2-year-old.

Specimens were submitted for a full toxicological analysis, including an alcohol analysis by headspace gas chromatography with flame ionization detection; a screen for drugs of abuse and several prescription drug classes using an enzyme-linked immunosorbent assay technique (ELISA); and a screen for basic compounds using gas chromatography-mass spectrometry (GC-MS). Positive findings were confirmed and quantitated using GC-MS. Chloroquine was detected in subclavian blood at a concentration of 34.4 mg/L.

Chloroquine is used as an antimalarial agent. It is not available as an over-the-counter medication in the U.S. and it is suspected that the family brought chloroquine from Africa. Symptoms of chloroquine toxicity range from headache, confusion, dizziness, gastrointestinal upset, and visual disturbances, to hypotension, vasodilation, respiratory depression, and eventual cardiac arrest. The cause of death in this case was determined to be "*chloroquine intoxication,*" and the manner of death was "*accident.*" A discussion of the case circumstances, the autopsy and toxicology findings, and chloroquine pharmacokinetics will be presented.

Chloroquine, Fatality, Child

K15 Performance Characteristics of the Cozart® EIA Cannabinoids Microplate Kit for Oral Fluid in Comparison With GC-MS

Gail A. Cooper, PhD, Ahmed Jehanli, PhD, and Chris Hand, PhD, Cozart PLC, 45 Milton Park, Abingdon, Oxfordshire OX14 4RU, United Kingdom*

After attending this presentation, attendees will understand the analysis of cannabinoids in oral fluid by ELISA and GC-MS.

This presentation will impact the forensic community and/or humanity by providing information on the testing of cannabinoids in oral fluid and detailing the analysis of samples collected from individuals being monitored for drug use.

Goals: This project was carried out to evaluate the performance characteristics of the Cozart® EIA Cannabinoids microplate as a preliminary screening device for delta-9-tretrahydrocannabinol (Δ9-THC) in oral fluid.

Methods: Oral fluid samples (N=100) were collected from individuals being monitored within a drug treatment program and were screened according to the manufacturers instructions. Samples were collected using the Cozart® RapiScan collection system, which included a 1:3 dilution of the sample in a preservative buffer. All samples, calibrators (0, 6, 30, and 150 ng/mL equivalent in neat oral fluid) and controls (0 and 45ng/mL) were assayed in duplicate. Gas chromatography–mass spectrometry (GC-MS) confirmation for Δ9-THC was carried out on all samples. The LOQ/LOD for Δ9-THC was 3 ng/ml by GC-MS.

Results: Of the samples screened 75 screened positive and 25 screened negative, 73 were confirmed positive for Δ9-THC and 27 were confirmed negative by GC-MS. Concentrations of Δ9-THC ranged from the LOD of 3 ng/ml to greater than 1µg/ml. Sensitivity and specificity for the assay were 100% and 93% respectively.

Conclusions: The Cozart® EIA Cannabinoids Microplate Kit for oral fluid employing a 30ng/ml cut-off had good sensitivity and specificity with an overall assay agreement of 98% with GC-MS and provided adequate performance as a screening procedure for the identification of Δ9-THC in oral fluid.

Cannabinoids, ELISA, Oral Fluid

K16 Cocaine Related Deaths: An Enigma Still Under Investigation

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The goal of this presentation is to present to the forensic toxicology community several references to aid in the determination of cocaine related death.

This presentation will impact the forensic community and/or humanity by providing information about the interpretation of cocaine related deaths, which is still very difficult and disputed. Although literature offers many toxicological data about cocaine involving death, the correlation of a specific blood or tissue concentration with toxicity is not directly proportional to the height of these levels. Many factors make the interpretation of toxicological findings in cocaine associated deaths more complicated:

- fast absorption of drug assumed by "snorting" or "intravenous"
- different metabolism in chronic or occasional user
- *in vitro* degradation
- postmortem redistribution of cocaine and its major metabolite, benzoylecgonine
- different rates of crossing blood-brain barrier (benzoylecgonine crosses with greater difficulty)
- interactions of cocaine and alcohol or other drugs (such as disul firam, amitriptyline, procanamide, quinidine, vasoactive compounds, etc.)

As a consequence, many authors recommend caution in not misinterpreting toxicological data, especially by untrained and inexperienced operators, (not including real forensic toxicologists), because, with the exception of massive overdose (when the mechanism of death is perfectly clear), most cocaine related deaths occur in chronic drug users. Also, the cocaine concentration found in postmortem blood might not be representative of the concentration present at the time of death.

Isolated blood cocaine levels, without any other parenchymal distribution analytical data, cannot be used to explain the cause of death, because - for example - cocaine associated sudden death is not dose related.

Several studies have demonstrated that blood and brain ratios of cocaine/benzoylecgonine concentrations are greatly important to suggest a parameter to identify and discriminate death due to cocaine overdose from death where the presence of cocaine is simply an incidental finding.

Blood and brain levels used to determine cocaine and benzoylecgonine concentrations ratios are the best matrix for postmortem analytical researches, because even if cocaine blood concentrations change significantly after death, cocaine appears to be more stable in the lipid-rich tissue of the brain.

In Spielher and Reed's 1985 study, the interpretative value of the determination of cocaine and benzoylecgonine in brain tissue was investigated.

They found that in 37 autopsied cases of cocaine related deaths (overdose) the concentration of cocaine found in the brain is four to ten times higher than in the plasma; where cocaine was only an incidental finding (46 cases - instances of murder, accidental death, etc.), the average blood/brain ratio was only 2:5 for cocaine and 1:40 for benzoylecgonine. In the forensic toxicology division, all suspected cocaine cases (overdoses and incidental deaths) were investigated as to cocaine and its metabolites distribution.

The authors apply Spielher and Reed's model to cases performed during 1990 to the first six months of 2004 on 77 cocaine overdose fatalities, and 30 cases where cocaine was incidental to the cause of death.

Cocaine and benzoylecgonine were extracted by SPE and derivatized compounds were identified and quantified by means of a gas chromatography-mass spectrometry (GC/MS) using selected ion monitoring detection (SIM).

The findings were in agreement with those of Spielher and Reed. The authors found that in overdose cases the ratios of cocaine/benzoylecgonine in the brain was 10:28 and in the blood 0:69. These ratios were clearly different from those found in incidental cases (brain mean was 0:71 and blood mean was 0:21).

The brain/blood ratios of cocaine and benzoylecgonine concentration in overdose cases were found to be 8:06 for cocaine and 0:67 for benzoylecgonine; in incidental cases the ratios were 2:28 for cocaine and 1:67 for benzoylecganine.

In conclusion, brain tissue appears to be a good sample for the determination of cases of cocaine involved deaths. The brain concentration levels related to the blood provide useful information in the determination of overdose as compared to cocaine as an incidental finding.

Cocaine, Death, Brain

K17 Observations of Endogenous Levels of GHB in Urine Over Time

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The goal of this presentation is to provide the forensic toxicology community with information about the fluctuation of endogenous GHB levels in urine over time among different individuals.

This presentation will impact the forensic community and/or humanity by aiding forensic toxicologists with interpretation of urine GHB concentrations obtained in forensic casework. It will be made apparent that comparison of a background urine sample from an individual, with the forensic urine sample obtained from the same individual at the time of assault does not provide valuable information.

This poster will display the results obtained from the thesis research project completed as part of the Criminalistics MS program at California State University, Los Angeles. The focus of the project was to study the fluctuation of endogenous GHB concentration in human urine over time.

Gamma-hydroxy butyric acid (GHB) is a central nervous system depressant with hallucinogenic and euphoric effects. In a criminal context, it can be used along with alcohol for its incapacitating effects in drug facilitated sexual assaults. Forensic toxicologists commonly receive requests to analyze urine for the presence of GHB in sexual assault cases. The interpretation of the quantitative results in these cases can be ambiguous. This is due to the fact that GHB is an endogenous compound in human urine. It has also been demonstrated that the concentration of endogenous GHB varies between subjects. Therefore, it is essential to verify the amount of GHB found in urine as endogenous or exogenous in origin. To date, there is no widely accepted concentration threshold that distinguishes endogenous levels from ingested levels of GHB in urine.

Inter- and intra-individual variations of endogenous urine GHB levels were evaluated. The first goal of the study was to compare urine GHB concentrations between subjects. The second goal was to determine if an individual's endogenous GHB concentration is consistent over time. The establishment of a fixed endogenous GHB concentration level per individual would be valuable for forensic casework. The ability to compare the GHB concentration of a background sample obtained from a victim with the forensic sample, obtained from the same victim at the time of assault, would simplify the interpretation of the results.

In order to achieve its goals the study was divided into two parts. One hundred forty-seven urine samples from five individuals (non GHB users) were collected over a 30-day period and subsequently analyzed. During the first 48 hours of the study, an aliquot of every urine void from each subject was collected and analyzed. The second part of the study involved analysis of samples collected from the remaining 28 days, at which time only an aliquot of the daily morning first void from each individual was collected and analyzed. Fluctuations of endogenous urine GHB concentrations in both the two-day study as well as the month long period appear random in all participating individuals. No clear concentration pattern was observed. This implies that it is not feasible to try to establish a fixed background endogenous GHB level for any one individual.

The average GHB concentration among all individuals in the study was 3.2□g/mL. The highest concentration found among all samples was 9.8□g/mL. Several specimens in this study approached 10□g/mL, which some analysts consider a threshold level indicative of GHB ingestion. Findings of endogenous urine GHB concentration at such levels suggest necessary reassessment of 10□g/mL as the threshold level of endogenous urine GHB.

Toxicology, GHB, Endogenous

K18 Is Car Driving Under the Influence of Sauerkraut Punishable?

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After attending this presentation, attendees will understand that an alcohol level greater than 2 g/kg cannot be explained by an endogenous production and that one should not believe any allegation made by a driver under the influence of alcohol.

This presentation will impact the forensic community and/or humanity by demonstrating the utility of using any possibilities to find the real source of alcohol in blood in case of major alcohol-impaired driving.

The forensic expert must occasionally face issues that are not only unusual but also quite interesting on an anecdotal level, without ever compromising the underlying scientific validity of the expert's work. This case certainly belongs to this peculiar type of forensic investigations.

The case concerns a criminal investigation of a woman driver, aged 57 at the time of the events, and suspected of driving under the influence of alcohol. The driver was involved in a traffic accident, causing only minimal material damage. Her alcohol levels were measured at 2.3 g/kg, as determined by an ethylometer test conducted by the police after the accident. A blood test, carried out shortly after, revealed an alcohol level (2.16 g/kg) consistent with major alcohol-impaired driving.

The driver assured the investigators that she did not consume the slightest drop of alcohol. A medical certificate delivered subsequently by her treating physician indicated that the observed alcohol levels were caused by gastrointestinal fermentation of sauerkraut ingested prior to the accident. The physician's conclusions relied on evidence found in the scientific literature and on various tests carried out on his patient.

A forensic expert was mandated by the investigative magistrate to determine whether the woman driver was capable of producing ethanol endogenously and if so, to describe the circumstances and the magnitude of this phenomenon.

The goal of the forensic investigation was to determine whether sauerkraut consumption could indeed lead to alcohol levels above 2 g/kg, in which case the authorities should recommend that prior to driving, sauerkraut should only be "eaten in moderation."

Drunk Driving, Endogenous Alcohol Production, Sauerkraut

K19 Oxycodone Blood Concentrations in Seventy Postmortem Cases

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The goal of this presentation is to assist the forensic pathologist and toxicologist in evaluation of postmortem oxycodone blood concentrations.

This presentation will impact the forensic community and/or humanity by assisting forensic pathologists and toxicologists in assessment of the role of oxycodone in sudden and unexpected deaths.

The authors present the postmortem blood oxycodone findings in 70 deaths: 4 cases of fatal intoxication due solely to oxycodone (3 men, ages 22, 23, 46 yrs; 1 woman, 21 yrs); 38 cases of multiple drug intoxication involving oxycodone (22 men, mean age 37 yrs, ranging from 19 to 78 yrs, and 16 women, mean age 39 yrs, ranging from 20 to 61 yrs); 28 cases of natural causes of death where oxycodone was an incidental finding (19 men, mean age 35 yrs, ranging from 18 to 79 yrs, and 9 women, mean age 39 yrs, ranging from 35 to 63 yrs). Oxycodone was isolated from blood by solid phase extraction with n-butyl chloride/acetonitrile mixture. Acetyloxycodone derivative was prepared with acetic anhydride/pyridine and

analyzed by GC/MS with separation on a HP-5MS column (30m x 0.25mm id x 25 um film thickness) at the following temperatures: initial, 60ºC; ramp, 20ºC/min; final 280ºC; with a retention time of 14.52 min for oxycodone and deuterated oxycodone (IS). Ions monitored in SIM mode for acetyl-oxycodone, and acetyl-d_3-oxycodone was 357,358,314 m/z and 360,317m/z, respectively. The calibration was linear from 0.10 - 2.0mg/L. Oxycodone blood values are given in Table 1.

Table 1.	N	Oxycodone Blood Mean, mg/L (Range, mg/L)	
Sole agent	4	0.50	(0.23 – 0.76)
Mixed drug	38	0.42	(0.06 - 1.6)
Natural	28	0.19	(0.10 – 0.6)

Acetaminophen (APAP) was present in 12 of the 38 deaths due to multiple drugs indicative of ingestion of oxycodone/APAP combination tablets. Commonly encountered drugs in the multiple drug deaths were; benzodiazepines, 13 cases; carisoprodol, 13 cases; cocaine, 8 cases; and antidepressants, 4 cases. In addition to oxymorphone, a metabolite of oxycodone, other opiates present were fentanyl, 3 cases and methadone in 2 cases. While tolerance is a major consideration in the interpretation of postmortem oxycodone concentrations, these data are consistent in that therapeutic blood values are expected to be less than 0.25 mg/L, and toxic or lethal blood concentrations would be expected to be greater than 0.40 mg/L.

Oxycodone, Fatal Poisoning, GC/MS

K20 Use of Tetrahydrozoline (Visine®) for Chemical Submission and Sexual Assault in Children

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After attending this presentation, attendees will have knowledge of the potential use of tetrahydrozoline as an agent for chemical submission and sexual assault.

This presentation will impact the forensic community and/or humanity by providing a better recognition of a drug potentially used for sexual assault. Without this knowledge this drug may go undetected in potential criminal cases.

This is a report of the use of a commonly available over-the-counter drug to induce an obtund compliant victim with no memory of the period during the sexual assault. It provides the results from a police investigation into crimes against children as well as the investigation of the method used by the perpetrators of the crimes to repeatedly allow assault while inhibiting any memory of the time under sedation. It will also discuss toxic mechanism of tetrahydrozoline.

