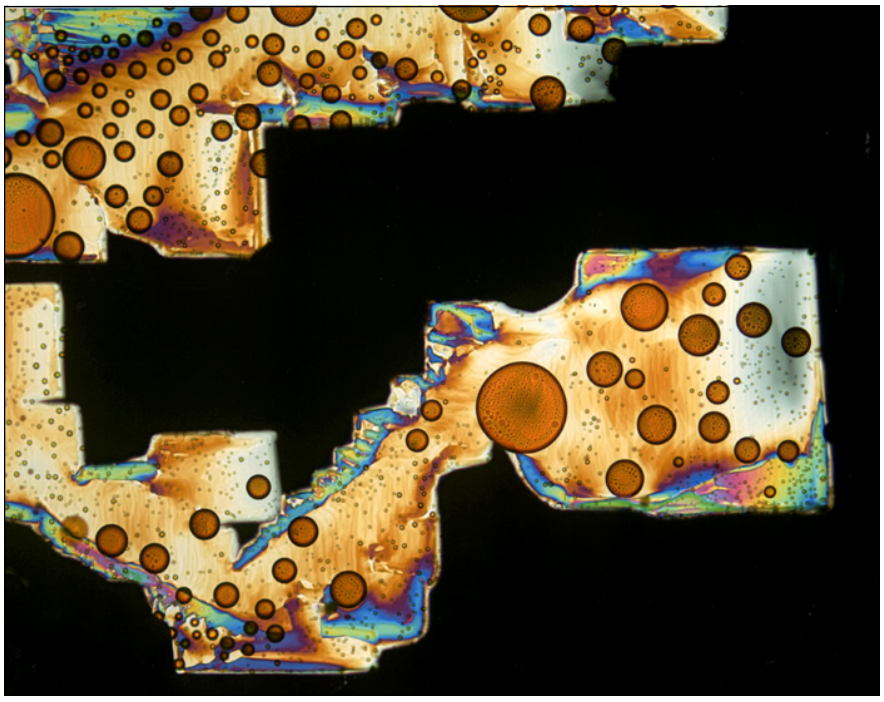
INTER/MICRO 2015

An International Microscopy Symposium
June 8 – 12, 2015
McCrone Research Institute, Chicago



Sponsored and hosted by
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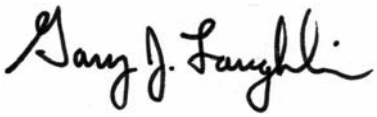
Welcome to Inter/Micro 2015

Microscopy includes any instrument or technique that enables the microscopist to characterize, identify and study microscopic substances. This includes all light and electron microscopes, microspectroscopes, microprobes, automatic image analyzers and other microscopes based on X-rays, sound, protons, etc. Inter/Micro presentations from some of the world's leading microscopists will cover new techniques for improving contrast, increasing resolution, and obtaining and recording more characterization data. You will also learn how new techniques and new instruments are used to solve important problems.

This year marks the 67th anniversary of the Inter/Micro conference, which was introduced by Dr. Walter C. McCrone in 1948 and is now held annually at McCrone Research Institute in Chicago. Inter/Micro gives all of us the opportunity to come up-to-date on new instruments, new techniques and new applications of microscopy and microanalysis.

We encourage all speakers to submit research papers based on their Inter/Micro presentations for publication in *The Microscope*, the official journal of this conference. Papers will be peer reviewed and published in the order they are received. Inter/Micro 2015 attendees can take advantage of an introductory one-year subscription for $38.50 (regular rate is $75).

Thank you for participating at Inter/Micro 2015.



Gary J. Laughlin
Chairman, Inter/Micro

Cover image by Sebastian Sparenga, McCrone Research Institute
This polarized light microscope image shows bismuth iodide recrystallized on a slide under a coverslip and viewed under crossed polars. The image was voted Best Overall Winner of the 2014 Inter/Micro Photomicrography Competition, sponsored by pH2, LLC.

MONDAY, JUNE 8
TECHNIQUES AND INSTRUMENTATION

8:00 a.m. – 5:00 p.m. Registration and packet pickup, McCrone Front Desk

9:00 a.m. – 12:10 p.m. Morning Session, McCrone Lecture Room

Chair: Kelly Brinsko, McCrone Research Institute

An Introduction to Digital Image Processing in Quantitative Microscopy
Aryeh Weiss — Bar Ilan University, Ramat Gan, Israel

Visualization of Latent Fingerprints Using Vacuum Deposited Silver
Martin Kocanda — Northern Illinois University, Department of Electrical Engineering

Are New Leeuwenhoek Microscopes Awaiting Discovery?
Brian J. Ford — Caius College, University of Cambridge

Characterization of Foreign-Object Debris in Jet Engines
Richard Brown — MVA Scientific Consultants, Inc.

Visual Derivation of the Michel-Lévy Interference Color Chart
Donald J. Petka — Orange County Crime Lab

Microchemistry: Not Such a Small Thing
Brendan Nytes, Christopher S. Palenik and Skip Palenik — Microtrace, LLC

A Modified Method of Dispersion Staining
Kelly Brinsko — McCrone Research Institute

12:10 – 2:00 p.m. Lunch Break, McCrone Garden

2:00 – 5:10 p.m. Afternoon Session, McCrone Lecture Room

Chair: Christopher S. Palenik, Microtrace, LLC

Microspectroscopic Dichroism Regarding Commercial Origin of PET Fiber Evidence
David L. Wetzel — Microbeam Molecular Spectroscopy Laboratory, Kansas State University

Brief Cases Regarding Suspect Food and Drink Contaminants
Andrew A. Havics — pH2, LLC

A Tale of Two *Corchorus* Species: Jute and Its Substitutes in Common Goods
Barbara L. Fallon — Michigan State University Forensic Science Program
Christopher S. Palenik and Skip Palenik — Microtrace, LLC

Examination of Postcard Fiber Compositions from Different Eras
Walter J. Rantanen — Integrated Paper Services

The Use of Optical Techniques for the Analysis of Diatom Traces in Forensic Investigation
Kirstie R. Scott, Ruth M. Morgan, Vivienne J. Jones and Nigel G. Cameron — University College London

Using "Toluene Bombs" to Recover DNA from Permount or Repair Aged Permount-Fixed Slides
Arthur Young — Guardian Forensic Sciences

Characterization of Extracted Dyes by Capillary Microspectrophotometry: Proof of Concept
Katelyn Hargrave, Skip Palenik, Jay Beckert and Christopher S. Palenik — Microtrace, LLC

Surrounded by Spheres: Microspheres and Nanospheres in the World Around Us
Christopher S. Palenik — Microtrace, LLC

MONDAY, JUNE 8

AN EVENING WITH BRIAN: "350 YEARS OF MICROSCOPY"

5:30 – 7:00 p.m. Cuban cuisine dinner in the McCrone Garden, $25. See the front desk to pay for the dinner if you did not pre-register.

7:00 – 8:00 p.m. An Evening with Brian, McCrone Lecture Room (free)

The science of microscopy was effectively launched with the publication of *Micrographia* in London 350 years ago this year. Microscopy had been a minority interest up to this time, and Robert Hooke's great book brought the new science to a substantial new public. The book is filled with astonishing revelations, many of them of a quality that would serve us well today. Yet we have no portrait of its author. Rival interests had Hooke's likeness destroyed. Who was he? Where did he come from? How was the *Micrographia* project born? This evening, we will discover new insights into a great pioneer of microscopy and rediscover the era in which he worked. *Micrographia* holds surprising secrets that are only now being revealed.

***Brian J. Ford** is a leading authority on the microscope and a best-selling author, who has presented his work on television and radio. His research is widely quoted in publications, and he is a popular keynote speaker worldwide. He is the author of the Critical Focus column, published in* The Microscope *journal. Ford has given his Evening with Brian presentations at Inter/Micro for almost 30 years.*

TUESDAY, JUNE 9

ENVIRONMENTAL AND INDUSTRIAL MICROSCOPY

8:00 a.m. – 5:00 p.m. Registration and packet pickup, McCrone Front Desk

9:00 a.m. – 12:10 p.m. Morning Session, McCrone Lecture Room

Chair: Sean M. Fitzgerald, Scientific Analytical Institute

Characterization of Talc Fibers and Transitional Minerals in Cosmetic Talc
Long Li, Monica McGrath and Matthew S. Sanchez — RJ Lee Group

Determining the Provenance of Commercial Talc Based on Composition and Mineral Assemblages
Marian Buzon and Mickey Gunter — University of Idaho

Characterization of Talc Using High-Resolution Automated Scanning Electron Microscopy
Nicole McAllister, Steve Schlaegle and Richard J. Lee — RJ Lee Group

Forensic Petrography: An Explanation of the Source, Fate and Transport of Pensacola, Florida's Radioactive Groundwater Contaminants
Wayne C. Isphording — Tulane University and University of South Alabama

Reconsidering Richterite
Sean M. Fitzgerald — Scientific Analytical Institute

Amphibole Type and Morphologies that Occur in Vermiculite from Select Sources Around the World
Matthew S. Sanchez — RJ Lee Group, Inc.
Mickey E. Gunter — Geological Sciences, University of Idaho

Fibrous/Acicular Zeolite Identification and Regulatory Issues
Kristina Pourtabib and Mickey Gunter — University of Idaho

Franciscan Ghosts in a Pure White Shroud/The California State Snake
Sean M. Fitzgerald — Scientific Analytical Institute

12:10 – 2:00 p.m. Lunch Break, McCrone Garden

2:00 – 5:10 p.m. Afternoon Session, McCrone Lecture Room

Chair: Andrew M. Bowen, U.S. Postal Inspection Service

A Review of Some ASTM Standards for the Microscopist, Part 2
Andrew A. Havics — pH2, LLC

Proud To Be a Squint
James R. Millette — Millette Technical Consulting

Examples of "Junk" Microscopy in Asbestos Analysis
Eric J. Chatfield — Chatfield Technical Consulting Limited

Forged Provenance for a Collectible Corvette: A Case Study
David Burroughs — Prove It Authentications
Joseph G. Barabe — Barabe & Associates LLC

Alleged Food Contaminants: Identifying Materials of Botanical Origin
Katie M. White, Skip Palenik and Ethan Groves — Microtrace, LLC

A Microscopical Analysis of Electrolytic-Fractured Aluminum
Martin Kocanda — Northern Illinois University, Department of Electrical Engineering

Development of a Modern Compendium of Microcrystal Tests for Illicit Drugs and Diverted Pharmaceuticals: Project Completion
Sebastian Sparenga — McCrone Research Institute

Case Examples from the U.S. Postal Inspection Service's National Forensic Laboratory
Andrew M. Bowen — U.S. Postal Inspection Service

TUESDAY, JUNE 9

REGGIE'S ROCK CLUB ROOFTOP DINNER

5:30 – 8:30 p.m. Reggie's Rock Club, 2105 S. State Street
$25 (free for ASTEE members)

Kick back on a pleasant evening with fellow Inter/Micro attendees, exhibitors and sponsors for refreshments, dinner and a trivia contest on Reggie's rooftop, located just a few blocks away from McCrone Research Institute.

Transportation to Reggie's from McCrone will be provided by Reggie's colorful bus.

The Inter/Micro 2015 Reggie's rooftop dinner is sponsored by Cargille and the American Society of Trace Evidence Examiners (ASTEE).

WEDNESDAY, JUNE 10

CHEMICAL AND FORENSIC MICROSCOPY

8:00 a.m. – 5:00 p.m. Registration and packet pick up, McCrone Front Desk

9:00 a.m. – 12:10 p.m. Morning Session, McCrone Lecture Room

Chair: Donald J. Petka, Orange County Crime Lab

You Never Know What You Are Going to Find Until You Look
Jason Beckert — Microtrace, LLC

Bicycle Locks, Vaults and a Shipping Container
Peter D. Zoon — Netherlands Forensic Institute

Microscopy and Microanalysis of Tattoo Inks
Michelle D. Miranda — Farmingdale State College, State University of New York

Chaos in the Forensic Industry
Brian J. Ford — Caius College, University of Cambridge

A Microscopical and Ultrastructural Analysis of Postmortem Hair Root Bands
Jack Hietpas, JoAnn Buscaglia, Adam Richard, Hilda Castillo, Stephen Shaw and Joseph Donfack — FBI Laboratory, Quantico, VA

Histology: The Root of the Problem, As I See It
Lynne D. Herold

Performance and Ricochet Characteristics of 9 mm Frangible Ammunition
Peter Diaczuk and Jack Hietpas — D&H Criminalistics Agency
Xiao Shan Law — John Jay College of Criminal Justice, CUNY

Plastic Bags and a Couple of Bad Eggs
Donald J. Petka — Orange County Crime Lab

12:10 – 2:00 p.m. Lunch Break, McCrone Garden

2:00 – 4:50 p.m. Afternoon Session, McCrone Lecture Room

Chair: Wayne Moorehead, Pennsylvania State University Forensic Science Program

Recrystallization from Fusion Methods in the Analysis of Various Street Drugs
Nicole A. Zambelli and Wayne Moorehead — Pennsylvania State University, Forensic Science Program

Simple Micro-Extraction Techniques for Illicit Drugs and Diverted Pharmaceuticals
Meggan King — McCrone Research Institute

Evaluating Standardless Quantification of Stainless Steels
Ethan Groves — Microtrace, LLC

A Preliminary Survey of the Frank Smithson Microscope Slides and Specimens
Skip Palenik — Microtrace, LLC

Differences of Refractive Index Measurements Between External Surfaces and the Bulk of Container Glass — A Preliminary Study
Joseph Insana and Patrick Buzzini — West Virginia University, Department of Forensic and Investigative Science

Teaching Forensic Microscopy from the Trace Evidence Instructor Perspective
Wayne Moorehead — Pennsylvania State University Forensic Science Program

A Student Perspective on Learning Forensic Microscopy
Catherine Cantolina and Kathryn Mantz — Pennsylvania State University Forensic Science Program

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Winners of the silent auction, sponsored by the State Microscopical Society of Illinois (SMSI), will be announced following Wednesday afternoon's speaker presentations.