In 2003, police investigation located pictorial evidence on the Internet of adults having sex with children. Further investigation located these children in the United States and they were removed from the home. An adult male relative with sole legal custody had primary care of the children and was a suspect in the investigation. The 4 female children were 2 years old through 8 years old at the time the abuses occurred. After being removed from the home the children were interviewed and entered into counselling. However, during all interviews and counselling sessions over the subsequent year following removal from the home the children denied having any specific memories of the sexual assaults, despite the pictorial evidence in which police could positively identify them. The children did give a history of being given a substance by their "father" when they were "bad," prior to their punishment, so that they "would not remember." The home of the male guardian was searched for drugs of abuse and those drugs known to be used in chemical submission. No drugs were located. Interviews with the wife of the suspect (not the mother of the children) indicated the suspect would give the children Visine® prior to any sexual assault and the suspect would routinely carry around a bottle of Visine® with him. This history was obtained more than one year after the children had been removed from the home and so prohibited any testing of the children for tetrahydrozoline. It is unclear where the suspect learned of sedative effects of Visine®.

Visine® contains 0.05% tetrahydrozoline. Tetrahydrozoline is a central alpha-1 agonist with a similar effect to clonidine and tizanidine. Effects from unintentional and intentional ingestion may include the narcotic-like effects of sedation, coma, miosis, and respiratory depression along with the cardiovascular effects of bradycardia and hypotension. The toxic dose is poorly defined but may be as small as 2 ml of a 0.05% solution for a child. No fatalities have been reported. The effects from tetrahydrozoline may be more pronounced in children than adults. Overdoses have been reported in both children and adults, but intentional use for chemical submission has not been previously reported. One case report of a suicide attempt in an adult reports the patient learned of the effects of tetrahydrozoline from bartenders and prostitutes that had used it to subdue rowdy customers. Tetrahydrozoline is well absorbed with clinical effects evident in 15 minutes after ingestion.

Tetrahydrozoline will not be detected on routine toxicology investigation. It had been reported to produce false negative results for cannabinoids with urine immunoassay screens.

An underground rumor, with continuance of the rumor by Internet web sites, suggest that putting Visine® in an unsuspecting victim's drink will cause them to have sudden onset of "explosive" diarrhea. It is reported to be a method of "revenge" against difficult customers in bars and restaurants. Gastrointestinal effects from tetrahydrozoline are not supported by the medical literature but the perpetuation of the rumor suggests this may still be used upon unsuspecting victims with unintended and potentially life threatening consequences.

This case suggests that tetrahydrozoline should be added to the list of drugs suspected in cases of chemical submission and sexual assault. Along with other drugs used for this purpose, such as GHB (gamma hydroxybutyrate) and ketamine, tetrahydrozoline may not be detected on routine drug screens.

Tetrahydrozoline, Chemical Submission, Sexual Assault

K21 Arizona Tea, It's Not For Everyone: An Anabasine Accidental Lethal Ingestion

Kimberly G. McCall-Tackett, BS, R.E. Kohlmeier, MD, Charles E. Spies, MS, and Norman A. Wade, MS, Maricopa County Forensic Science Center, 701 West Jefferson Street, Phoenix, AZ 85007-2908*

After attending this presentation, attendees will be afforded a review of poisoning and fatalities due to anabasine, including the symptoms of anabasine toxicity and the procedure for analysis of the compound by GC/NPD and GC/mS.

This presentation will impact the forensic community and/or humanity by providing the forensic community with data from a recent postmortem case in which anabasine toxicity was determined to be the cause of death. There is scant toxicological literature regarding the minimal lethal concentration of this drug, and presentation of this case may help in compiling such data.

The authors will present forensic science information regarding a death attributed to acute anabasine toxicity. Anabasine (3-(2-piperidiyl) pyridine) or neonicotine is the major alkaloid of the plant *Nicotiana glauca*, commonly known as tree tobacco. The shrub can grow up to 6 meters in

height, has large fleshy gray-green leaves, and tubular yellow flowers. The plant has worldwide distribution including Israel, Australia, and South and North America. In Arizona and the desert southwest, it is commonly found along riverbeds. Anabasine ($C_{10}H_{14}N_2$) is similar in chemical structure and pharmacological effects to nicotine. A 50-year-old male transient was living near the river basin of the Salt River outside Phoenix, Arizona. He was witnessed to drink a heated tea-like solution consisting primarily of desert shrubbery and then complained of feeling numb from the level of his mid chest down to his toes. Other transients summoned emergency personnel but resuscitation efforts were unsuccessful, and he was pronounced dead at the scene. The decedent's prior medical history is unknown. A full autopsy was performed approximately 19 hours after death with significant findings being a slightly enlarged heart; moderately congested lungs, and mild diffuse cerebral edema. Routine specimens consisting of femoral blood, urine, vitreous fluid, bile, liver, kidney, brain, and stomach contents were collected for toxicological analysis as well as the tea solution recovered from the scene. What appeared to be leaves were observed in the gastric contents. Blood and urine specimens were subjected to a qualitative analysis using a basic pH drug screen performed by liquid-liquid extraction and analyzed by GC-NPD and GC-MS, with volatiles being assayed by GC-FID. The blood was also screened by ELISA for methamphetamine, benzodiazepines, barbiturates, opiates, and benzoylecgonine, with negative results. A trace amount of methamphetamine was found in the urine by GC-NPD and GC-MS. Quantitative analysis of anabasine was performed on all specimens as follows: briefly, to each tube was added 2 mL of specimen, a 100 uL aliquot of internal standards (0.20 mg/L alpha-phenethylamine, mepivicaine, and dibucaine) and a 100 uL aliquot of concentrated ammonium hydroxide. This was then extracted into 10 mL of n-butyl chloride. A back extraction was performed into 3 mL of 0.2N sulfuric acid. A wash was done with 3 mL of n-butyl chloride and then a 100 uL aliquot of 10N NaOH was added and a re-extraction was done into 10 mL of n-butyl chloride. The solvent was decanted to a conical evaporation tube containing 25 uL of isoamyl acetate and evaporated to 10uL. 1 uL of extract was injected into an Agilent model 6890 gas chromatograph equipped with an Agilent nitrogen-phosphorous detector (NPD) and an Agilent 25 meter HP-5 capillary column (0.33 um film thickness). Split injection (10:1) was done at 260ºC. The temperature program was 60ºC for 1 minute then increased to 315ºC for 5.5 minutes at 9º/minute. Under these conditions the retention time of anabasine was 0.65, relative to mepivicaine. The concentration was determined by comparing the peak area ratios of anabasine to the internal standard against a standard curve with linearity demonstrated up to 1.0 mg/L. Fractional volumes were used for samples exceeding linearity. The concentration of anabasine in the decedent's femoral blood was found to be 0.81 mg/L while tissue levels were: brain 1.11 mg/kg, liver 1.78 mg/kg, kidney 1.58 mg/kg, and gastric 34.4 mg/L. The concentration of the tea like solution was determined to be 151.7 mg/L. Anabasine, like other nicotine alkaloids is rapidly absorbed through the gastrointestinal mucosa as well as by the respiratory mucosa and skin. The symptoms of anabasine poisoning are similar to those of nicotine and include hypersalivation, vomiting, diarrhea, hypertension, tachycardia, diaphoresis, headache, dizziness, twitching, auditory and visual hallucinations, and paralysis. The initial mechanism is stimulation of the nicotine receptors but this may be followed with a blockade at the neuromuscular junction, leading to skeletal and respiratory muscle paralysis. Death is always due to respiratory failure and the few previously reported deaths have occurred within one hour of the onset of symptoms.

Anabasine, Nicotiana Glauca, Gas Chromatography/Mass Spectrometry

K22 How HHS is Applying Recommendations From the Hair Testing Working Group

Carl M. Selavka, PhD, Massachusetts State Police, 59 Horse Pond Road, Sudbury, MA 01776; and Donald J. Kippenberger, PhD, U.S. Army Medical Command (USAMEDCOM), Toxicology Specialty Command, Ft. Sam Houston, TX 78160*

After attending this presentation, attendees will understand how well the recommendations provided by the Hair Testing Working Group to the Department of Health and Human Services have apparently been received and are being incorporated in the current version of the Notice of Proposed Revisions to Mandatory Guidelines for Federal Workplace Drug Testing Programs on alternate matrix testing.

This presentation will impact the forensic community and/or humanity by providing a full list of the areas in which previous HTWG guidance had been incorporated or not followed by HHS in the NPRMG. In addition, since HHS (through SAMHSA and its DTAB process, in all likelihood) will have met several times between the electronic upload of this abstract (deadline of 1 August 2004) and the AAFS meeting (February 2005), feedback will be provided on changes made to the NPRMG in relation to hair drug testing to date.

The Hair Testing Working Group (HTWG) met on four (4) separate occasions from November 1998 to January 2001. These meetings were requested and supported by the Department of Health and Human Services (HHS) Division of Workplace Programs to provide input as the Substance Abuse and Mental Health Services Administration (SAMHSA) began considering and developing rules for active regulatory oversight of alternate matrix drug testing. Over the course of its 4 meetings, the HTWG involved dozens of individuals representing over 10 laboratories, the U.S. Military, ONDCP, RTI and academic researchers in the field.

When the Notice of Proposed Revisions to Mandatory Guidelines for Federal Workplace Drug Testing Programs (NPRMG, FR Doc 04-7984) was ultimately promulgated in April 2004, over 150 public comments were received by HHS. The work of the HTWG had been the subject of significant deliberation and interest by SAMHSA's Drug Testing Advisory Board (DTAB) during the authors' original work from 1998-2001. Therefore, as with many within the laboratory testing industry, MRO population and companies using workplace testing, a great deal of interest in the NPRMG was had. As Co-Chairs of the HTWG, the authors had intimate knowledge of the many hours of discussions from HTWG meetings.

Based on review of the NPRMG, a public comment was forwarded to HHS which spelled out specific areas of the document that were especially outstanding. Also specified are those areas of the NPRMG in which either the field would have reservations or trouble instituting, or for which there appeared to be misstatements about the science involved. For example, it was encouraging that the NPRMG recognized some of the less than favorable elements of urine drug testing approaches and applications and recognized the complementary nature of urine, hair, oral fluid, and sweat drug testing. No single matrix provides the information necessary for every investigation, detection and deterrence strategy, and the NPRMG was clearly building a much better environment for complementary uses of drug testing technologies for the future.

Several of the areas (among many) in which the NPRMG needed changes included: 1) over-discussion in the Preamble of unproven biases that have been suggested among populations of tested individuals; 2) lowering of overall industry standards through the Instrumented Initial Testing Facility (IITF) guidelines outlined in Section M of the NPRMG; 3) clearer guidelines involving metabolites, effective washing techniques and appropriate cutoff levels to differentiate environmental contamination and actual drug ingestion; 4) PT performance standards based more on efficient extraction/recovery procedures; 5) MDMA immunoassay detection recommendations; 6) allowance of body (other than pubic) hair rather than just head hair; 7) minimization of sample handling to prepare duplicates for testing; 8) changes in selected cutoffs and analytes representing drug classes; and 9) unnecessary "invalid sample" collection requirements.

This presentation will provide a full list of the areas in which previous HTWG guidance had been incorporated or not followed by HHS in the NPRMG. In addition, since HHS (through SAMHSA and its DTAB process, in all likelihood) will have met several times between the electronic upload of this abstract (deadline of 1 August 2004) and the AAFS meeting (February 2005), feedback on changes made to the NPRMG in relation to hair drug testing to date will be provided.

Hair Drug Testing, Mandatory Guidelines, HHS/SAMHSA/DTAB Revisions

K23 Bupropion and Its Metabolites in Twenty-Nine Postmortem Cases

Justin L. Poklis, BS, Ruth E. Winecker, PhD, Jeri Ropero-Miller, PhD, and Diana Garside, PhD, Office of the Chief Medical Examiner, 1001 Brinkhous-Billit Building, Chapel Hill, NC 27599-7580; and Alphonse Poklis, PhD, Department of Pathology, Virginia Commonwealth University School of Medicine, Richmond, VA*

The goal of this presentation is to assist forensic pathologists and toxicologists in evaluation of postmortem concentrations of bupropion and its metabolites.

This presentation will impact the forensic community and/or humanity by assisting forensic pathologists and toxicologists in evaluation of postmortem concentrations of bupropion and its metabolites.

Bupropion is a unique antidepressant unrelated to tricyclic, tetracyclic, selective serotonin re-uptake inhibitors or other antidepressant agents. It is also widely prescribed at low doses for smoking cessation. Bupropion is extensively metabolized via hydroxylation of the tert-butyl side chain to morpholinol-bupropion (M), and via reduction of the carbonyl group to the amino-alcohol isomers, threohydro- bupropion (Threo) and erythrohydro-bupropion (Erythro). Animal studies have demonstrated the morphinol and the amino-alcohol metabolites have approximately 50% and 20% the antidepressant activity of bupropion, respectively. Postmortem toxicological finding have been reported in only a few overdose cases.

We present the postmortem blood and liver bupropion and bupropion metabolite toxicology findings in 29 deaths: 10 cases of massive ingestion of bupropion where the drug was considered a major contributor to fatal drug overdose; 13 cases of fatal mixed drugs intoxication where there was little indication of excessive bupropion ingestion; and 6 cases of death by natural causes where the decedent was receiving bupropion. Bupropion and its metabolites were isolated from alkalized blood and liver specimens by liquid/liquid extraction with n-butyl chloride/ether mixture. Extracts were back-extracted into acid, extracted with hexane for cleanup and following sample alkalization isolated with butyl chloride. The residues were then analyzed by GC/MS with separation in a DB-5MS column (15m x 0.25mm id x 25 *u*m film thickness) at the following temperatures: initial, 70ºC; ramp, 15ºC/min; finial 250ºC; yielding retention times: bupropion, 7.13; Erythro, 7.87; Threo, 7.98; M, 8.89 and alphaprodine (IS), 8.73 min. Ions monitored for bupropion, Erthyro, and Threo were 44/100/139 m/z; for M, 44/116/224 m/z; and IS, 172/187 m/z. Typical calibrations for all bupropion analytes were from 0.20 - 4.0mg/L. Heart or aorta bupropion and metabolite blood values are given in Table 1 and liver values in Table 2. Femoral blood or other blood specimens from peripheral sites were also analyzed.

Table 1. BLOOD Mean, mg/L (Range, mg/L)

	Bupropion	Erythro	Threo	Morpholinol
Overdose	2.7 (0.28-7.4)	1.4 (0.5-2.8)	11 (2.5-27)	3.1 (1.7-4.2)
Incidental	0.37 (0.1-0.65)	0.43 (0.27-1.1)	2.1 (0.34-5.6)	0.79 (0.57-1.4)
Natural	0.43 (0.26-0.60)	0.51 (0.39-0.75)	2.6 (1.8-4.1)	0.65 (0.51-0.77)

Table 2. LIVER Mean, mg/Kg (Range, mg/Kg)

	Bupropion	Erythro	Threo	Morpholinol
Overdose	5.6 (1.3-16)	6.6 (6.4-15)	81 (40-160)	18 (3.7-61)
Incidental	2.0(0.6-5.4)	2.6 (1.0-4.5)	12 (3.6-50)	4.4 (0.73-17)
Natural	0.59 (0.3-0.7)	2.4 (1.4-4.6)	15 (7.0-17)	2.5 (1.0-5.9)

Only one of the overdose cases was due to bupropion as a single agent. In the other nine bupropion overdose cases, at least one other drug was present in significant toxic amounts; 8 cases involved other antidepressants and 1 involved opiates. Obviously, other drugs were present in the 13 bupropion incidental cases; 9 involved at least one opiate. Comparing blood bupropion data from heart/aorta with peripheral sites revealed no significant postmortem redistribution in these cases. In general, parent bupropion values in blood and liver are good indicators of overdose. Additionally, liver Threo concentrations provide a good discriminater between overdose and therapeutic use. In fatal poisoning, bupropion is seldom encountered as the single causative agent.

Bupropion, Bupropion Metabolites, Fatal Poisoning

K24 Consequences of Introducing a Zero-Concentration Limit for Scheduled Drugs in Blood of Drivers: The Swedish Experience

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The goal of this presentation is to give an overview of driving under the influence of drugs in Sweden before and after a zero-concentration limit was introduced for scheduled drugs in blood of drivers.

This presentation will impact the forensic community and/or humanity by bringing to the attention of the forensic community how a simple change in legislation impacts on traffic law enforcement and the crime of driving under the influence of drugs (DUID).

This presentation gives an overview of driving under the influence of drugs (DUID) in Sweden before and after a zero-concentration limit was introduced for controlled substances in the blood of drivers. The zero-concentration limits apply to illicit as well as prescription drugs if the latter are included on the list of controlled substances. However, medicinal drugs are exempt from the zero-limit law if they were being used in accordance with a physician's prescription. This raises the tricky question of interpreting a measured blood-concentration of a sedative-hypnotic or painkiller and concluding that the person was over-dosing or abusing the substance. This requires careful scrutiny of controlled studies relating c_{max} to the dose and other factors that influence c_{max} e.g., gender, age, adiposity, and disease state. Another confounding factor arises when a drug concentration measured in whole blood, the specimen submitted for forensic toxicology, is compared with concentrations in serum or plasma derived from therapeutic drug monitoring programs. The plasma/whole blood distribution ratios for many drugs of abuse are not well documented.

In connection with the zero-concentration law for controlled substances, the police were allowed to examine the driver's eyes to gather evidence of being under the influence of a psychoactive substance. A small flashlight and pupillometer device were available to measure pupil size and reaction to light and to document any gaze nystagmus that might have existed. In addition, the suspect's behaviour and ability to walk, talk and answer questions were also recorded. Depending on the outcome of these roadside tests, a decision is made to proceed with sampling blood and urine for forensic toxicology.

When urine was submitted for analysis, this specimen was screened for various drug-classes by immunoassay methods (EMIT and CEDIA) and all positive findings were verified by quantitative analysis of blood specimens with GC-MS and GC-NPD detection. The concentration of carboxy-THC and 6-acetyl morphine in urine was determined by LC-MS and GC-MS respectively. Finding a banned substance in blood above the LOQ of the method is sufficient to initiate a prosecution for DUID under the new zero-limit law. The LOQ is different for different substances and might change depending on future developments in the analytical methodology.

The typical DUID suspect in Sweden is a poly-drug user who might combine a stimulant like amphetamine or methamphetamine with a depressant like alcohol or diazepam. Because the punishment for DUID is the same regardless of the number of banned substances identified in blood, this has prompted researchers to re-evaluate analytical routines and in the future plan to verify only a single illicit substance. Since the new law was introduced (July 1999) the number of blood samples submitted by the police for toxicological analysis has increased more than 8-fold. About 90% of specimens contain one or more banned substance. The spectrum of drugs found in blood of drivers has not changed since the new law came into force. Illicit drugs like amphetamine (~50%) and tetrahydrocannabinol (~25%) dominate, followed by diazepam and its metabolite nordiazepam (~15 %), then morphine and codeine (~10%), the metabolites of heroin, and flunitrazepam.

Different countries have their own traditions for dealing with the problem of drug-impaired driving and in European countries the trend is towards zero-concentration limits for illicit drugs. Hitherto, prosecution for DUID required evidence that drugs impaired the person and each suspect was examined by a physician or a drug-recognition expert (mainly in USA). The unequivocal finding of a psychoactive substance in the person's blood and the concentration present provided additional evidence for the prosecution case. Finding an illicit drug in urine was not sufficient to bring a charge of DUID. Because of the development of tolerance and also the short half-life of some drugs, the toxicological results often conflicted with the signs and symptoms reported by the police or the physician. Many prosecutions for DUID were unsuccessful and the police authorities became unwilling to proceed with arresting and charging a person for DUID in borderline cases.

The zero-concentration limit has done nothing to deter people from driving under the influence of drugs. Alcohol and drug abuse are facts of life in modern society and people found guilty of DUID are mostly criminal elements who lack a valid driving permit and have committed other offences. Recidivism is a major problem in DUID suspects in Sweden with over 50% of individuals re-offending within 4 years of their first conviction. How to deal with these traffic delinquents is a major dilemma for the criminal justice system. The zero-limits for controlled scheduled drugs have stimulated police efforts to apprehend offenders and many more successful convictions have been obtained. This has also meant an appreciable increase in the workload for forensic toxicology.

Drugs, Driving, DUID

K25 Purposeful Destruction of a Flat by an Explosion? Forensic Toxicological and Medicolegal Interpretations of an Unusual Case

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The goal of this presentation is to present three recent autopsy cases demonstrating teamwork between pathologist and forensic toxicologist.

This presentation will impact the forensic community and/or humanity by demonstrating optimized teamwork between forensic toxicologists and forensic pathologists to solve an unusual explosion case.

Case circumstances: A thirty-seven-year-old man was found dead under the rubble after an explosion had completely destroyed the flat he inhabited. His three-year-old son, whom he should have returned to his ex-wife several hours prior, and a neighbor were also found dead. The man, who had apparently tried to commit suicide several times in the past, had bought three bottles of camping gas the day before for no apparent reason. The circumstances of the explosion were indicative of a suicide with homicide, the motive probably being the frustration due to the separation from his son. The camping gas bottles had been opened prior to the explosion.

Autopsy: Board certified forensic pathologists performed a conventional forensic autopsy. Toxicology: The body fluids were analyzed with regard to volatiles using a standard method involving two runs on each of two headspace gas chromatographs with flame ionization detectors (2x HS-GC-FID). The screening for drugs and medications was performed by EMIT, GC-MS, and GC-NPD. Confirmation and quantification of Cannabinoids in blood were performed by GC-MS. Results: External examination of the body of the man showed extensive excoriations of the skin of the chest, abdomen, and back. Interestingly, singed hair was detected in the face, namely the beard, eyebrows, and head (with exception of the occipital regions) and the forearms and hands. The autopsy displayed extensive blunt trauma of the chest inner organs and the right arm.

Toxicological analysis of the blood demonstrated a THC level of 6 ng/mL, but no THC-COOH. This is an indication that lighting the joint was the cause of the explosion. The bile, by contrast, showed 27 ng/mL of THC-COOH but no THC. Alcohol could not be detected in the blood. In the blood of the man and the boy, traces of butane and propane gas were detected, indicating they were in the same flat exposed to the gas prior to the explosion. The blood of a neighbor analyzed negative for butane and propane indicating that she was in another flat and not exposed to the gas.

Ignition, Gas Explosion, Cannabis Joint

K26 A Homemade Device to Cheat the Urine Drug Screen

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Attendees will gain awareness of possible cheating in urine drug testing.

This presentation will impact the forensic community and/or humanity by increasing awareness of cheating on drug tests.

The goal of this paper is to report a novel mechanism that may have allowed a male subject to continue the use of illicit drugs while participating in a urine drug-screening program. The mechanism to be described was discovered during a postmortem examination.

Urine drug testing is currently recognized as the "gold standard" for drug testing because of its proven accuracy, reliability, and fairness. It is used to identify users of illicit substances in order to provide security for critical workplaces and to allow monitoring of known drug abusers during treatment. The mechanism described here provides a pathway to "pass" the urine drug screen while continuing the use of illicit drugs.

The recognition and prevention of methods and devices that can be used to alter the urine drug screen process is critical to the success of any drug-testing program. The following are details of the mechanism used in this case to interfere with the screening process.

The decedent was a 21-year-old Caucasian male who was found prone on the bed with his feet touching the floor. The decedent was nude but wearing his glasses. He had numerous tattoos and body piercings that included two penile piercings. There were multiple puncture marks on the body including the antecubital and femoral fossae. The puncture mark on the left upper arm was surrounded by blue-green discoloration. Prescribed medications at the scene included alprazolam, dextroamphetamine, Flonase, ketorolac, OxyContin, and two boxes of Duragesic (fentanyl) patches.

The "novel mechanism" encountered in this case was a container wrapped in duct tape. The container was in a plastic bag, and surgical

tubing ran from the container through the piercing in the penis. According to the decedent's roommate, this device was used to hold urine samples that would be forced through the tubing at the time of urine drug screening. The decedent had a past history of street drug use but had been clean in the recent past. The autopsy findings included multiple old and more recent bilateral injection sites on the antecubital and femoral fossae. The examination of the container and tubing recovered from the scene showed that it could easily be hidden on the body under the clothing, thereby allowing for the replacement of the decedent's urine with a sample known to be free of drugs.

The device described here creates concern about the vulnerability of urine drug screen collection procedures. This case may be the sentinel event that refocuses attention on the conflict between the right of privacy and the need to maintain a safe and secure workplace

Urine Drug Testing, Homemade Device, Urine Substitution

K27 Comprehensive Drugs of Abuse Screening of Overdose Cases By Accurate Mass Liquid Chromatography/ Time-of-Flight Mass Spectrometry

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After attending this presentation, attendees will understand a new analytical technology for identifying drugs of abuse in overdose cases.

This presentation will impact the forensic community and/or humanity by exposing the attendees to a new approach to identification and quantification of drugs of abuse that can be applied to poisons and other toxicological investigations.

Comprehensive drug screening of overdose patients is presently performed by GC/MS. The methodology includes extraction and analysis of both acidic and basic drugs. Over 70 drugs of abuse are included in the standard screen. The methodology is both laborious and time consuming and includes derivatization steps for many of the targeted compounds. In addition, there are cases where the screen does not produce results indicative of the overdose. The speed of analysis can be a critical issue where the patient/victim is unconscious and proper medical attention may depend on identification of the unknown toxin. Even in these cases where toxicological signs indicate a drug overdose, the analytical methodology may be slow.

This work will show the comparison of present analytical methods using GC/MS with Liquid Chromatography/Time-of-Flight Mass Spectrometry (LC/TOF MS). Acid and base extraction of blood serum and their analysis using an Agilent LC/MSD TOF with reversed-phase chromatography is used for fast drug screens of overdose patients. This instrumentation has been shown to provide routine mass accuracy measurements better than 3 ppm for compounds with mass above 200 amu. This technology combined with the ability to perform fast reversed-phase chromatography is used to develop a drug screen without the need for derivatization. The screen will examine the more than 70 compounds targeted by GC/MS and include designer drugs and other drugs of abuse not presently sought. The results will be evaluated for quantitative accuracy and precision, qualitative confidence, and overall speed of the analysis. In addition, the ability to use the accurate mass measurement capability of the technology to propose an identification for peaks found in the screen that are not among the comprehensive list of target compounds will be determined and presented. The results will be summarized so that feasibility of this new technology can be assessed.

Time-of-Flight, Mass Spectrometry, Drugs of Abuse

K28 Fluorescent Derivatization for Trace Detection of Opiates and Other Drugs of Abuse by Capillary Electrophoresis

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Attendees will learn a number of new procedures for the fluorescent derivatization and detection of tertiary amines such as opiates and other drugs of abuse using capillary electrophoresis with laser induced fluorescence.

This presentation will impact the forensic community and/or humanity by providing improved methods for the trace detection of drugs of abuse by capillary electrophoresis.

The described procedure involves a facile demethylation followed by a fluorescent derivatization reaction that can be used by forensic practitioners to determine 6-monoacetyl morphine and other tertiary amines at ultra trace levels. Highly selective conditions are then described for the separation and detection of these compounds using capillary electrophoresis with laser induced fluorescence. In addition, other fluorescent derivatization reactions are utilized for the analysis of primary and secondary amines such as benzyl piperazine using diode lasers with capillary electrophoresis.

Capillary electrophoresis (CE) methods are becoming increasingly popular as screening tools for forensic drug analysis. However, most separations using CE involve UV detection with relatively short detection window pathlengths when compared to HPLC. This limits sensitivity. While a number of useful techniques have been developed for sample preconcentration based on field amplified sample stacking, (especially for basic drugs) there still is a need for improved detection for toxicological samples. One of the best and most successful ways to improve CE detection limits is with laser-induced fluorescence. Because native fluorescence is limited to only a few compounds, most drugs of abuse need to be derivatized. This derivative should be fairly polar for best compatibility with CE. Unfortunately most fluorescent derivatization reactions involve reactive dyes that interact mainly with primary and secondary amines. Compounds such as opiates and cocaine that contain tertiary amines will not react with these dyes. In this project researchers explore methods for generation of secondary amines from these compounds and examine a variety of derivatization reactions for compatibility with capillary electrophoresis separation methods.

Spiked urine samples were extracted using Bond Elute Certify SPE (Varian) columns following manufacturer's suggested protocols. Samples were then diluted in dichloroethane and reacted with 50 microliters of 1-chloroethyl chloroformate by heating to reflux for 2-4 hours. The solvent was then removed, and the sample was pH adjusted to 8.5 with bicarbonate and reacted for 30 minutes with fluorescein isothiocyanate. The resulting compounds produced a fluorescent emission at wavelengths above 520 nm that was compatible with commonly used 488nm argon-ion lasers. Alternatively, samples were reacted with the dye Cy5 NHS ester in a mixture of triethyl amine and DMSO. These samples were analyzed using an inexpensive diode laser operating at 635nm with emission at 665nm.

Separation of derivatized samples such as opiates, which have very similar structures, can be particularly challenging by any method. To perform these separations by capillary electrophoresis, beta-cyclodextrins were added to the buffer in order to form highly specific inclusion complexes with the derivatized drugs. In addition, altering the formation constants of these complexes using a mixture of organic solvents further optimized separations. Sample analysis was performed using a Beckman P/ACE MDQ capillary electrophoresis system with LIF detector, and the method was developed to be compatible with microfluidic devices. The results provided a highly sensitive screening tool for specific drugs of abuse with detection limits as low as 50pg/mL.