WEDNESDAY, JUNE 10

STATE MICROSCOPICAL SOCIETY OF ILLINOIS
2015 AWARDS DINNER

Presented at Café Bionda, 1924 S. State Street, Chicago. $65

6:30 – 7:30 p.m. Social hour; live auction hosted by Brian J. Ford
7:30 – 8:30 p.m. Dinner, Italian cuisine
8:30 – 9:30 p.m. Photomicrography competition winners, and Émile M. Chamot Award announcement and presentation.

Join Inter/Micro and the State Microscopical Society of Illinois as they honor **Thomas A. Kubic**, recipient of the SMSI 2015 Émile M. Chamot Award.

***Thomas Kubic** is associate professor and doctoral program director of forensic science in the criminal justice program at John Jay College, CUNY.*

His research interests include application of X-ray diffraction to problems of transfer evidence, especially soils and paints; identification and individualization of cosmetics by chromatography, ATR/FT-IR and microscopy; dust identification and analysis by PLM and SEM/EDS; and individualization of synthetic fibers by thermal microscopy. Kubic earned his Ph.D. in criminal justice and forensic science from the City University of New York.

THURSDAY AND FRIDAY, JUNE 11–12

WORKSHOP: INTRODUCTION TO BASIC HUMAN BODY TISSUES

9:00 a.m. – 5:00 p.m., McCrone Classroom

Taught by Lynne D. Herold, Ph.D.

This two-day workshop will introduce the seven basic human body tissues: nerve, muscle, bone, epithelium, connective tissue, blood and cartilage. The instructional methods will include lectures, group viewing of prepared and unprepared body tissues both macroscopically and microscopically, and individual hands-on laboratory exercises that will introduce attendees to the simple preparations and observations of body tissue.

Lynne Herold *has a Ph.D. from the University of Southern California and a B.S. from Kent State University, both degrees in biological sciences. Herold was a forensic scientist with Los Angeles County (California) from 1982 to 2014, assigned to the Los Angeles County Chief Medical Examiner-Coroner Department Laboratory Division from 1982 to 1989, and subsequently with the Los Angeles County Sheriff's Department Scientific Services Bureau from 1989 to 2014. In addition to her biological sciences background, she has always practiced traditional trace evidence analyses, including the sub-disciplines of physical matches, hairs, fibers, paint, polymers, impressions, general unknowns, arson, explosives and gunshot primer residues. Herold is an active member of the California Association of Criminalists (CAC), and was a member of the Scientific Working Group for Materials Analysis (SWGMAT) member from 1995 through 2012.*

PRESENTATION ABSTRACTS

MONDAY, JUNE 8
TECHNIQUES AND INSTRUMENTATION

An Introduction to Digital Image Processing in Quantitative Microscopy

Aryeh Weiss — Bar Ilan University, Ramat Gan, Israel

A major enabler for quantitative microscopy is the availability of high-quality, low-cost imagers that can be coupled to microscopes and acquire images with high spatial and photometric resolution. Digital image processing is the tool that allows quantitative and reproducible data to be extracted from these images. A proper understanding of image processing is required in order to avoid introduction of bias or other artifacts and to process the very large datasets that are often produced.

This talk will explain the stages of the image-processing workflow that follows acquisition and will cover the following topics:

1. Digital image formats and representations.
2. Basic tools for digital image characterization (for example, histogram and intensity line profile).
3. Image enhancement and noise reduction.
4. Identification of objects of interest (segmentation).
5. Analysis and data reduction.

Examples of quantitative analysis will be discussed. In this context, an open-source image processing system (ImageJ) will be presented.

Visualization of Latent Fingerprints Using Vacuum Deposited Silver

Martin Kocanda — Northern Illinois University, Department of Electrical Engineering

Various methods have been developed for the detection and preservation of latent fingerprints on surfaces. The commonly

used methods employ dry powders, cyanoacrylate vapors or wet chemistry principles to visualize the samples in the field and for additional laboratory analysis. This research examines a rarely used technique to visualize latent fingerprints. The method employs physical vapor deposition of silver sublimed on glass, plastic, paper and metal substrates. Varying thicknesses of silver ranging from 1.0 to 10.0 nm are deposited on substrates and examined for optimal spectral, transmittance and reflectance signals. Subsequent analyses of the latent fingerprints contained on the surfaces are performed after the vapor deposition and address the optical properties and visualization methods of fresh and weathered latent prints.

Are New Leeuwenhoek Microscopes Awaiting Discovery?

Brian J. Ford — Caius College, University of Cambridge

In 2009, a Leeuwenhoek microscope was sold in London for half a million dollars. Since then, it has vanished without trace. Now, two new examples of these microscopes have mysteriously emerged. One was found in a neglected drawer of oddments in London; the other was offered on eBay after it had been dredged from the bottom of a Dutch canal. The eBay seller unexpectedly announced that he had lost it, so he could not send it to the purchaser. Where is it now? What are these instruments like? Could they be genuine? How would we know? This presentation will give an update on the findings and explain a new protocol that is being devised for determining the authenticity of such antique instruments.

Characterization of Foreign-Object Debris in Jet Engines

Richard Brown — MVA Scientific Consultants, Inc.

A procedure for the location, documentation and analysis of foreign-object debris (FOD) in jet engines, using a combination of polarized light microscopy (PLM) and scanning electron microscopy-energy dispersive X-ray spectroscopy (SEM-EDS), will be presented. Case examples that show the location and damage occurring from FOD impacting fan and high-pressure compressor

blades (HPC) highlight the importance of determining the source of FOD with investigative microscopy techniques.

Visual Derivation of the Michel-Lévy Interference Color Chart
Donald J. Petka — Orange County Crime Lab

An understanding of the Michel-Lévy interference color chart is fundamental to the use of polarized light microscopy. This chart relates interference colors observed in anisotropic material with retardation, birefringence and sample thickness. This presentation will provide a visual derivation of the chart.

Microchemistry: Not Such a Small Thing
Brendan Nytes, Christopher S. Palenik and Skip Palenik — Microtrace, LLC

Microchemistry, spearheaded by the likes of Chamot, Mason, Feigl and Benedetti-Pichler almost a century ago, is still a relevant analytical method today. Our laboratory commonly utilizes the techniques pioneered by these microchemical masters, and they have become an invaluable tool in the identification of unknown materials. Laboratories today may be equipped with the latest, state-of-the-art equipment to analyze materials, but those methods (like any method) have their own limitations. A variety of situations occur where the application of traditional microchemical methods provide the most appropriate approach to answer a given question. Protein analysis represents one situation in which the results of common microanalytical methods, such as infrared and energy dispersive spectroscopy, can be supplemented by microscopical and microchemical analysis. In many cases, the tests only require minute amounts of reagents which, once purchased, can support a lifetime of analyses. As with all techniques, microchemical methods have limitations such as detection limits and specificity; however, these can often be determined for a given situation. This presentation will conclude with a survey of microchemical tests for proteins that were originally printed in the fifth edition of Merck Index, which will discuss the implementation and specificity of these tests.