Capillary Electrophoresis, Drug Analysis, Laser Induced Fluorescence

K29 Motor Vehicle Passive Cannabis Smoke Exposure and Intercept® Oral Fluid Testing

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The goal of this study was to determine if extreme passive exposure to cannabis smoke in a motor vehicle would produce positive results for delta-9-tetrahydrocannabinol (THC) in oral fluid tests.

"Passive cannabis smoke exposure" is an explanation offered by cannabis users for positive urine tests conducted in workplace programs. This defence has not been reported in more than 15,000 oral fluid positive cannabis tests in workplace programs, but might be attempted. This presentation will impact the forensic community and/or humanity by providing results from this study that demonstrate that such claims have no scientific basis absent the extreme conditions described. This information is essential in interpretation of oral fluid tests by forensic toxicologists and Medical Review Officers.

The objective of this study was to determine if extreme passive exposure to cannabis smoke in a motor vehicle would produce positive results for delta-9-tetrahydrocannabinol (THC) in oral fluid tests.

Passive exposure to cannabis smoke in an unventilated room has been shown to produce a transient appearance of THC in oral fluid for up to 30 minutes (1,2). However, it is well known that such factors as room size, ventilation conditions, and extent of smoke exposure can affect outcome results.

The authors conducted a passive cannabis study under extremely severe passive smoke exposure conditions in an eight-passenger van. The van had an approximate interior volume of 15.3 cubic meters. Four experienced, male cannabis users each smoked a single cannabis cigarette (mean 5.4 %THC) while seated inside the closed van in the presence of four passive, drug-free, male non-smokers. There were four rows of seats in the van; one cannabis smoker sat on each row alongside one passive subject. Cannabis cigarettes were lighted by the cannabis smokers in the van and smoked for approximately 20 minutes to completion. All doors and windows were closed and the van was turned off, providing no ventilation. After the completion of cannabis smoking, all participants remained in the closed, unventilated van for an additional 60 minutes.

Oral fluid specimens were collected with the Intercept® Oral Specimen Collection Device (OraSure Technologies, Bethlehem, PA) according to manufacturer's instructions. Oral fluid collections were made inside the van for the first 45 minutes. Participants were allowed outside the van after 60 minutes where specimen collection continued. Bilateral oral fluid collections (left and right side of the mouth) were made from all subjects at the following times: baseline; 0 (immediately at the end of smoking); 15, 30, 45 minutes inside the van, and 1; 1.25; 1.5; 1.75; 2; 2.5; 3; 3.5; 4; 6; and 8 hours outside of the van, and from passive subjects only at 10; 12; 24; 36; 48; 60; and 72 hours.

Oral fluid specimens were analyzed with the Cannabinoids Intercept® MICRO-PLATE Enzyme Immunoassay by OraSure Technologies (Bethlehem, PA) following manufacturer's procedures. Quantitative analysis of THC in oral fluid specimens was performed by GC-MS-MS. THC concentrations were adjusted for dilution (X3) and are reported as estimated neat oral fluid concentration. The screening and confirmation cut-off concentrations for THC in neat oral fluid were 3 ng/mL and 1.5 ng/mL, respectively. The LOD/LOQs for THC in the GC-MS-MS assay were 0.3/0.75 ng/mL.

Screening and GC-MS-MS results for the bilateral (simultaneous) oral fluid collections are shown side-by-side in Table I. Only results for specimens that tested positive in screening or GC-MS-MS were tabulated. The remaining oral fluid specimens collected from one through 72 hours tested negative in screening and confirmation with the exception of one specimen that appeared to be contaminated during handling of the Intercept collection device. The apparent contaminated specimen, collected at 2.5 hours by PASSIVE #C, screened positive and confirmed with a THC concentration of 3.0 ng/mL. The accompanying bilateral specimen collected simultaneously with the contaminated specimen screened negative and was negative for THC by GC-MS-MS at LOD.

Table I. THC Oral Fluid Screening (cutoff = 3 ng/mL) and Confirmation (cutoff = 1.5 ng/mL) Results for Passively Exposed Subjects (two specimens per time point, collected bilaterally).

Minutes	PASSIVE #A THC Screen	PASSIVE #A GC-MS-MS ng/mL	PASSIVE #B THC Screen	PASSIVE #B GC-MS-MS ng/mL	PASSIVE #C THC Screen	PASSIVE #C GC-MS-MS ng/mL	PASSIVE #D THC Screen	PASSIVE #D GC-MS-MS ng/mL	Mean GC-MS-MS (SEM), ng/mL
0	+/+	4.8/3.6	+/+	6.0/7.5	+/+	6.6/5.1	+/+	3.9/4.5	5.3/5.2 (0.6/0.8)
15	+/+	4.2/6.0	-/-	2.7/2.8	-/-	<1.5/1.8	+/+	3.9/2.3	3.6/3.2 (0.4/0.9)
30	-/+	3.3/4.8	-/-	2.4/1.6	+/-	3.0/<1.5	+/-	2.8/2.9	2.9/3.1 (0.2/0.8)
45	-/-	2.0/1.7	-/-	<1.5/<1.5	-/-	<1.5/<1.5	-/-	<1.5/2.6	2.0/2.1 (NA/0.3)

This study confirms and extends earlier findings (1,2) on the effects of passive exposure to cannabis smoke on oral fluid results. The risk of a positive test result in screening and confirmation for THC was limited to 30 minutes or less following passive cannabis smoke exposure under extreme environmental conditions.

The extreme nature of the conditions employed in this passive cannabis smoke study is worthy of comment. Each passively exposed subject remained seated alongside a cannabis smoker during the hour of passive smoke exposure inside the van. The cannabis smokers smoked cannabis cigarettes to completion. The van doors and windows remained closed throughout the study and the van was turned off, providing no ventilation. Oral fluid collections were made for the first 45 minutes inside the van in the presence of cannabis smoke further increasing the risk of environmental contamination during collection. Given the extreme nature of the conditions employed in this study, it is concluded that the risk of positive oral fluid tests from passive cannabis smoke exposure would not occur under realistic conditions.

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Cannabis, Passive Exposure, Oral Fluid

K30 An Unusual Case of Homicide by Chronic Methanol Poisoning

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The goal of this presentation is to present the forensic community with an unusual agent and method of homicide due to chronic methanol poisoning.

This presentation will impact the forensic community and/or humanity by alerting toxicologists that methanol can be used as an agent of

murder and is often initially misdiagnosed. In addition, it will alert the community that beverages can be used as a route to administer poisons chronically.

An unusual case of homicide by chronic methanol poisoning is presented. Prior to his poisoning, the victim a 37 yr-old man, was in good health and physically active, exercising and playing sports. Approximately, one month prior to his death, he complained of intermittent gastric distress, nausea, and episodes of shortness of breath. When his symptoms first developed, his physician considered heart disease; however, he underwent a stress echocardiogram that yielded normal findings. After a family gathering, the victim awoke the next morning "feeling sick." Despite burning in his throat, nausea, and shortness of breath he went to work; however, his symptoms increased during the day and he returned home. His gastric distress worsened, he vomited ten times, and his breathing became labored, at which point EMT's were called and he was transported to the hospital. On admission, he complained of severe gastrointestinal pain and tenderness, he was diaphoretic, tachycardic, mentally confused, and tachyapneic with labored breathing. Initial chemistries revealed a severe metabolic acidosis; pH 7.07; HCO_3^-, 2.3 meg/L; pCO_2, 8.0 mm Hg; glucose, 181 mg/dL. His calculated ion gap was 28 and osmol gap was 28. Serum toxicology findings were: methanol, 750 mg/L; other volatiles including ethanol, negative; ethylene glycol, negative; salicylate 2.8 mg/dL; acetaminophen and tricyclic antidepressants, negative. Despite hemoperfusion and ethanol antidote administration, the patient developed multi-organ failure and was pronounced dead two days after admission. The investigation revealed that the victim had no occupational or recreational exposure to methanol. The victim had a history of ingesting the nutritional supplement creatine. His wife would mix a large tablespoonful of this powder into 20 fluid ounce bottles of Gatorade. The victim had ingested such a bottle of Gatorade the evening before his hospitalization. Police recovered a bottle of prepared creatine/Gatorade from the victim's home refrigerator, two more bottles from a refrigerator at the victim's workplace and a 1/3 full bottle on his desk at work. All these items were found to contain approximately 1 fluid ounce of pure methanol. The recent medical history of the victim and toxicology findings were consistent with chronic exposure to methanol with increasing or an increased dose resulting in a fatal accumulation of the toxic metabolite formic acid. His continued physiological deterioration prior to and during his hospitalization, despite heroic treatment, is consistent with the delayed severe toxicity of methanol. The family member was convicted on charges of "first degree murder."

Homicide, Methanol, Poisoning

K31 Internet-Advertised Drug-Removal Products: Effects on Cocaine, Opiates, and Carboxy-THC in Hair

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The goal of this presentation is to show that products commonly advertised to remove drugs from hair only remove drugs from the surface of the hair samples. Various screening and extraction methods will be discussed.

This presentation will impact the forensic community and/or humanity by clarifying the methodologies required for reliable hair analysis.

Numerous products are advertised on Internet websites as being effective at removing drugs from hair. To test the effects of these products on results of analysis of hair for the presence of cocaine, opiates, and carboxy-THC, hair from a user of these drugs was treated with eight different products according to package instructions of the respective products. As a control, the hair was also treated with Prell shampoo. Following the Prell and experimental treatments, the hair was washed and analyzed for the presence of the drugs by routine procedures. Products tested included Bio-Cleanse™, Dr. Potter's Detoxifying Hair Mudd, All Drugs Follicle Cleanse, Totally Clean, Clear Choice, testPure All-In-One Cleansing Shampoo & Conditioner, AllClear Hair Purifying & Cleansing System. In addition, Nexxus Aloe Rid Shampoo and Clarifying Treatment were tested because, although they are not Internet products, there are websites claiming that use of these can remove drugs from hair. After Prell treatments, the washed hair contained an average of 152 (+ 27, S.D.) ng cocaine/10 mg hair, 12.5 ($\pm$ 2.5 ng, S.D.) morphine/10 mg hair, and 3.9 (average of duplicates) pg carboxy-THC/10 mg hair. After application of the various "removal" products, the results were essentially the same as the Prell results: 108 –177 ng cocaine/10 mg hair; 8.3 – 14.8 ng morphine/10 mg hair; and 2.6 – 4.4 pg carboxy-THC/10 mg hair. These products were thus shown to be ineffective, essentially equivalent to normal shampooing, at removing that drug in hair that is resistant to removal by effective laboratory washing.

However, for methods that do not extract the hair sample's full drug content for analysis, the products would require testing under the actual extraction conditions. It is known from a study performed in Psychemedics laboratory of cocaine users, for example, that contamination of users' hair samples with cocaine ranged from almost none to 20 times the amount of the hair content after washing. Therefore, screening methods that only partially extract the drug from the hair prior to analysis may not detect a positive sample that has been well cleansed of surface contamination by a cosmetic product. In such cases, the effects of various hair care and drug removal products should be tested under the conditions in use to detect positives.

Hair Analysis, Cocaine Opiates C-THC, Cosmetics Treatments

K32 Forensic Entomotoxicology: A Study in the Deposition of Amphetamines Into the Larvae of the Black Blow Fly, *Phormia regina*

Michelle R. Peace, MFS, Virginia Commonwealth University, 1000 West Cary Street, Richmond, VA 23284; Alphonse Poklis, PhD, Department of Pathology and the Forensic Science Program, Virginia Commonwealth University, Richmond, VA 23284*

The goal of this presentation is to better understand the potential implications of using insects as a toxicological specimen.

This presentation will impact the forensic community and/or humanity by helping to build a database to better understand the utility using insects as a toxicological specimen.

Due to events in severe decomposition, either no soft tissue remains on which to perform a toxicological analysis or putrefactive fluids complicate and interfere with the analysis of the soft tissues. The purpose of this experiment was to study the trends in the deposition of amphetamines into the larvae of the black blow fly, *Phormia regina*, in order to better understand the value of entomological evidence as toxicological specimens. Drug deposition was analyzed by linear regression to find a correlation between whole larvae drug concentration and food source drug concentration. *P. regina* larvae were raised at 21ºC on pork homogenized with three concentrations of ephedrine (36.5, 73, 146 mg/kg), methamphetamine (1.5, 3, 6 mg/kg), and fenfluramine (25, 50, 100 mg/kg). The middle dosage of each drug reflected the LD_{50} of the drug in rabbits. At the end of the feeding stage, the larvae were harvested, washed, and frozen. Ten larvae were subsequently homogenized, diluted in 2 ml water, and subjected to a liquid-liquid extraction. The extracted drugs were derivatized with HFBA and analyzed by GC/MS. In the concentration ranges investigated, the concentrations of ephedrine, methamphetamine, and fenfluramine found in the larvae correlated with the concentration of the drug in the food source (R^2 = 0.9081, 0.9886, and 0.8302 respectively). Fenfluramine was the only drug which biotransformed in the larvae to a

known metabolite, norfenfluramine. The concentrations of fenfluramine and norfenfluramine were added to reflect the total concentration of "fenfluramine" extracted from the larvae. As a result, the concentration of total fenfluramine in the larvae was found to correlate more strongly (R^2 = 0.9107) with the concentration of drug in the food source. The data showed that with increasing concentrations of drug in the food source, the more drug that was accumulated in the larvae and subsequently extracted.

Entomology, Toxicology, Amphetamines

K33 The Quantitation of Sildenafil (Viagra®) and its Metabolite (UK-103,320) in Postmortem Specimens Using LC/MS/MS/MS

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Attendees will be briefed on an analytical method for the quantitation of sildenafil and its active metabolite in postmortem fluid and tissue specimens.

This presentation will impact the forensic community and/or humanity by demonstrating an introduction to applicable LC/MS methodology.

During the investigation of fatal civil aviation accidents, postmortem samples from accident victims are submitted to the FAA's Civil Aerospace Medical Institute for toxicological analysis. The FAA Laboratory develops analytical methods for the identification and quantitation of compounds that may be encountered. This presentation describes a rapid and reliable method for the identification and quantitation of sildenafil (Viagra®) and its active metabolite, UK-103, 320, from postmortem tissues and fluids. This procedure incorporates solid-phase extraction and LC/MS/MS/MS utilizing an atmospheric pressure chemical ionization (APCI) ion trap mass spectrometer (MS) in the positive ionization (PCI) mode. Solid-phase extraction provided an efficient sample extraction yielding recoveries of approximately 80%. This method is highly selective and sensitive, having a limit of detection of 1 ng/mL for both compounds. Sildenafil and UK-103, 320 were found to have a linear dynamic range of 2-800 ng/mL and 4-800 ng/mL, respectively. This procedure showed intra-day (within day) relative errors of £ 6% and relative standard deviations (RSDs) within 4% for both 50 ng/mL and 200 ng/mL controls. The inter-day (between day) relative errors were £ 4%, while the RSD was within 12% for both control concentrations. Sildenafil and UK-103,320 were shown to be stable in blood for at least one week at 4°C. This method was applied to fluid and tissue specimens collected from two separate fatal aviation accident victims. The concentrations of these two compounds in various specimens will be discussed.

Sildenafil, LC/MS, Postmortem

K34 Methylenedioxymethamphetamine (MDMA)-Related Deaths in Ontario, Canada (1999-2002)

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Attendees will be provided a retrospective review of the role of MDMA (3, 4 methylenedioxymethamphetamine) in sudden unexpected deaths in the province of Ontario, Canada over the four-year period from 1999 to 2002.

This presentation will impact the forensic community and/or humanity by adding to the current database of knowledge regarding postmortem blood MDMA concentrations. Exemplar cases to be included in the oral presentation will also further understanding of the type of toxicities observed following MDMA overdose. One of the unique aspects of this research is that it provides information for a region (Ontario, Canada) that has not yet been documented in the scientific literature. However, this research shows that the data for Ontario concurs with previously published research from the U.S. and abroad.

Introduction: MDMA and its pharmacologically active metabolite methylenedioxyamphetamine (MDA) were initially synthesized for use in clinical practice as appetite suppressants but have evolved as popular street drugs. In particular, MDMA ("Ecstasy," "Love Drug," "E") has been associated with the dance music community and all-night rave parties as a result of its CNS stimulant effects, which allow users to resist fatigue; and its mild hallucinogenic properties that enhance the visual light shows at these venues. As a result of the current popularity of MDMA, it is often the role of the forensic toxicologist to interpret blood concentrations of this drug. It has been noted, however, that there are difficulties in interpreting postmortem concentrations of MDMA and MDA. Fatal MDMA concentrations have been shown to vary widely depending on the circumstances under which the drug is administered. This data will further the understanding of MDMA blood concentrations through (1) comparison of MDMA blood concentrations in deaths attributed solely to MDMA intoxication with blood concentrations in cases where MDMA was deemed incidental, (2) exemplar case histories, and characterization of the circumstances surrounding MDMA-related deaths and (3) review of the demographic characteristics of MDMA-related deaths in the current study and in the scientific literature.

Methods: MDMA-related deaths were retrospectively identified from the files of the toxicology sections of the Centre of Forensic Sciences and the Northern Regional Laboratory, which provide the sole toxicology testing for coroner's investigations in the province of Ontario (approx. population 12 million). Inclusion criteria were the: time periods between 1999 and 2002 and the detection of MDMA and/or MDA in postmortem blood. Further case history information pertaining to the circumstances of death, autopsy findings, and cause and manner of death was obtained from the Office of the Chief Coroner of Ontario.

Identification of MDMA and its major metabolite MDA (methylenedioxyamphetamine) were by GC-NPD and GC/MS following liquid-liquid extraction. Quantitation of MDMA and/or MDA was by GC-NPD after derivatization with acetic anhydride.

Results & Discussion: MDMA and/or MDA were detected in 37 postmortem cases in the province of Ontario for the years 1999 to 2002, inclusive. The typical MDMA-related death was young (mean age=26 years) and male (n=33). Although the range of ages observed was 16 to 50 years, 74% of individuals were found to be less than 30 years of age at the time of their death.

The mean blood MDMA concentration in deaths attributed solely to MDMA intoxication was 6.3 mg/L (n=11, range=0.4-27 mg/L) with corresponding MDA concentrations ranging from traces (<0.1 mg/L) to 3.8 mg/L. This concentration range was found to overlap with MDMA blood concentrations detected in traumatic deaths (e.g. GSW, MVA, drowning) where MDMA was considered an incidental finding (n=14, mean=0.7 mg/L, range=traces-2.5 mg/L). MDA concentrations ranged from undetectable to 0.1 mg/L. The remaining 12 MDMA-related deaths were attributed to overdose with a drug other than MDMA (e.g. heroin (n=3), methadone (n=1)) or were ruled to be mixed-drug intoxications by the investigating coroner. Blood MDMA concentrations in these cases were similar to concentrations observed in the traumatic deaths (mean=0.7 mg/L, range=undetectable-1.9 mg/L). MDA concentrations were also similar, with the exception of one, mixed-drug intoxication case, which was found to have a blood MDA concentration of 12 mg/L.

On an annual basis, the number of MDMA-related deaths over the time period studied did not change. However, a trend in the circumstances under which MDMA was taken was noted. For example, fatal MDMA intoxications in more recent years were less likely to be associated with rave parties (0/3 deaths in 2002). This observation may be due to the influence of harm reduction organizations as well as a decreasing trend towards all-night rave parties.

MDMA, Drug Concentrations, Postmortem

K35 Interpretation of Glucose and Lactate Levels in Postmortem Vitreous Fluid

Henrik Druid, MD, PhD, Joakim Strandberg, BA, Kanar Alkass, Kugelberg C. Fredrik, PhD, and Per Holmgren, Department of Clinical Pharmacology, Linköping University, University Hospital, Linköping, SE-581 85, Sweden*

After attending this presentation, attendees will attain a more in-depth understanding of the interpretation of postmortem levels of glucose, lactate, and electrolytes.

This presentation will impact the forensic community and/or humanity by making the forensic scientist understand the advantages and the shortcomings with vitreous fluid analysis, and how hyperglycemia may be diagnosed postmortem.

Background: In order to identify an antemortem hyperglycemia in postmortem cases, it has been suggested that d-glucose levels could be used. Since one glucose molecule during anaerobic conditions is converted to two lactate molecules several investigators have proposed that the sum of the glucose and the double of lactate levels be used in postmortem cases. The authors decided to study the vitreous concentrations of glucose, lactate and potassium in a large number of cases to evaluate the use of this data in medicolegal investigations.

Material and methods: 0.15 mL vitreous fluid was gently aspirated from the center of the eye (Cloquets canal) from 374 consecutive cases as soon as possible after arrival of the body to the morgue. The fluid from both eyes was pooled. Glucose, lactate and electrolytes were analyzed with ion-specific electrodes, using a Radiometer AVL500 blood gas instrument. A separate study was conducted on whole-vitreous samples; the samples were vortex-mixed, and half of the fluid was then transferred to a separate tube containing NaF at a concentration of approx 1%. Both samples were centrifuged and analysis was carried out on the supernatant and the pellet. In addition, separate samples were treated similarly, but were also subjected to sonication before centrifugation.

Results: Mean postmortem glucose levels in the consecutive cases was 0.99 mmol/L, but the median was as low as 0.1 mmol/L. Lactate levels increased linearly with time after death, as assessed by the vitreous potassium concentration, except for a minor proportion of cases that still showed low lactate levels even after long postmortem intervals. There was no obvious drop in glucose levels with increasing potassium levels, suggesting that glucose stays stable after the initial phase. In three cases, very high glucose levels were found (57, 46, and 23 mmol/L), and the cause of death was certified as hyperglycemia. In additional cases hyperglycemia might have contributed to death. Regarding "whole-vitreous" samples, the addition or omission of NaF did not affect the concentrations of glucose, lactate, or potassium. Further, analysis of the supernatant and the pellet after centrifugation yielded the same results. Sonication of the samples before centrifugation did not affect the results either. Re-analysis of several samples after long periods of storage showed similar results as the primary analysis.

Conclusion: Vitreous fluid is a robust matrix, and suitable for postmortem chemistry. As to the analysis of electrolytes, glucose and lactate, it is not necessary to centrifuge the samples, or to add fluoride, to avoid further changes. To estimate the antemortemantemortem blood glucose levels, d-glucose alone should be used. Lactate is of no value for the diagnosis of hyperglycemia.

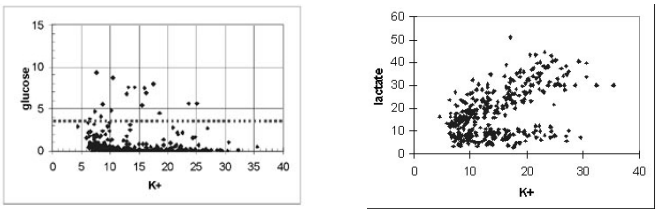

Fig 1. (left) Elevated glucose levels may be found even at long postmortem intervals (highest values not shown). (right) Lactate values do not assist in the diagnosis of hyperglycemia.

Postmortem Chemistry, Glucose, Fatal

K36 Investigation of Cocaine Metabolite Concentrations in Postmortem Cases

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Attendees will learn the cocaine metabolic pathway; understand the methodologies used for quantitatively measuring cocaine and 13 cocaine metabolites in postmortem blood and urine; and acquire information concerning cocaine metabolite concentrations in postmortem specimens.

This presentation will impact the forensic community and/or humanity by providing preliminary data to suggest that analysis of minor cocaine metabolites may aid in the differentiation of cocaine from non-cocaine related deaths.

Toxicological testing of apparent cocaine-related deaths typically involves identification, confirmation, and quantification of the parent analyte (cocaine) and a selection of cocaine metabolites, for example: cocaine (COC), benzoylecgonine (BE), cocaethylene (CE), and ecgonine methyl ester (EME). CE is produced if cocaine is used with ethanol. Other analytes that may be measured include anhydroecgonine methyl ester (AEME), a pyrolysis product, and norcocaine (NCOC). A previous study of 13 cases [Jenkins and Goldberger, *J. Forensic Sci.* 42(5): 824-827, (1997)] found no relationship between cause of death and concentrations of cocaine, BE, EME, and/or CE. However, it is not known if these analytes in addition to other cocaine metabolite concentrations could be useful in understanding cocaine related deaths.

This study examined a total of 13 cocaine metabolites from 103 cases, containing both cocaine and non-cocaine related deaths in postmortem blood and urine. The analytes of interest included AEME, EME, ecgonine ethyl ester (EEE), NCOC, norcocaethylene (NCE), *o,m,p*-hydroxycocaine (*o,m,p*-HOCOC), CE, norbenzoylecgonine (BNE), and *o,m,p*-hydroxybenzoylecgonine (*o,m,p*-HOBE). The COC and BE findings for 100 of these cases have been previously reported [Jenkins, Levine, Titus, and Smialek, Forensic Sci. Int. 101:17-25 (1999)] and will not be discussed in this report.

Heart blood and urine specimens from postmortem cases were analyzed according to a previously published method [Cone, Hillsgrove and Darwin, Clin. Chem. 40 (7): 1299-1305 (1994)]. Briefly, buffered specimens were extracted with calibrators and controls using deuterated internal standards by solid phase extraction followed by gas chromatographic/ mass spectrometric analysis of the silyl derivatives.

Cases were divided into 2 groups for evaluation: those cases in which "cocaine intoxication" was listed as the cause of death were classified as cocaine related; and those for which cocaine intoxication was not listed in the cause of death were classified as non-cocaine related deaths. This latter group included gunshot wounds, drowning, asphyxia, blunt force injuries, as well as deaths determined to be due to other drugs (narcotics, alcohol, N=15).

There were 34 cocaine related deaths. Metabolites were grouped according to the prevalence in which they were found positive in the various cases. Other than BE (previously reported) the two most common metabolites detected were EME (N=33 for blood, N=34 for urine), followed by *m*-HOBE (N=29 for blood, N=34 for urine). The concentration ranges (mean +/- SD) of EME in blood and urine specimens were 16-6413 ng/ml (835.8 +/- 14.9 ng/ml) and 6-179524 ng/ml (11183.7 +/- 309.3 ng/ml), respectively and for *m*-HOBE, the concentration ranges were 4-563 ng/ml (72.9 +/- 14.7) and 5-166804 ng/ml (5190.4 +/- 281.7), respectively. In the blood specimens, other analytes were found in the following order, from most common to least common: *p*-HOBE (N=29); EEE, CE, and *o*-HOBE (N=25); *p*-HOCOC (N=21); *m*-HOCOC (N=18); AEME (N=14); BNE (N=13); NCOC (N=12); *o*-HOCOC (N=9); NCE (N=2). However, the urine specimens demonstrated a slightly different prevalence: NCOC (N=33); *m*-HOCOC, CE, *p*-HOBE (N=32); EEE (N=31); *p*-HOCOC (N=29); BNE (N=28); NCE (N=27); *o*-HOBE (N=15); *o*-HOCOC (N=9).

There were 69 non-cocaine related deaths. In these cases, apart from BE, the same two common metabolites in cocaine-related deaths were most prevalent: EME (N=68 for blood, N=69 for urine) and *m*-HOBE (N=52 for blood, N=69 for urine). The concentration ranges (mean +/- SD) of EME in blood and urine were 2-717 ng/ml (155.6 +/- 16.4) and 28-54939 ng/ml (6112.9 +/- 108.7) respectively and for *m*-HOBE, the ranges and mean concentrations were 1-1171 ng/ml (43.7 +/- 15.0) and 7-62751 ng/ml (3284.4 +/- 110.8) respectively. In the blood specimens, other analytes appeared in the following order, from most common to least common: *p*-HOBE (N=49); CE (N=46); *o*-HOBE (N=43); *p*-HOCOC (N=40); EEE (N=33); *m*-HOCOC (N=32); AEME (N=15); BNE (N=10); *o*-HOCOC (N=8); NCOC (N=7); NCE (N=6). For the urine specimens prevalence was as follows: NCOC (N=69); *m*-HOCOC, *p*-HOBE (N=68); CE (N=67); EEE (N=65); *p*-HOCOC, BNE (N=58); NCE (N=53); AEME (N=51); *o*-HOBE (N=39); *o*-HOCOC (N=24).

Minor metabolites of cocaine are readily detectable in postmortem specimens. It appears the most prevalent minor metabolites detected in both cocaine and non-cocaine related deaths were *m*-HOBE and *p*-HOBE. However, there were some differences between the two groups. In blood, AEME, EEE, *o*-OHCOC, and BNE were more than twice as likely to be present in cocaine related deaths and NCOC was more than three times as likely to be present than in non-cocaine deaths. More variability was observed with the urine data. The data demonstrated that the mean concentrations of the majority of metabolites in blood and urine were lower in the non-cocaine deaths than the cocaine-related deaths, except for NCE and EEE. This study has provided preliminary data to suggest that analysis of minor cocaine metabolites may aid in the differentiation of cocaine from non-cocaine related deaths.

Forensic Science, Toxicology, Cocaine Metabolites

K37 Topiramate (Topamax®) Positive Death Investigation and Impaired Driving Cases in Washington State

Ann Marie Gordon, MA, and Barry K. Logan, PhD, Washington State Toxicology Laboratory, 2203 Airport Way South, Suite 360, Seattle, WA 98134*

After attending this presentation, attendees will understand that topiramate is increasingly prescribed for seizure disorders and off-label use. This presentation gives context for evaluation of topiramate blood concentrations in two populations, death investigation cases, and suspected impaired drivers.