A Modified Method of Dispersion Staining

Kelly Brinsko — McCrone Research Institute

A modified dispersion staining method has recently been introduced by two Japanese microscope manufacturers, Nikon Instruments and Meiji Techno, and marketed for asbestos analysis for use on some of their microscopes. This method has several misleading names, including “annular dispersion staining” and “phase contrast dispersion staining,” and should not be confused with traditional central stop dispersion staining. The microscope set-up is actually very similar to phase contrast: A phase contrast condenser with a phase annulus is used in conjunction with an objective that has a matching annular ring. However, unlike phase contrast, this annular ring is opaque. When a polarizer is also placed into the light path, the image and dispersion staining colors are nearly identical to central stop dispersion staining. This talk will review the mechanics and procedures of conventional dispersion staining methods and the modified method. Advantages, disadvantages and caveats will also be discussed.

Microspectroscopic Dichroism Regarding Commercial Origin of PET Fiber Evidence

David L. Wetzel — Microbeam Molecular Spectroscopy Laboratory, Kansas State University

Polyethylene terephthalate (PET) polymeric materials are ubiquitous. However, in the case of PET fibers, a final step in their production for a specific retail product use involves the application of a controlled stress from an uptake roll immediately following a heated zone. The resulting customized man-made polymer fiber is potentially distinguishable by infrared microspectroscopy from the dichroic ratio of several infrared absorption frequencies in the spectrum of individual fibers. The practical contribution to fiber evidence is exemplified by first producing a rudimentary dichroic spectral library of commercially produced, North American PET fibers. Based on the dichroic ratios of prevalent infrared bands obtained from fiber evidence specimens, most of the manufacturing facilities of origin are eliminated and

the likelihood of finding a match is realistic. Discriminant analysis of single-fiber, dichroic-ratio microspectroscopic data will be presented.

Brief Cases Regarding Suspect Food and Drink Contaminants

Andrew A. Havics — pH2, LLC

Three investigations into food and drink contamination will be presented. The first case will examine grape juice consumed by a young girl, who was later hospitalized with stomach pains. The second will focus on toxicity concerns from wine bottle residue, and the third will look at a person who reportedly fractured a tooth while biting into a piece of pizza. The analyses conducted include light microscopy, microchemical testing, scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS) and microhardness testing.

A Tale of Two *Corchorus* Species: Jute and Its Substitutes in Common Goods

Barbara L. Fallon — Michigan State University Forensic Science Program
Christopher S. Palenik and Skip Palenik — Microtrace, LLC

Natural fibers from jute (*Corchorus capsularis* and *C. olitorius*) are common in commodities such as cordage, sacking and textiles. Jute can be identified and distinguished from other common vegetable fibers on the basis of its microscopic characteristics. Currently neither chemical nor microscopic methods exist to differentiate fibers from these two jute species. We will present several of the techniques we are employing in an attempt to discriminate between them, including measurement of physical dimensions and confocal Raman microscopy.

Furthermore, other natural fibers and some synthetic fibers may be substituted in commercial goods advertised as jute. Examples of these substitutions will be presented, as will the ways in which polarized light microscopy can be used to identify real and fake jute. Ultimately, it is the goal of this research to compile a list of items in which jute is present and/or substituted. In labs

with limited time and resources, this compilation is anticipated to be a useful resource to assist examiners in a more thorough analysis of particular product types.

Examination of Postcard Fiber Compositions from Different Eras

Walter J. Rantanen — Integrated Paper Services

Sending postcards became popular in the latter half of the 19th century and greatly increased in the 20th century. With the use of email and digital photography today the habit of sending postcards by mail has significantly declined. This study is a comparison of the paper fiber compositions of postcards from different time periods.

The Use of Optical Techniques for the Analysis of Diatom Traces in Forensic Investigation

Kirstie R. Scott, Ruth M. Morgan, Vivienne J. Jones and Nigel G. Cameron — University College London

Diatoms are microscopic silica algal organisms, extensively utilized within the earth sciences because of their morphological diversity and environmental specificity. Traditionally diatom valve characteristics have been examined in order to provide inferences on past environmental changes; however, the presence of diatoms in a range of crime-scene environments can contribute valuable circumstantial forensic evidence when recognized by a crime-scene examiner. Though primarily applied within forensic pathology, this presentation will consider the geo-forensic collection procedures and optical analysis techniques available for the assessment of diatoms following their transfer and persistence on clothing.

This presentation will examine the use of both low- and high-powered microscopy for the quantitative and qualitative assessment of diatoms in solution and on substrate material. Sampling was performed in London, and diatoms were collected from clothing using an H_2O_2 extraction technique. This study will contribute towards the development of an empirical framework that

supports the use of diatoms as environmental trace-evidence indicators and will highlight recommendations for the optimal collection and analysis of particulates. Finally, traditional microscopical identification techniques based on diatom cell-wall morphology will be discussed within the context of increasing research, which considers genetic approaches to the forensic analysis of environmental evidence.

Using "Toluene Bombs" to Recover DNA from Permount or Repair Aged Permount-Fixed Slides

Arthur Young — Guardian Forensic Sciences

In 1982, the testimony of FBI analyst Michael Malone helped put Donald Gates in prison for a rape that he did not commit. Almost 30 years later, a single vaginal slide held the key to his exoneration. A method had to be devised to liquefy the cracked and yellowed Permount so that the sperm cells could be recovered for DNA analysis. The method that was devised, nicknamed "the toluene bomb," was so successful that the Permount was restored to a clear liquid. Hence, this method can also be used to repair slides that have cracked and yellowed with age.

Characterization of Extracted Dyes by Capillary Microspectrophotometry: Proof of Concept

Katelyn Hargrave, Skip Palenik, Jay Beckert and Christopher S. Palenik — Microtrace, LLC

In 2013, a new technique to characterize dyes extracted from fibers by microspectrophotometry (MSP) through the use of a flat capillary was presented. This talk will present the final results of the fiber analysis and a new experiment in which colorants extracted from human and animal hairs are characterized using a flat capillary and MSP. It will discuss the technique and show comparisons of the MSP spectra collected from the dyed hairs (in situ), the extracted solution, the dyes from which they were made and how they relate to each other. The aim of this talk is to show the practicality of using this technique to analyze dyes from casework-sized samples (i.e., single fibers).

Surrounded by Spheres: Microspheres and Nanospheres in the World Around Us

Christopher S. Palenik — Microtrace, LLC

We live on a sphere. We play games with spheres. We eat spheres. We breathe spheres. In fact, spheres and spheroids are so prevalent that they can be found at every observable scale, from the immensity of astronomy to the minutia of microscopy. The latter scale, which is the subject of this talk, features a wealth of materials spanning natural sources, by-products of human activities and an increasing number of materials specifically designed to achieve particular properties. These particles are formed from liquids and gasses, include organic and inorganic compounds, and range from relatively simple structures to highly engineered, multi-layered systems. Their presence impacts us on a daily basis through their incorporation into consumer products, by improving the efficiency of industrial processes and even as forensic trace evidence. This talk will illustrate the prevalence and properties of this unique shape through the insights that a microscopical and microanalytical examination can provide.

TUESDAY, JUNE 9

ENVIRONMENTAL AND INDUSTRIAL MICROSCOPY

Characterization of Talc Fibers and Transitional Minerals in Cosmetic Talc

Long Li, Monica McGrath and Matthew S. Sanchez — RJ Lee Group

Recent allegations claim that commercial talc samples contain asbestos. We have examined a number of samples, which have been claimed to contain asbestiform amphiboles, and found previous allegations represent cases of "mistaken identity." The origin of these errors lies in the fact that laboratories ignore, do not fully follow or do not understand the requirements for mineral identification in complex industrial mineral systems. This talk will summarize the results of detailed selected area electron diffraction (SAED) experiments and compare those results with simulated diffraction patterns from mineral particles originally thought to be amphibole but which are in fact structurally coherent intergrowths of talc and anthophyllite, or talc and tremolite. These intergrowths occur in such orientations that it is easily possible to misidentify particles as amphibole based on a visual inspection of the (SAED) pattern.