This presentation will impact the forensic community and/or humanity by providing information as to the topiramate concentrations detected in two populations, death investigations and suspected impaired drivers, and will assist other forensic toxicologists in interpreting the level of this drug in their own cases.

Topiramate (Topamax®) has been available since 1996 and has proven very effective for treating seizure disorders. As with many other anti-epileptic drugs (AED), topiramate has recently gained attention for its off-label use. A search in PubMed® disclosed articles describing topiramate use for the treatment and prevention of migraines, cluster headaches and childhood headaches; psychosis, mania, schizophrenia, bipolar disorder, depression and kleptomania; eating disorders including bulimia, binge eating obesity, anorexia nervosa, and as adjunct therapy to treat weight gain with olanzapine, SSRIs and other anti-psychotic medications; neuropathic pain; alcohol dependency and craving, morphine dependency; and benzodiazepine withdrawal. One article even described its use in treatment of refractive scars.

The effects of topiramate are concentration dependent and according to the manufacturer, not subject to the development of tolerance. Dosage for anti-seizure therapy ranges from 200 to 800 mg/day. Side effects include sedation, dizziness, ataxia, speech difficulty, nystagmus, and paresthesia. Metabolic acidosis has been reported in 2 cases.

Peak plasma concentrations in patients stabilized on 800 mg/day have been reported at 5.5 mg/L. Blood/plasma ratios are inversely proportional to concentration averaging 7.1 at a blood concentration of 3 mg/L and 1.3 at a blood concentration of 15 mg/L.[1] Mozayani *et al.*[2] reported a topiramate overdose with blood levels of 8.9 mg/L, and Langman *et al.*[3] reported a fatal topiramate toxicity with a postmortem central blood concentration of 170 mg/L.

In an effort to evaluate the role of topiramate in human performance and death investigation casework, the authors reviewed the findings in all positive topiramate cases from 1998 to June 2004.

Topiramate was first detected in a death investigation case in 1998. Since then the authors have reported 107 cases positive for topiramate; 51 death investigations, 55 suspected impaired drivers and 1 sexual assault. The subjects were predominantly female (71%) and had a median age of 40 (mean of 41). The median blood topiramate concentration was 6.2 mg/L (mean 10.8 mg/L, range 1-180 mg/L).

In the subset of death investigation cases, the mean and median age was 40 (range 12 to 63) and 61% were female. The median blood topiramate concentration was 6.6 mg/L (mean 15.2 mg/L, ranged 1.25 to 180 mg/L). At least one other drug was detected in 94% of the death investigations and 91% of the drivers. In one case, an 18 year old, female with one prior suicide attempt, was found unresponsive by her father. She was prescribed topiramate, quetiapine and bupropion for bipolar disorder. Numerous capsules and empty pill bottles were discovered at the scene. Toxicological analysis revealed: topiramate 180 mg/L, quetiapine 34.9 mg/L, bupropion 0.12 mg/L, bupropion metabolite 1.56 mg/L, and atomoxetine 1.55 mg/L. The cause of death was ruled a combined quetiapine and topiramate toxicity and the manner of death was a suicide.

In the driving subset, there was a higher incidence of females (80%) and the median blood topiramate concentration was 6.1 mg/L (mean 6.7 mg/L, range 1 -20.4 mg/L).

One of the driving cases involved a 40-year-old male city bus driver. He had developed a seizure disorder in 1999, had corrective brain surgery in 2001 and was subsequently prescribed topiramate and lamotrigine. He was concerned that topiramate affected his ability to process information, caused him to respond slowly and made multi-tasking difficult, and had complained to his physician. Despite his complaints, his physician wrote a letter in support of his reinstatement as a driver even while trying to wean the subject from his topiramate. In December 2003, the subject struck and killed a co-worker in the bus yard. The driver was evaluated by a drug recognition expert (DRE). During the evaluation he slurred his words and was noted to have coordination and balance difficulties. The DRE conclusion was that the subject was under the influence of a CNS depressant. The toxicological findings revealed lamotrigine concentration of 6.6 mg/L and a topiramate concentration of 3.7 mg/L. What is the conclusion regarding the significance of both drugs here? Any interaction?

Information on blood concentrations of topiramate is scant. This review of 107 cases including both death investigations and suspected impaired drivers found the median blood concentrations to be approximately 6 mg/L in both populations, and identified cases in which topiramate was implicated as the principle causative agent in deaths, and played a role in causing driver impairment.

References:

1. Baselt, R. *Disposition of Toxico Drugs and Chemical s in Man*, 6th ed, Biomedical Publications, Foster City, CA, 2002, pp 1045-1046

2. Mozayani, A, Carter J and Nix R. Distribution of topiramate in a medical examiner's case. *J. Anal Toxicol*. 1999 Oct; 23(6): 556-8.

3. Langman LJ, Kaliciak HA and Boone SA. Fatal acute topiramate toxicity. *J. Anal Toxicol.* 2003 Jul-Aug; 27 (5): 323-4

Topiramate, Death Investigation, Imparied Driver

K38 Drugs in Driving Fatalities in British Columbia, Canada

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Attendees will be briefed on the drugs commonly associated with driving fatalities in BC, Canada.

By understanding the drugs commonly associated with driving fatalities, this presentation will impact the forensic community and/or humanity by helping to design appropriate interventions for target groups.

Objective: Since January 1, 2004, the Provincial Toxicology Centre and the British Columbia Coroner's service have implemented a policy that allows for complete drug screening on all samples collected from driving fatalities. This abstract represents a preliminary review of these results (from January 1, 2004 to June 30, 2004), however, the data presented will cover cases collected from January 1, 2004 until December 31, 2004.

Methods: Toxicology results were included in the study, retrospectively from cases where the deceased was identified as the driver involved in a fatal motor vehicle incident investigated by the BC Coroner's service. Drug screening was performed for illicit drugs including morphine and cocaine and metabolite (COC) and cannabinoids (THC) by immunoassay. Basic drugs were screened by liquid-liquid extraction followed by GC-NPD and GC-MS electron impact detection. Acidic and neutral drugs were screened by liquid-liquid extraction followed by HPLC-DAD. Amphetamine type stimulants (AMP) were screened by LC-MS. Volatiles was assayed by GC-FID.

Results: During the first 6 months of the year there have been 96 driving fatality investigations, where a full drug screen was conducted. The mean age (SD) of cases was 35y (13y), the median 32y, and the range 15 - 66y (N=90). The gender was identified in only 48 of the cases; 38 males and 10 females. Approximately 33% (N=34) of the cases had a negative toxicology screen. The mean age of these cases was 35y (15y), the median was 31y, and the range was 15 - 60y (N=32). The remaining 67% of cases (N=62) had at least one drug identified. The mean age was 35y (12y), the median was 33y, and the range was 16 - 66y (N=58). Of the cases containing drugs, 36 had one drug detected, 15 had two, 7 had three, 2 had four and 2 had five. Ethyl alcohol (EA) was detected most frequently in 58% (N=36) of cases. The mean EA concentration was 0.16 ± 0.10 % (35 ± 21 mmol/L) median 0.18 (39 mmol/L). The following drugs and the mean (SD), median and range of ages is described:

	Age (y)				
Drug	**Mean**	**SD**	**Median**	**Range**	**N=**
Ethyl alcohol	33	10	33	16 - 51	36
Cannabinoids	29	12	34	16 - 62	17
Cocaine and metabolite	33	14	30	16 - 66	16
Opiates				23 - 57	7
Amphetamine Type Stimulants				22 - 66	7
Other prescription drugs	37	12	40	16 - 62	28

Of the AMP group, there were 5 cases that contained methamphetamine, one with MDMA, and three with pseudephedrine. One case contained all three. In the opiate containing cases, all had levels of morphine with two of the cases having low levels of codeine, while one case identified MAM. In the cases where EA was identified the most commonly additional identified drugs were COC (N=9), followed by THC (N=5).

Conclusions: The preliminary study indicated that EA is the drug most frequently associated with driving fatalities, followed by THC and COC. There doesn't appear to be a significant difference in the ages of the cases and the different drugs detected. However, due to the relatively small number of cases in the preliminary study, any difference may not yet be apparent. Examination of the data for the year will give a more complete assessment of the demographics of the driving fatalities in BC.

Drugs, Driving, Fatalities

K39 Suicide by Acute Cyanide Ingestion in a 40-Year-Old Male

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Attendees will learn of the use of an unusual compound in the commission of suicide at the workplace and the methods used to analyze this compound.

This presentation will impact the forensic community and/or humanity by providing a reminder that autopsy findings in acute cyanide ingestions do not necessarily reveal the nature of the poison and not all toxicology laboratories are equipped to perform cyanide screening. It is therefore essential that the circumstances of the fatality and case history be closely examined.

Ingestion of cyanide is a rapid and effective means of suicide. While cyanide is not readily available in the average place of employment, certain occupations do employ its use and subsequently provide access to this deadly poison. This report describes the autopsy findings and laboratory results of an individual with suicidal intent and occupational opportunity to choose cyanide as the means of his demise.

The deceased was a 40-year-old Caucasian male employed in an electroplating facility where potassium cyanide, silver cyanide, and sodium cyanide were routinely used. According to a supervisor at the workplace, the decedent had a history of depression and had recently exhibited suicidal tendencies. A family member stated that the decedent's brother had committed suicide in 1979. During the morning break period at the electroplating facility, the decedent slipped away unnoticed and was found minutes later unresponsive at his desk. The medical response team initiated CPR and observed a bluish facial color and foaming at the mouth. He was transported to the Lake County Coroner's Office for autopsy. External examination of the body was unremarkable, with notation of an oral endotracheal tube and a 1½-inch irregular laceration of the left posterior parietal scalp. Internal examination revealed severe pulmonary edema. Examination of the gastro-intestinal system gave no indication of esophageal or gastric mucosa inflammation. Microscopic description of the lung indicated intra-alveolar hemorrhage and vascular congestion. No other significant findings were reported.

Routine toxicology testing, including a volatile screen, drugs of abuse screen and general drug screen, was performed on postmortem blood with negative results. Qualitative detection of cyanide was performed using the Merckoquant Cyanide Test [Merck KGA, Darmstadt, Germany] with a blue/lavender color indicating the presence of dissociable cyanide ions. The limit of detection of the qualitative method is 0.2 mg/L. Confirmation and quantitation of positive results was achieved by separation using microdiffusion and measurement with an electrode selective for cyanide ions. A five point curve utilizing 0.5, 2.0, 10, 50, and 100 ppm blood calibrators was generated; correlation coefficient = 0.99556. A low control of 1.0 ppm and a high control of 20.0 ppm were included. The limits of detection and quantitation were determined to be 0.1 ppm and 0.2 ppm, respectively. Linearity was demonstrated from 0.1 – 100 ppm. Analysis of available biological fluids and tissues was performed with the following cyanide results: blood (cardiac) 261.3 mg/L, blood (femoral) 13.7 mg/L, gastric contents 7024 mg/L, urine 1.3 mg/L, vitreous humor 4.5 mg/L, lung 25 mg/kg, liver 6.3 mg/kg, spleen 314 mg/kg. The death was ruled a suicide caused by acute cyanide intoxication.

Cyanide can be detected in the general population in blood concentrations of 0.040 mg/L or lower, with elevated results common in smokers. Reports of suicide in the U.S. by cyanide ingestion are infrequent, and, as this fatality demonstrates, are generally associated with individuals in occupations that employ the use of hydrocyanic acid and its sodium and potassium salts (such as chemists, metal polishers, exterminators, jewelers,

and electroplaters). Autopsy findings in acute cyanide ingestions do not necessarily reveal the nature of the poison and not all toxicology laboratories are equipped to perform cyanide screening. It is therefore essential that the circumstances of the fatality and case history be closely examined.

Cyanide, Suicide, Occupational Opportunity

K40 Fentanyl in Seven Medical Examiner's Cases in the City and County of San Francisco

Nikolas P. Lemos, PhD, Steven B. Karch, MD, Elin Lin, MS, Glenn Nazareno, MD, Venus Azar, MD, Jon Smith, MD, Amy P. Hart, MD, and Boyd G. Stephens, MD, Office of Chief Medical Examiner, Hall of Justice, North Terrace, 850 Bryant Street, San Francisco, CA 94103*

The goal of this presentation is to alert the general community on the apparent rise of fentanyl in medical examiner cases and will also aid forensic toxicologists in the interpretation of postmortem fentanyl levels.

This presentation will impact the forensic community and/or humanity by alerting the general community on the apparent rise of fentanyl in medical examiner cases and will also aid forensic toxicologists in the interpretation of postmortem fentanyl levels.

Fentanyl, a potent opioid analgesic and extremely potent □ agonist, is being detected with increasing frequency in medical examiner cases. At one time, fentanyl abuse was a practice largely confined to medical professionals with ready access. However the advent of the fentanyl patch has drastically changed the situation, and the pattern of abuse is becoming more like that observed with other, less exotic, drugs of abuse. Routes of administration for fentanyl include transdermal, transmucosal/oral, intravenous and combinations of the various routes. There are seven published reports of abusers heating patches and inhaling the vapors. The Office of the Chief Medical Examiner for the City and County of San Francisco serves a population of approximately 750,000 and this number has remained stable for several decades. In 2002, 1,463 cases came under the jurisdiction of the SFOCME; fentanyl was detected in blood, urine and/or tissue of seven cases, giving an incidence of 0.9 per 100,000 people, a rate of detection nearly twice that of MDMA. The data presented herein is the result of a retrospective analysis of all death investigations carried out by the SFOCME, from January 1, 2002 until December 31, 2002. The median age of decedents was 51.3 years (SD=9.0, range 37-71 years). Decedents were overwhelmingly male (86%), and predominantly white (57%). In 2002, the seven deaths were attributed to bronchopneumonia due to chronic polysubstance abuse (2 cases, 29%), complications of acute and chronic cocaine abuse & pulmonary emphysema (1 case, 14%), pulmonary hemorrhage due to complications of end stage renal disease & hypertension and acute and chronic drug abuse (1 case, 14%), asphyxia due to airway obstruction due to carcinoma on the tongue & polypharmacy (1 case, 14%), hypertensive arteriosclerotic cardiovascular disease & acute subdural hematoma (1 case, 14%) and unknown (1 case, 14%). Cocaine was present in two of the seven cases, as was diazepam and hydrocodone. Other drugs present in the postmortem specimens of these seven cases included alcohol, acetaminophen, amphetamine, chlorpherniramine, ibuprofen, methamphetamine, oxycodone, paroxetine, and trazodone. Fentanyl was extracted from biological specimens using liquid-liquid extraction for alkaline drugs and identified and confirmed/quantified by gas chromatography - mass spectrometry (GC-MS) in the electron impact ionization mode. The mean fentanyl blood concentration was 0.03 ± 0.01 □g/mL and the mean fentanyl urine concentration was 0.15± 0.10 □g/mL. In two cases where fentanyl was measured in the liver, the concentrations were 0.04 and 0.19 □g/g, respectively. Fentanyl was finally quantified in cerebrospinal fluid in one case and the concentration was 0.17 □g/mL. For comparison, a case review from another Medical Examiner's Department where a 55-year-old white female died of an acute fentanyl intoxication complicating treatment for chronic pain (with amitriptyline use listed as contributory cause) with a postmortem blood concentration of 0.02 □g/mL. In that case amitriptyline and nortriptyline were present in postmortem blood at concentrations of 1.1 and 1.1 □g/mL, respectively. These findings show that the City and County of San Francisco just like other areas of the country has experienced a rapidly increasing encountering of fentanyl in medical examiner cases. This may suggest that fentanyl is becoming an additional desired opioid similar to oxycodone and methadone. Expectations are that this study will alert the general community on the apparent rise of fentanyl in medical examiner cases and will also aid forensic toxicologists in the interpretation of postmortem fentanyl levels.

Fentanyl, Postmortem, Polysubstance Abuse

Last Word Society

LW1 The Axeman of New Orleans: One Killer or Two?

James A. Filkins, MD, JD, PhD, Department of Law, City of Chicago, 30 North LaSalle Street, Suite 1020, Chicago, IL 60602*

The goal of this presentation is to inform the forensic community of a notable historical case and to illustrate the importance of distinguishing serial murders from "copycat" crimes.

This presentation will impact the forensic community and/or humanity by underscoring the importance of trying to distinguish "copycat" crimes from serial murders so that investigative resources can be used most efficiently and the chances of catching the person responsible increased, while the possibility of apprehending the wrong person is decreased.

An ax murderer, known simply as the Axeman, terrorized New Orleans from the spring of 1918 to the fall of 1919. He attacked between midnight and dawn. The only eyewitnesses were the victims themselves and family members awakened by the sounds of a struggle. Those who survived or who did not die immediately could only offer vague descriptions of a large man in dark clothing. Local newspapers and the police believed that the crimes were the work of a single individual because of a pattern common to most of the attacks: an ax left at the scene, a chiseled out door panel, no evidence of theft, and an Italian-American victim. The single killer interpretation has largely prevailed to this day, but it has not gone unchallenged. Although most of the attacks followed the usual pattern, two deviated from it significantly enough to suggest that at least one "copycat" might have been at work.

Joseph Maggio and his wife were the first victims. On May 23, 1918, the couple was found in their home behind the grocery store they owned. They had each been struck with an ax and were the Axeman's only victims whose throats were also cut. A bloody ax and straight razor were left at the scene along with the chisel that had been used to remove a door panel. A small safe was open, but no money appeared to have been taken. The next morning, written in chalk on the sidewalk a block away, were found the words "Mrs. Maggio will sit up tonight just like Mrs. Toney." Police interpreted the writing to be a reference to a series of ax murders that had taken place in New Orleans in 1911. One of the victims had been Mrs. Tony Schiambra, presumably the "Mrs. Toney" mentioned in the writing. Only in the investigation of the Maggio attack was any reference to the earlier murders ever encountered.

Victims three and four were Louis Besumer, a Polish immigrant, and his common law wife, Anne Harriet Lowe. The Axeman used Besumer's own ax, which was found at their home, to attack the couple on June 28, 1918. A door panel had been also been chiseled out. Besumer survived the attack, but Lowe died six weeks later from her wounds. On August 5, 1918, Mrs. Edward Schneider became the Axeman's fifth victim. She recovered fully. In contrast to the previous attacks, no ax was found and no door panel had been removed. Five days later the Axeman struck again, returning to his custom of entering through a chiseled out door panel and leaving an ax at the scene. The victim, Joseph Romano, died two days later without ever giving any description of his killer. One of Romano's nieces, who was sleeping in the next room, only awoke in time to see a tall man in a dark suit and black hat, who quickly vanished.

For the next seven months the Axeman lay dormant. Then he struck in Gretna, Louisiana on March 10, 1919. His victims were Charles and Rose Cortimiglia and their baby daughter, Mary. Charles and Rose suffered fractured skulls, but survived. Mary died in her mother's arms. Once again a door panel had been chiseled out and an ax left at the scene. Rose could only describe a large white man wearing dark clothing and holding an ax.

The Axeman returned on August 10, 1919 when his attack fractured Steve Boca's skull. A bloody ax was found in the kitchen, a door panel had been chiseled out, and nothing had been stolen. Although Boca recovered, he could give no description of his assailant. The next victim, Sarah Laumann, also survived. The Axeman entered her home through an open window on September 3, 1919, but placed beneath the window the ax used in her attack. Although no one knew it at the time, the last attack took place on October 27, 1919. Awakened by the sounds of a struggle, Mike Pepitone's wife rushed into her husband's bedroom to find him dead and covered in blood. She glimpsed the Axeman as he fled through another door, but could provide no better description of him than any of the other witnesses. Once again a chiseled out door panel provided the means of entry and an ax the intruder's calling card.

In all, there were eight discrete attacks involving a dozen victims. Six of the twelve died. Eight victims were Italian-American and, of these, all but one was a grocer or a member of the grocer's family. In seven of the eight attacks an ax was left at the scene; in six, a door panel had also been chiseled out. The attacks on Mrs. Edward Schneider and Sarah Laumann deviated most significantly from the pattern and are the two attacks thought most likely to represent the work of a "copycat." Neither victim was Italian; the assailant entered through a window, and only at the Laumann scene was an ax found. The only other non-Italian victims were Louis Besumer and Anne Harriet Lowe, but apart from this deviation their attack followed the usual pattern. In two respects, however, all of the attacks deviated from the first one, the attack on the Maggios. First, only the Maggios had their throats cut suggesting deliberateness in the execution of their murders lacking in the attacks that followed. Second, only the investigation of the Maggio attack led to any reference to the 1911 ax murders suggesting the possibility of a connection between the deaths of the Maggios and the earlier murders.

The Axeman murders were never solved. The failure of the police to solve the crimes fueled public hysteria, which in turn intensified public pressure on the police department to make an arrest. At one point the police held two men in custody for different Axeman murders while publicly stating that all the murders were the work of one man. Altogether six men were arrested for one or another of the murders on the basis of negligible evidence or conflicting witness statements. Of the six, three men were tried; two were convicted and one was sentenced to hang. Although the convictions were reversed, the failure of the police to investigate the Axeman crimes in a coherent manner could have led to the execution of an innocent man.

The case of the Axeman of New Orleans underscores the importance of trying to distinguish "copycat" crimes from serial murders so that investigative resources can be used efficiently. It will never be known whether the New Orleans police would have been able to solve the Axeman crimes had modern forensic science and investigative techniques been available to them in 1918. When investigations lack direction and pursue conflicting theories, as in the Axeman case, the chances of catching the person responsible decrease while the potential for a miscarriage of justice multiplies.

Serial Killers, Copy Cat Crimes, Investigation

LW2 Who and What Killed the Kingfish?

James A. Filkins, MD, JD, PhD, Department of Law, City of Chicago, 30 North LaSalle Street, Suite 1020, Chicago, IL 60602*

The goal of this presentation is to illustrate the questions and problems created by the absence of autopsy findings for either the victim or his putative killer in attempting to understand the circumstances of a notable assassination.

This presentation will impact the forensic community and/or humanity by demonstrating underscoring the importance of forensic autopsies and investigations in answering questions about the circumstances of a homicide victim's attack and subsequent medical care.

Huey P. Long was the "Kingfish" of Louisiana politics from the late 1920s to the mid-1930s. His political career was meteoric: railroad commissioner, governor, United States senator, "dictator" of Louisiana, and martyr, all by the age of forty-two. Nearly seventy years after his death two questions still linger regarding the circumstances of his assassination – who killed him and what did he die from? Had autopsies been performed on Huey Long and the man generally thought to be his assassin, Carl Weiss, perhaps these questions could be answered more satisfactorily and the controversy surrounding his medical care and death avoided.

Born on August 30, 1893, in Winnfield in north central Louisiana, Huey Pierce Long was the seventh of nine surviving children. In contrast to the image Huey would meticulously cultivate over the course of his political career, the Longs were not poor, dirt farmers. In fact, the family was well off, if not wealthy. All of the nine children, except Huey and his younger brother Earl, graduated high school and attended college. As a child Huey was precocious and restless. Although he lacked the patience to study and make good grades, in high school he excelled at debate. Huey was intelligent and read widely among the books and magazines available to him. His favorite book, one he reread throughout his life, was *The Count of Monte Cristo*. Of the book's protagonist, Edmond Dantes, Huey is said to have remarked, "that man in that book knew how to hate ... and until you learn how to hate you'll never get anywhere in the world."

Huey left high school shortly before he was to have graduated. In 1910 he went on the road as a traveling salesman who soon developed the ability and the reputation of being able to sell almost anything to almost anyone. By 1912 he settled briefly in Oklahoma where he attended the University of Oklahoma Law School for one semester. In 1913 he married Rose McConnell and began working as a salesman for the Chattanooga Medicine Company, a manufacturer of patent medicines. When the company folded in 1914, Huey and Rose moved to New Orleans. Huey enrolled as a non-credit student at Tulane Law School where he planned to take some courses and cram for the Louisiana bar examination. For the only time in his life Huey mustered the self-discipline to attend classes and study rigorously. His hard work paid off – he passed the bar and was sworn in on May 15, 1915. At 21 he was Louisiana's youngest lawyer and his political career was underway. As he later said, "I came out of that courtroom [where he was sworn in] running for office."

Huey was first elected to office as a railroad commissioner in 1918. Six years later he ran unsuccessfully for governor, but was elected the next time out in 1928 as "the friend of the common man." As governor, Huey ruthlessly pushed through the state legislature programs and taxes to improve highways, build bridges and to provide free textbooks to every school child in public and parochial schools. Louisiana State University, "my university" as Huey referred to it, became a special project of his. Academic standards improved and enrollment grew under his sponsorship. Just as ruthlessly, Huey set about consolidating his political power. He succeeded in forcing the legislature to give him control of major state agencies such as the Board of Health, the Department of Conservation, and Charity Hospital in New Orleans. Coupled with his control of the Highway Commission, at that time the largest pool of patronage jobs in the state, Huey's dominance of state politics was almost unassailable. Only when he proposed a tax on oil refinery products that could have led to the loss of the Standard Oil refinery in Baton Rouge, the largest in the South and a major employer, was he impeached and nearly convicted.

Undaunted at nearly losing the governorship and fueled by national political ambitions, Huey ran for and won a seat in the United States Senate in 1930. As senator, he advocated a program of "Share the Wealth," not just for Louisiana, but for the nation. None of the bills, however, that he sponsored as senator ever passed. Few even received more than a handful of votes. At the 1932 Democratic National Convention, Huey helped steer the nomination to Franklin Roosevelt on the fourth ballot. By 1935 Huey was positioning himself to challenge F.D.R. for the White House in 1936. That challenge never came. On Sunday, September 8, 1935, Huey Long's political career suddenly ended amid gunfire in the Louisiana state capitol.

Huey had attended a special session of the legislature that evening to make certain that his supporters would show up and vote for his legislative package the next morning. The session ended about 9:15 p.m. As Huey and his entourage were making their way out of the capitol, Dr. Carl Weiss, a local otolaryngologist, confronted them. Weiss fired his semiautomatic handgun at Huey, which he had concealed behind a straw hat, hitting the senator in the abdomen. At almost the same moment, Huey's bodyguards fired at Weiss striking him perhaps two dozen or more times. Thus, the official version of the assassination was that Weiss shot Huey and Huey's bodyguards shot Weiss. By the 1950s two alternatives to the official version began to gain some support. The first revisionist interpretation held that while Weiss pointed a gun at Huey and fired, the fatal shot was inadvertently inflicted by one of Huey's own bodyguards. Whether either of these two versions is correct, however, makes little difference to the issue of Weiss's guilt because either way Huey's death was attributable to Weiss's actions. A second revisionist interpretation exonerated Weiss. This interpretation held that an unarmed Weiss entered the capitol to confront Huey on a political matter, not to kill him. The two men argued and when Weiss struck the senator in the face, Huey's bodyguards opened fire on Weiss fatally wounding Huey in the process. The bodyguards then planted at the scene Weiss's semiautomatic, which they had taken from his car, to conceal their own culpability.

Meanwhile Huey was taken to Our Lady of the Lake Hospital where Dr. Arthur Vidrine, Long's personal physician, operated on him. Dr. Vidrine found an entrance wound on the abdomen just below the ribs and an exit wound on the back just below the ribs on the right side. Internally, Dr. Vidrine found only a small perforation of the large intestine at the hepatic flexure with minimal contamination of the peritoneum. The bowel perforation and the wounds of entrance and exit were sutured and the abdomen closed. Even in the pre-antibiotic era, Huey should have survived the wound. But by the time surgeons from New Orleans arrived in the early morning hours of September 9th, Huey's postoperative course had deteriorated significantly. Not until six hours after the operation was Huey catheterized. Bloody urine returned indicating a retroperitoneal injury, which Dr. Vidrine had apparently missed. By that point, Huey was too weak to withstand another surgery. Transfusions and intravenous fluids delayed the inevitable. On September 10, 1935, 30 hours after he was shot, Huey P. Long died. His last words reportedly were "What will my poor boys at L.S.U. do without me?"

Huey was never autopsied and his hospital records were sealed. The precise path of the bullet, the nature of the retroperitoneal damage, and the presence of additional injuries that could corroborate or rebut the account of a fight are unknown. No postmortem examination of Weiss was undertaken until he was exhumed in 1991. The Weiss exhumation provided useful evidence bearing on the assassination of Huey Long. Although other physical evidence has come to light over the years, in the absence of any autopsy findings for the "Kingfish" and his assassin, the questions surrounding the shooting and subsequent medical care of Huey Long will never be fully answered.

Autopsy, Assassination, Abdominal Wound

LW3 Dead Presidents

Adrienne S. Segovia, MD, Office of the Medical Examiner, County of Cook, 2121 West Harrison Street, Chicago, IL 60612*

After attending this presentation, attendees will gain insight into the standard of medical care in the eighteenth, nineteenth, and early twentieth centuries

Presidents are among the individuals in society who receive the best medical care. Their care, therefore, reflects the standard of medical care for the time in which they lived. This presentation will impact the forensic

community and/or humanity by demonstrating the examination of the treatment of four presidents which offers insights into the history of medicine and surgery.

The highest standards for the practice of medicine in a society are reflected in the care of its most famous and influential citizens. Among the famous and influential, the illnesses and medical treatments of the nation's presidents have always received widespread coverage. This is true regardless of the century. The illnesses and treatments of four past presidents, George Washington, Abraham Lincoln, James Garfield, and William McKinley, serve as a window into the history of medicine.