Determining the Provenance of Commercial Talc Based on Composition and Mineral Assemblages

Marian Buzon and Mickey Gunter — University of Idaho

Talc is the softest mineral on the Mohs hardness scale and is easily ground to a brilliant white powder, making it useful in a wide variety of industries, including the paper, paint, body powder, ceramics and cosmetic industries. We are creating a compositional database of talc ore, talc products and monomineralic talc from known locations by using a suite of analytical techniques. These include, but are not limited to, electron probe micro-analysis (EPMA), X-ray powder diffraction (XRD), X-ray fluorescence (XRF), laser ablation-inductively coupled plasma-

mass spectrometry (LA-ICP-MS) and polarized light microscopy (PLM), including data published by other workers. By applying the principles of talc formation, this database will ultimately allow us to source talc based on composition. Applications for this database might include sourcing talc grains in human tissue, better understanding the compositional and mineralogical variations in talc deposits for industrial purposes, and tracing soapstone artifacts.

Characterization of Talc Using High-Resolution Automated Scanning Electron Microscopy

Nicole McAllister, Steve Schlaegle and Richard J. Lee — RJ Lee Group

Detection and characterization of trace contaminants is an important aspect of qualifying and certifying talc minerals for use in an environmentally conscious world. Recent reports claim to have identified asbestos in samples of cosmetic talc. We will report on the use of a newly developed, automated scanning electron microscope (SEM) software program that permits the characterization of large numbers of particles in a rapid manner to characterize any number of commercial talc samples that have been alleged to contain tremolite or anthophyllite asbestos. No asbestiform amphibole minerals were detected in any of the analyses. We will also illustrate the use of the automated, high-resolution scanning electron microscopy (HRSEM) software to present the analytical results of more than 40,000 particles on four samples.

Forensic Petrography: An Explanation of the Source, Fate and Transport of Pensacola, Florida's Radioactive Groundwater Contaminants

Wayne C. Isphording — Tulane University and University of South Alabama

Pensacola, Florida, obtains all its drinking water from wells drilled into Coastal Plain aquifers. Starting in the 1950s, numerous contaminants were detected in the wells. These include ra-

dium, fluorides, sulphates, nitrates, arsenic, lead, as well as dieldrin, DDT and tetrachloroethylene (PCE). So it was no surprise that a national survey listed Pensacola as having the "worst" drinking water in the country. Studies by the EPA and state agencies determined that two sites were responsible for most of the contamination: a former wood-treatment facility and a fertilizer plant that began production of "super phosphate" in 1920, using ores from peninsular Florida. Production waste products from the fertilizer site were clearly acknowledged as the source of many of the groundwater contaminants. However, the origin of one isotope of radium (Ra 228) was strongly challenged by industry personnel. This was because high levels of Ra 228, combined with quantities of radium 226 derived from decay of uranium in the ores, was responsible for closure of two major drinking-water wells and forced water from a third well to be "blended" with that from another well to bring radium into compliance with the EPA limit of 5 pCi/L. Industry experts argued that the chief ore mineral, carbonate fluorapatite, did not contain sufficient thorium 232 (the parent isotope of Ra 228) to explain the excesses in total radium that shut down the wells and, further, that Ra 228 does not even originate from decay of uranium in the ores. Detailed petrographic examination of actual ores, however, disclosed that all ores contained the mineral monazite [(Ce,Y,La,Th) PO4]. Quantities of Ra 228 derived from thorium in monazite, when added to the small amounts of Ra 226 from uranium, were more than sufficient to explain the objectionable quantities of radium that closed the two drinking-water wells.

Reconsidering Richterite

Sean M. Fitzgerald — Scientific Analytical Institute

Although commonly perceived by the experienced asbestos analytical community as the most common type of asbestiform amphibole associated with Libby vermiculite, the mineral richterite is also often encountered when analyzing products and ore samples of talc for potential contamination or co-mineralization of regulated asbestos. This is due to the way in which the talc

and richterite form in the earth. Specifically, richterite is a sodium calcium magnesium silicate mineral belonging to the amphibole group. If iron replaces the magnesium within the structure of the mineral, it is called ferrorichterite; if fluorine replaces the hydroxyl, it is called fluororichterite. Richterite crystals are long and prismatic, or prismatic to fibrous aggregates, and can be highly asbestiform. Richterite most commonly occurs in thermally metamorphosed limestones in contact-metamorphic zones. It also occurs as a hydrothermal product in mafic igneous rocks and manganese-rich ore deposits, either supergene or at depth. Example deposits of this study in which asbestiform richterite has been found include talc mines in western Texas, North Carolina and even in vermiculite as made infamous in Libby, Montana. In fact, a key lesson learned from this study is that when richterite is found in a material sample, caution should be used when evoking the "Libby amphibole" moniker, as it may well mislead the interpreter of results as a product derived from Montana-sourced constituents. Specific analytical differentiation in exemplar richterite will be demonstrated by polarized light microscopy and transmission electron microscopy.

Amphibole Type and Morphologies that Occur in Vermiculite from Select Sources Around the World

Matthew S. Sanchez — RJ Lee Group, Inc.
Mickey E. Gunter — Geological Sciences, University of Idaho

Research performed at the University of Idaho a decade ago analyzed vermiculite samples acquired from various known sources around the globe and demonstrated that with trace elemental analysis it was possible to use Ba to determine the source of an unknown garden-variety bulk vermiculite to the deposit near Libby, Montana (Gunter et al. 2005). Additional work was done on these same sample sets employing bulk powder X-ray diffraction that demonstrated amphibole detection and quantification down to 0.1 percent by weight (Sanchez and Gunter, 2006; and Gunter and Sanchez, 2007). This paper further explores these same vermiculite samples and shows the amphibole

types and morphologies from these sources as observed in digested residues. In addition to the sources identified in the above papers, additional sourced vermiculites were also obtained. It was found that only the vermiculite sourced from Libby contained sodic-calcic group, e.g., winchite/richterite, amphiboles by scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS). Also, only the Libby-sourced material contained observable asbestiform amphiboles. Non-asbestiform amphiboles were obtained from the other sources. These observed amphiboles ranged in composition and were tremolite, actinolite, magnesio-hornblende and anthophyllite.