George Washington died three years after leaving the presidency. His medical treatment received criticism, both in the United States and in England. The illness that brought three physicians to Washington's bedside, one of whom had recently been appointed coroner, remains unclear. The diagnosis in 1799 was "cyanache trachealis." In post-colonial days this diagnosis referred to an inflammatory process of the glottis, larynx or upper part of the trachea. Several recent reviewers suggest the illness was epiglottitis. Many believe that George Washington died, not as a result of his illness, but from the treatment he received. This consisted of 4 to 5 bleedings, induced vomiting, intestinal purges, gargles and the application of blister powders to the neck. Between 1560 to 2460 milliliters of blood was removed in 18 hours. Hypovolemia due to excessive bleeding combined with purging, and lack of fluid replacement were more than contributory factors to Washington's death.

Criticism came from local and foreign sources. An English physician wrote in *The Medical and Physical Journal*, that it was "inexplicable" that so much bleeding should have been performed. Locally, one writer went so far as to say, "There can scarcely be a doubt that the treatment of his last illness by the doctors was little less than murder."

Abraham Lincoln was shot, while attending a performance of "Our American Cousin" at Ford's Theatre on April 14, 1865. John Wilkes Booth shot Lincoln in the back of the head with a .44 caliber Derringer. A head only autopsy was performed at the White House, the following day. To this day the path of the bullet, which was recovered, remains unclear. Until the 20th-century the cause of comminuted fractures in the anterior cranial fossa was thought to be the result of "contra coupe" fractures caused by the brain impacting and fracturing the thin orbital plates of the skull. There was however, little controversy surrounding the medical treatment of Abraham Lincoln. What remains clear today as it was in 1865 was that Lincoln would have died despite the vast improvements in medical care.

James Garfield was shot at the Baltimore and Potomac railroad station on July 2, 1881, while preparing to leave on vacation. At the time of the occurrence a single, District of Columbia policeman guarded him. Charles Guiteau, a dissatisfied, unstable office seeker, shot him. Guiteau fired two shots from a .44 caliber English bulldog revolver. The first bullet entered Garfield's back; the second grazed his sleeve. Garfield, whose progress was reported almost daily, survived until September 19, 1881. When he died his physicians were criticized and accused of malpractice. Garfield died from a ruptured traumatic aneurysm of the splenic artery. He had become septic; his physicians with their fingers and their instruments had probed his wound several times throughout his illness.

Criticism centered on the management of Garfield's wound. Even Guiteau argued that the President's death was the result of malpractice. Dr. Esmarch, professor of surgery from Kiel believed the cause of the suppuration was the result of the repeated probing with fingers and instruments. Physicians in the United States did not fault the finger probing – this was the accepted standard at the time. They faulted the use of instrument probes, which they argued were responsible for the creation of false passages. Few, but not many found fault with the nutritional management, which consisted of nutritive enemas, Garfield, had lost 85 pounds in 2½ months.

Garfield's physicians felt it was important to locate the bullet. Alexander Graham Bell became involved when his "induction balance" was used in an attempt to locate the bullet. Although unsuccessful, this work was later used in more elaborate form for the detection of land mines. The emphasis upon locating the bullet was also a point of criticism. Following the shooting, the physicians shot cadavers and dissected them in an attempt to identify the wound course. Many felt that these efforts were pointless.

The autopsy, which omitted the head, was performed on the emaciated, embalmed body of Garfield. Garfield's weight had dropped from 210 pounds to 125 pounds. The autopsy revealed a ruptured splenic artery aneurysm. The point of rupture was 0.4 inches long and occurred 2.5 inches from the celiac axis. The autopsy showed that the physicians had been wrong in their guess as to the course of the bullet through the body, and that probing the wound had in fact created a false passage. A subhepatic abscess, an abscess of the left kidney, and pus which tracked from the adipose tissue behind the right kidney into the right iliac fascia were identified. The bullet was recovered encased in fibrous tissue in the left retroperitoneal space.

President McKinley was shot at approximately 4:07 p.m. on September 6, 1901 while attending the Pan-American exposition in Buffalo, New York. Leon Czolgosz, an anarchist who believed in the destruction of all rulers, shot him. Czolgosz had an Iver Johnson .32 caliber revolver hidden in a bandage around his hand. McKinley was shot twice, one bullet grazed the upper sternum on the right side, and the second entered the left upper quadrant of the abdomen, involved both walls of the stomach at the greater curvature and grazed the upper pole of the left kidney. McKinley arrived by motor ambulance to an emergency hospital on the exposition grounds at 4:18 p.m. At 5:29 p.m., exploratory surgery was begun. Gaslights were present but could not be used because ether was the anesthetic agent. Initially, the fading rays of the sun had to be focused onto the operative field with a hand mirror until an electric light could be arranged. During the first week the President progressed satisfactorily and a full recovery was anticipated. However, on the seventh day, shortly after a favorable bulletin was issued, the President became progressively worse. He died at 2:15 a.m. on September 14, 1901. The autopsy was performed the same day beginning at 11:00 a.m.; it lasted four hours and failed to recover the bullet. Blood cultures and swabs from numerous sites were taken for culture. The barrel of the weapon, the empty shells and cartridges were also cultured because of speculation that the bullets had been dipped in toxin. The anatomic diagnoses were - gunshot wound involving both walls of the stomach with surrounding necrosis, gunshot involving the superior aspect of the left kidney, and necrosis of the substance of the pancreas. The death was attributed to localized necrosis surrounding the stomach and pancreas. It was believed that bacterial infection was not a factor.

Criticism at the time centered upon the lack of x-rays to locate the bullet after surgery; the lack of a drainage tube in the abdominal cavity; insufficient light, and not waiting for a more experienced surgeon. Dr. Mann, who performed the surgery, was well known in the field of gynecology. Although his practice was not limited to this area, it is reasonable to believe he had never before operated on a case involving a gunshot wound of the abdomen. Dr. Rosswell Park, a surgeon of international fame, was performing a surgery in Niagara Falls at the time. Park had been shocked at the management of Garfield twenty years before and had subsequently studied, lectured on, and written widely on gunshot wounds. Dr. Park insisted that it was necessary to do surgery extensive enough to debride the entire bullet track and that it was crucial to provide adequate abdominal drainage at the end of the procedure. Another criticism was that despite excellent hospital facilities in Buffalo the procedure was performed at a first aid station.

Although the comments here seem critical and the medical care provided in these four cases may seem negligent in some respects, current medical standards cannot be compared with those available in the days of Washington, Lincoln, Garfield and McKinley. Presumably they received the best medical care available. Their care therefore reflects the standards of medical care in the time in which they lived and held office.

Presidents, Assassins, History of Medicine

LW4 The Tragic Voyage of the Morning Dew

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After attending this presentation, attendees will be informed of the Morning Dew incident which illustrates the consequences of hypothermia and timing of death, as well as the legal issues resulting from failure of the Coast Guard to recognize a Mayday call from the doomed sailing vessel.

The Morning Dew incident will impact the forensic community and/or humanity by illustrating the consequences of hypothermia and time of death in cold water situations, as well as clarify the legal issues raised by failure of the Coast Guard to respond to a Mayday call.

In December 1997, a 49-year-old accomplished sailor MC and his two sons aged 16 PC and 13 JC drove from Hiltons, Virginia to Light Keeper's Marina in Little River, South Carolina, to pick up the sailing vessel Morning Dew ("S/V Morning Dew"), a thirty four foot sailboat purchased by the family one month earlier. A 14-year-old cousin BH accompanied the family on the trip. They intended to sail the vessel to Jacksonville, FL along the intracoastal waterway. They proceeded from North Myrtle Beach, SC into the ocean instead of following the intracoastal waterway. During this time, the National Weather service issued a small craft advisory with winds from the east expected to exceed twenty-five knots and with seas ranging from five to eight feet. Visibility was expected to be below one nautical mile. The actual conditions were observed to be windy, rainy and rough. At about 2:17 a.m. on December 29th, the Morning Dew collided with the north jetty leading into Charleston harbor and all persons on the sailing vessel were drowned. Because of prior communication to the Coast Guard by one of the sons of MC, and the failure of the Coast Guard to follow up the May Day call, the personal representatives of the decedents claimed the victims lost their lives because of the acts and/or omissions of the Coast Guard. The May Day call was not brought to light until December 31, 1997, and was finally disclosed to the state investigative agency, the South Carolina Department of Natural Resources on March 20, 1998. Moreover, another call for help by one of the boys was relayed to the Coast Guard by a 617 foot automobile carrier which was passing by the Charleston jetties. Evidence indicates that the father MC was immediately thrown off the sailboat at the time of the collision, and that the sons and nephew were left to survive on their own, in the hazardous conditions of the storm, and did survive approximately five hours. Issues of interest in this case include 1) the culpability of the Coast Guard, and their liability to suit (did they have a legal obligation to respond to a distress call), 2) survivability and times of death of the individuals involved, 3) drowning and hypothermia issues, 4) autopsy findings, 5) the role of the National Transportation Safety Board and many other agencies in the investigation of this disaster, 6) the culpability of the victims themselves in their own demises, 7) pain and suffering issues and, 8) the final outcome of the trial.

Drowning, Hypothermia, Time of Death

LW5 Whose Body Was in the Crippen Coal Cellar? A Mitochondrial DNA Research Project to Determine Identity

John H. Trestrail III, BS, DeVos Children's Hospital Regional Poison Center, Suite 203, 1300 Michigan Street, NE, Grand Rapids, MI 49503*

After attending this presentation, attendees will be briefed on the use of mtDNA in the identification of body parts, which can be identified in no other manner.

This presentation will impact the forensic community and/or humanity by demonstrating the possible solution of one of the most famous murders of the early 1900s.

Hawley Harvey Crippen, MD, was at the center of probably one of the most famous murder cases in the criminal history of the United Kingdom. Dr. Crippen, was born in the United States in 1862, and qualified as a physician in 1885. In 1887, he took up residence in London, England, representing *"Munyons's Homeopathic Remedies,"* a patent medicine company. In the year 1910, Dr. Crippen was accused of murdering his wife Cora (a.k.a. *"Belle Elmore"*), with the anticholinergic plant alkaloid Hyoscine (Scopolamine), in order to begin a new life with his secretary/mistress Ethel Le Neve. Cora was never found, but remains were recovered from the coal cellar at their home. Dismemberment is a most unusual occurrence for a homicidal poisoning crime, and Crippen's conviction was partly based on a small piece of human tissue recovered from the scene. Dr. Crippen was quickly found guilty of the murder of his wife, and in 1910 was hanged for the crime. This presentation will discuss the historical background of the case along with current research being carried out to determine if the remains were those of his missing wife.

Poison, Murder, Crime Scene

LW6 Lo, Though the Night Has No Eyes: Predawn Autopsy Exposes the Unforeseen

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The goal of this presentation is to familiarize the forensic community with Mary Lily Kenan Flagler Bingham's mysterious death on July 27, 1917 who was the richest woman in America at the time of her death.

This presentation will impact the forensic community and/or humanity by examining historical events surrounding the mysterious death of America's richest woman in 1917. Further examination of the circumstances of her death will clarify or refute previously documented findings.

David Chandler, author and Pulitzer Prize winner, presented three possible hypotheses to explain Mary Lily's controversial death, one of which implicated Robert Worth Bingham whom she had recently married. Other than dying from natural causes, Chandler's first hypothesis is that Bingham's actions contributed to her death because he would benefit financially, second that Bingham was a victim because he attempted to disguise her death to protect her reputation, and third that she caused her own death that may have been accidental or deliberate.

When Mary Lily was twenty-four, family friends, the Pembroke Joneses of Wilmington, North Carolina, invited her and a Peace Institute companion, Miss Elizabeth Ashley, to accompany them on a Caribbean cruise. Miss Ashley's aunt and uncle, Henry and Alice Flagler, were among the guests included on the cruise. Flagler, Standard Oil co-founder and entrepreneur, enchanted Mary Lily. Following the cruise, for approximately ten years, she and a female companion often traveled with the Flaglers from New York to Palm Beach in his private rail car. During this time, Flagler's wife, Alice, was admitted to an asylum due to her deteriorating mental condition. Flagler divorced Alice in 1901 when the Florida Legislature amended the state law that allowed divorce on the grounds of insanity. Flagler was a generous man and in the divorce settlement gave Alice substantial financial resources for her medical care. He married Mary Lily on August 24, 1901 at her ancestral home, Liberty Hall, in eastern North Carolina. Just as Flagler was generous toward Alice, Flagler's generosity for Mary Lily also included no boundaries. Flagler provided Mary Lily with the lifestyle she yearned for as a young woman. When she wanted a marble palace, he built Whitehall in Palm Beach for her.

On January 15, 1913 Flagler fell down the stairs at their residence in Whitehall. Five months later he died at the age of eighty-four. His estate was estimated to be worth $170 million. Mary Lily was to receive $100,000 annually and eventually the bulk of his estate would become hers.

When Flagler died, Robert Worth "Bob" Bingham, Mary Lily's college boyfriend, reestablished his relationship with her. They were married November 16, 1916 in New York. She paid Bob's debt of $1 million, gave him an annual salary of $50,000, and an estimated $695,000 in Standard Oil stock. Within less than a year after their marriage, her health began to decline. On July 12, 1917, a maid found her unconscious and slumped over the side of the bathtub in her Louisville, Kentucky residence. Two weeks later on July 27 Mary Lily was dead at the age of fifty.

Mary Lily's body was returned to Wilmington for burial. Approximately five weeks after she was buried, concerned family members obtained an exhumation order to perform an autopsy. After much effort to exhume Mary Lily's body, the autopsy took place in Oakdale Cemetery, Wilmington, North Carolina. At 3 a.m., on September 18, 1917, they examined samples of Mary Lily's vital organs to determine the possible cause of her death. The team concluded she had been subjected to enormous amounts of morphine and injected with adrenaline. Also, the autopsy team discovered traces of heavy metal poisons, namely elements such as arsenic and possibly mercury. Samples were taken to New York for further analysis; however, the autopsy and toxicological results were never publicly released.

Two months following Mary Lily Kenan Flagler Bingham's death, her body was exhumed in the dark of night to determine the cause of death. Led by Dr. Charles Norris, the autopsy team included Dr. Alexander Gettler, Dr. Ludvig Hektoen and Dr. William George MacCallum who had been assembled from around the country for their task. They labored throughout the night. The controversy over her death rages still.

Initially, the Kenan family planned to contest a codicil to Mary Lily's will that was filed in Kentucky that awarded a large financial sum to Bingham. When the state court ruled in Bingham's favor, the case was appealed but the Kenan family chose not to contest the codicil at the appellate level. Bingham inherited $5 million from Mary Lily's estate.

Mary Lily Kenan Flagler Bingham, Cause of Death, Autopsy

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