Fibrous/Acicular Zeolite Identification and Regulatory Issues

Kristina Pourtabib and Mickey Gunter — University of Idaho

The need for a correct identification method for the fibrous/acicular zeolite erionite has become more in demand due to erionite's ties to mesothelioma in Turkey and now in the western U.S. The regulatory community still struggles to correctly identify potentially asbestiform minerals when they occur in natural rather than man-made environments due to the similar cation content and poorly understood differences in crystal structure between these zeolite species. Erionite presents a unique challenge because there is a lack of regulatory method for the correct identification of these fibrous/acicular particles in nature. Simplified identification techniques for the zeolites can be obtained largely by the use of selected area electron diffraction (SAED) with transmission electron microscopy (TEM), and indirect identification can be determined by polarized light microscopy (PLM). For instance, the smaller TEM scale provides direct structural data in the form of diffraction patterns and gives compositional data in the form of energy dispersive X-ray spectroscopy (EDS) (i.e. diffraction patterns of erionite along uv0 will show constraints of 00l = 2n along c* due to space group symmetry, while offretite will show no diffraction constraints along c*). By using scale-dependent identification methods such as TEM and PLM, these zeolites can be easily distinguished from one another.

Franciscan Ghosts in a Pure White Shroud/The California State Snake

Sean M. Fitzgerald — Scientific Analytical Institute

Part 1: Franciscan Ghosts in a Pure White Shroud. The short-fiber chrysotile of the New Idria formation in central California is massive asbestos formed by tectonic forces along the San Andreas Fault. As the serpentine body was pushed through the surrounding country rock, chrysotile asbestos became concentrated. This unique formation has been thought for decades to constitute the purest body of asbestos in the world, but studies that discovered amphibole in other serpentine bodies failed to find amphibole asbestos in this location. Amphibole contamination is potentially more causational to asbestos-related disease. Limited digestion studies of raw Calidria chrysotile ore have found low levels of amphibole but not consistently above detectable limits. However, inclusions of the country rock have found tremolite and actinolite. An extensive study of the air in the adjacent Clear Creek area by the EPA and Agency for Toxic Substances and Disease Registry (ATSDR) has shown airborne concentrations of amphibole as well as chrysotile asbestos in 8–10% of their samples. Additionally, examinations of the Franciscan formation, for the purpose of finding the rare gem benitoite, commonly find tremolite and actinolite fibrous inclusions commonplace and indicative. The serpentine asbestos formation was extruded through amphibolites, and inclusions of the amphibole have been observed topographically above and below the formation mined.

Part 2: The California State Snake. In April 1965, serpentine was named the state rock of California, paying homage to “the host rock of the state’s newest and most rapidly growing mineral industry — asbestos.” Recent efforts to change the state rock have been met with a flurry of support, outrage and mudslinging. This study gives a historical overview of asbestos formation and human interaction in the Golden State from the perspective of a geologist and asbestos scientist. A specific example of concerns from “NOA” (naturally occurring asbestos) will be illustrated by revisiting the now 30-year-old saga of El Dorado

County, east of Sacramento. In the late 1990s, concerns regarding NOA became a public controversy, first voiced by a few concerned citizens, which led to initial testing. A series of newspaper articles then led to extensive testing and involvement by the EPA, which included some of their first activity-based monitoring (ABM). Contending reports stating that the asbestos *is* and *is not* a problem still persist. This presentation will provide a timeline with contemporary testing, along with a review of past studies and how they relate to what I observed, boots on the ground.

A Review of Some ASTM Standards for the Microscopist, Part 2
Andrew A. Havics — pH2, LLC

The American Society for Testing and Materials (ASTM) has served as a de facto proponent of the microscope by sponsoring symposia and producing several Special Technical Publications on microscopy. There is a wide range of ASTM standards that consider the microscope a tool of choice, including analysis of concrete, fibers, water deposits, microbial agents in various media, paint, glass, particle sizes, metals, inclusions in metals and polymers, carbon black, soot, whiskers, asbestos, gunshot residue (GSR), drugs, paper, coal and more. These standards also provide specific characterization, while some are even focused on the preparation of metal to plastic to composite samples for microscopical examination, including etching and preparation of the microscope (PLM, SEM, etc.) for calibration. The second part of this presentation (the first part was given at Inter/Micro 2014) will include fractographic analysis, sample prep, evaluation and organism counting, and environmental air and surface sampling.

Proud To Be a Squint
James R. Millette — Millette Technical Consulting

What is a squint? In the TV series “Bones,” special agent Seeley Booth affectionately calls the Jeffersonian research team “squints” because they are always squinting into their microscopes.

During the first 40 years of my career in environmental foren-

sic microscopy (1974–2014) I have had the opportunity to use various microscopes and forensic techniques to solve a number of interesting environmental/industrial questions. The methods I have used over the years in environmental forensic investigations were drawn primarily from the criminal forensics, industrial hygiene, and environmental monitoring areas. Combining various aspects of these disciplines allowed me to generate procedures for each case that fit the varied environmental/ industrial situations. Many investigations required only a light microscope, but many others were accomplished utilizing a combination of visible light, infrared microspectroscopy and electron microscopy.

The capabilities of the various microscopy tools will be illustrated through short presentations covering several investigations, including the identity of white fibers in a kitchen faucet filter, a spot named Ralph on a carpet in a South Carolina courthouse that kept growing larger, yellow deposits, white dust, lead dust, fly ash particles in house dust that were reported to be evidence of an alien visitor, dark deposits, and characterization of dust generated by the 9/11 World Trade Center attacks.

Examples of "Junk" Microscopy in Asbestos Analysis

Eric J. Chatfield — Chatfield Technical Consulting Limited

With the introduction of the Asbestos Hazards Emergency Response Act (AHERA) and the upsurge of asbestos-related litigation that developed in the 1980s, a large number of microscope laboratories and consultants emerged to meet the demands of this new industry. Although much of the information relating to the determination of asbestos is available in published research, many of the laboratories and consultants engaged in asbestos analytical work have not invested the time to become familiar with it. Consequently, analytical methods in use by some have not necessarily been updated to take advantage of more recent developments.

Errors such as failure to identify fibers correctly in a lung tissue sample can result in millions of dollars of liability being assigned

to the wrong parties. Misinterpretation of analytical data can also result in unjustified public concern and unwarranted expenditures. Unfortunately, errors and misinterpretations in asbestos-related work continue to occur.

Forged Provenance for a Collectible Corvette: A Case Study

David Burroughs — Prove It Authentications
Joseph G. Barabe — Barabe & Associates LLC

In the world of collectibles, provenance (the documented history of an object) is often of great importance in supporting the possible authenticity of the object. Collectors of classic 1960s Corvettes typically rely on the original bill of sale, title, tank sticker or a document generated during the manufacture of the automobile that lists all of the options purchased with the car. This presentation discusses a case in which an early Corvette AMV236 and the car's provenance were evaluated. In addition to the questioned tank sticker, several exemplar documents of unquestioned authenticity were provided, as were the technical reports of analyses from four different laboratories, two of which were from forensic document examiners. All of the laboratories provided conclusions that supported authenticity.

However, a careful examination of the questioned and exemplar documents by both authors revealed discrepancies in printing processes and letter formation, which indicated that the questioned tank sticker could not have been produced in 1968. This presentation will introduce the topic of early Corvette authenticity issues, discuss the findings of the four other laboratories and demonstrate other methods of tank sticker forgery.

Alleged Food Contaminants: Identifying Materials of Botanical Origin

Katie M. White, Skip Palenik and Ethan Groves — Microtrace, LLC

Consumer complaints are a routine occurrence in the food industry. From insects to metal, plastic to hair, even escalated claims of harmful glass contamination, the range of materials encountered is vast and varied. But it's not just these

"traditional" foreign contaminants that have the potential to infuriate consumers. Some complaints can stem from poor quality control, such as carryover from other products made on the same line, insufficient mixing of ingredients or product buildup. Still, some of the most interesting contaminants we've encountered are plant materials introduced directly with the ingredients. Mass supply processing is not always a perfect and complete procedure — sometimes this process fails to remove the less-desirable components of the plant (e.g., stems, pits, etc.). Before roasted peanuts can be added to a granola bar, the fruit must first be extracted from the shell, and it is difficult to exclude every piece of shell during this process. When these contaminants become the subject of a consumer complaint, it is often the study of their microscopical structure and comparison to known specimens from our reference collection that results in identification. This talk will present some of our most interesting food contaminant cases involving plant material, discussing the methods of examination and presenting the observations used to reach our conclusions.

A Microscopical Analysis of Electrolytic-Fractured Aluminum

Martin Kocanda — Northern Illinois University, Department of Electrical Engineering

The synthesis of anodic aluminum oxide under controlled conditions has been used as a commercial manufacturing process for decades. A recent application of controlled anodization involved the synthesis of nanostructures serving as templates for nanorods and nanowires. Additional work has employed nanoporous aluminum oxide as sensor substrates, which elicit an electrical response to volatile organic compounds, explosives and microbial growth. Deviating from a controlled low-current density process, whereby high-current density fractures the epitaxial aluminum layer, patterns appear resembling initial fractal growth, needle-like structures, field-induced growth and self-assembled membranes. The structures are visualized using light microscopy with transmission, reflection and Nomarski methods.

Development of a Modern Compendium of Microcrystal Tests for Illicit Drugs and Diverted Pharmaceuticals: Project Completion

Sebastian Sparenga — McCrone Research Institute

This talk will give an update of the grant that McCrone Research Institute was awarded through the National Institute of Justice (NIJ-2011-2805 SL# 000944). Research during this past year has focused on performing optical characterization on the resultant crystals as well as laying out the compendium that will contain all the microcrystal test monographs and images. Select monographs from the compendium will be shown, and the date of availability to the public will be announced.

Case Examples from the U.S. Postal Inspection Service's National Forensic Laboratory

Andrew M. Bowen — U.S. Postal Inspection Service

The U.S. Postal Inspection Service's National Forensic Laboratory is a full-service forensic laboratory in Dulles, VA. As one of the many services provided, trace evidence examinations are often used to support investigations within our organization. The nature of the cases submitted to the laboratory is somewhat different from that of a typical crime lab due to the jurisdiction of the Inspection Service. This presentation will share several case examples that illustrate the nature of cases sent to the National Forensic Laboratory and the types of examinations performed.

As a vocal proponent of light microscopy, I often like to point out case examples where microscopy was critical to the solution of a chemical problem, while revealing the limitations of other analytical instrumentation. To be fair, however, chemical microscopy also has its limitations, and it is important for the microscopist to recognize and acknowledge these. This presentation will provide some examples where the microscope alone (at least in the hands of this microscopist) was insufficient to solve the problem at hand.

WEDNESDAY, JUNE 10
CHEMICAL AND FORENSIC MICROSCOPY

You Never Know What You Are Going to Find Until You Look
Jason Beckert — Microtrace, LLC

Almost all of our forensic cases, both criminal and civil, begin with a phone call. The client typically provides a brief background of the case and then wants to know if we can provide an answer to one or more specific questions. It is not uncommon for a client to ask us about a specific technique or material, only for us to recommend another avenue of inquiry that may be, at least in our opinion, a better means of answering their ultimate question. These preliminary discussions are often fruitful for generating ideas but nothing compares to observing the actual samples. The ability to directly examine the sample, both macro and microscopically, is the best way to determine how trace evidence can aid an investigation through the establishment of facts. Frequently, these observations open the doors to previously unexplored and unanticipated paths. In some circumstances, we do not know what assistance, if any, we can provide until we have the opportunity to explore the evidence. This presentation will focus on one such case in which we were retained to perform a discrete task but ended up with a greater level of involvement once we had the chance to attend an inspection of the vehicle in question.

Bicycle Locks, Vaults and a Shipping Container
Peter D. Zoon — Netherlands Forensic Institute

At the beginning of 2014, the microtrace department of the Netherlands Forensic Institute was faced with a series of cases that involved thefts and smuggling that used a common power tool: abrasive cut-off wheels. The metallic traces that are left behind by cut-off wheels are rather specific. They consist of a mixture of spherical particles, such as those that are formed by welding, and of more rectangular flakes, such as particles that

are often recovered as residue from saws. By employing an investigative strategy used in forensic glass examinations, interesting mixtures of microtraces have been recovered from different types of clothing and tools. The recovered particles were analyzed with microscopy, IR spectroscopy, scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS), and the quantitative elemental composition were determined with laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS).

This presentation will present several case examples showing that to reach the strongest evidentiary value, the collection of reference materials at the crime scene should include some specific samples. Furthermore, by analyzing the pallet of microtraces and their location on clothing, it is, in some cases, possible to determine which of the suspects was using the power tool and which one was the lookout.

Microscopy and Microanalysis of Tattoo Inks

Michelle D. Miranda — Farmingdale State College, State University of New York

The application of microscopical and spectroscopical methods for the analysis of modern organic pigments in tattoo inks was explored in this research. The aim was to scientifically evaluate tattoo inks by documenting the physical and optical properties of the inks, both macroscopically and microscopically, and by identifying the chemical properties of the pigments spectroscopically. This was done in an effort to qualitatively identify tattoo inks, resulting in the ability to discriminate between different colors, within similar colors and between different brands of tattoo inks. Analytical methods included Fourier transform-infrared spectroscopy (FT-IR), Raman spectroscopy, Surface-enhanced Raman spectroscopy (SERS), ultraviolet-visible spectroscopy (UV/Vis) and X-ray diffraction (XRD). The lack of an established method of analysis of tattoo inks for identification and comparison was an additional catalyst for this research. In forensic science, the recognition and identification of both inorganic and organic pig-

ments in human tissue can aid in the identification of charred, decomposed, mummified or otherwise unidentifiable remains in criminal investigations and mass disasters (natural, accidental or terrorist-related). In art conservation and cultural heritage, the characterization and archiving of organic pigments in traditional tattoo inks can aid in future anthropological and archaeological studies of human culture and history.

Chaos in the Forensic Industry

Brian J. Ford — Caius College, University of Cambridge

American forensic science has often been admired around the world, but recent disclosures have shown that there are serious reasons for concern. In some cases, innocent people have been locked away — and even executed — because of scientific evidence that was wantonly misused. How widespread is the problem? It was at Inter/Micro 1984 where Dr. Walter McCrone called for aspects of forensic microscopy to be objectively reconsidered. This presentation outlines areas where problems are still emerging.

A Microscopical and Ultrastructural Analysis of Postmortem Hair Root Bands

Jack Hietpas, JoAnn Buscaglia, Adam Richard, Hilda Castillo, Stephen Shaw, Joseph Donfack — FBI Laboratory, Quantico, VA

A postmortem root band (PMRB) is a distinct microscopic feature that occurs in the pre-keratin region of anagen and early catagen hairs derived from deceased individuals. However, interpretations of PMRBs have been challenged in recent criminal court cases (Kogut v. County of Nassau and State of Florida v. Anthony). The primary issue used to challenge the validity of interpreting hairs displaying PMRBs is that the mechanism of band formation is not known. To investigate this issue, detailed observations were made using high-magnification images of ultramicrotome sections of known PMRBs. Microscopical analysis of the "banded" regions indicate that the appearance of the PMRB is a manifestation resulting from the degradation of the non-keratin

intermacrofibrillar matrix (IMM) in the pre-keratin region of anagen hairs. In addition, PMRB formation is constrained to the cortex region of the hair with no observable damage to the layers of the cuticle.

In an attempt to further investigate potential mechanisms of PMRB formation, antemortem anagen head hairs were subjected to several conditions (e.g., pH series, protease digestions and buffer solutions) that may affect the IMM. The results from these in vitro studies indicate that some microscopic characteristics of PMRBs can be replicated. This is most readily demonstrated when anagen hairs are immersed in slightly alkaline aqueous ammonium salt solutions. The degradation that occurs in these hairs appears to be quite similar to known PMRBs. NH_4^+/NH_3 are viable causative agents because these compounds are produced in significant amounts during autolytic and bacterial degradation of protein during decomposition. These results provide valuable insights that may assist in uncovering the mechanism for the formation of PMRBs.

Histology: The Root of the Problem, As I See It

Lynne D. Herold

Histology is a branch of anatomy that deals with the minute structure of animal and plant tissues as discernible with the microscope (versus gross anatomy). It is a systematic, basic skill and applied science that can distinguish the basic tissue types, structures, identifications, organizations and functions. With the use of various histological stains, not only can contrast be created for observations of materials, but also some of the basic structural, chemical and functional properties of tissues and organs can be explained. Together, this information can be used to answer or help answer forensic (criminal or civil), industrial, benevolent or probative questions in a way that no other technique allows.

This presentation will show several cases in which the applied science histology was used to answer the true probative questions. These cases will illustrate why DNA typing and/or presumptive blood chemical testing are not always applicable, adequately

discriminating or reliable techniques in the same circumstances. It is likely that Inter/Micro attendees have some knowledge of histological applications, whether or not they recognize the term histology. In addition, this presentation will illustrate why, as with so many other sciences, an incomplete knowledge of the science and terminology, can lead to erroneous conclusions.

Performance and Ricochet Characteristics of 9 mm Frangible Ammunition

Peter Diaczuk and Jack Hietpas — D&H Criminalistics Agency
Xiao Shan Law — John Jay College of Criminal Justice, CUNY

Frangible bullets are designed to minimize the dangers from ricochet by breaking up or disintegrating upon impact with hard unyielding substrates. The energy of these smaller post-impact fragments or powder is so small that they cannot travel very far from the initial impact site. To perform this way, these bullets are made of various formulations of powdered metals held together by adhesives or resins. In contrast to the formulations that are bonded together, at least one manufacturer has developed a line of frangible ammunition that instead incorporates a jacket to encase the frangible core. Because of this novel design, the manufacturer claims that their bullets will also behave on soft organic targets as they behave on hard unyielding materials, i.e., by breaking up into small pieces.

Using high-speed photography, the performance of various brands of 9 mm Parabellum frangible bullets are compared to each other and to traditional 9 mm full-metal jacketed bullets to determine the critical angles with respect to common yielding and unyielding materials. Recovered bullet or jacket fragments were examined microscopically to determine if stria were present and, if so, were they useful for comparison purposes.

Plastic Bags and a Couple of Bad Eggs

Donald J. Petka — Orange County Crime Lab

Typically, when plastic bags are encountered in case work they contain drugs of abuse. In extremely rare cases, these bags may

be planted on an unsuspecting victim. This presentation will review a case in which polarized light microscopy was used to compare zip-closure plastic bags planted in the victim's vehicle to plastic bags obtained from a suspect.

Recrystallization from Fusion Methods in the Analysis of Various Street Drugs

Nicole A. Zambelli and Wayne Moorehead — Pennsylvania State University, Forensic Science Program

In an attempt to bypass laws, manufacturers of street drugs are altering their products into structurally different chemical forms to avoid legislative prohibitions of scheduled drugs. While many instrumental methods are used and published in the analysis of street drugs, few recent articles on these substances are found in the areas of fusion methods, crystallography, recrystallization and microcrystal tests. The study of the fusion morphology of the different drugs can benefit drug analysis in the future through quick and relatively inexpensive means. This research includes the use of a hot stage combined with a polarized light microscope to analyze various street drugs as well as to determine the ability to uniquely identify substances based upon their morphology, melting point, recrystallization and other optical properties. These observations will be used to categorize and determine if selected drugs contain additional phases at temperatures higher than room temperature. This data can help in the quick and certain identification of a drug in addition to a further understanding of the drug's chemical properties.

Simple Micro-Extraction Techniques for Illicit Drugs and Diverted Pharmaceuticals

Meggan King — McCrone Research Institute

In the last several years, McCrone Research Institute has been working on the development of a modern compendium of microcrystal tests for illicit drugs and diverted pharmaceuticals, which is funded by the National Institute of Justice (NIJ-2011-2805 SL# 000944). Most real-world illicit drug and pharmaceutical

samples contain far more than just the active ingredient. These excipients and diluents can sometimes cause interferences with microcrystal tests. Simple micro-extraction techniques can be employed to successfully separate the drug of interest from tablets, organic materials and alternative delivery mechanisms such as syrups, gels and transdermal patches. These quick and straightforward micro-extraction techniques will be discussed.

Evaluating Standardless Quantification of Stainless Steels

Ethan Groves — Microtrace, LLC

Metals represent the largest group of elements in existence, yet only a handful are routinely controlled for during the production of commercial alloys. Varying the combinations and quantities of certain elements can drastically change the properties of a metal alloy. This has led to the development of numerous alloys, many of which contain the same elements in varying concentrations. The ability to confidently identify and quantitate the elemental composition of a metal sample can be crucial when attempting to determine the source of an unknown fragment.

Elemental analysis of a metal sample begins by utilizing the proper instrument, which depends on the goals of the analysis (e.g., major versus trace element analysis, discrete inclusions, coatings, etc.). The instrument parameters (e.g., spot size, vacuum and limits of detection), the geometry and size of the sample, and the detector-instrument arrangement can dramatically impact the quality of the results and may skew the ultimate identification. We have explored the elemental analysis of 11 stainless steel standards to evaluate the standardless quantification of three instruments routinely used in our laboratory for the analysis of metal samples; two SEM/EDS systems and one μ-XRF spectrometer. This data has been compared with mill specification data for the known samples, and the published compositional ranges for the particular alloy to evaluate the accuracy of the software deconvolution algorithms and provide validation data to support the identification of unknown stainless steel samples.

A Preliminary Survey of the Frank Smithson Microscope Slides and Specimens

Skip Palenik — Microtrace, LLC

Frank Smithson is not well-known today, even among microscopists or geologists. Most people who hear the name confuse it with the geologist who gave his name to the mineral smithsonite. In 2014, we had the opportunity to acquire a collection of many of the mineral and heavy-mineral slides as well as the sound material that Dr. Smithson used to prepare specimens for sale by the well-known supplier and publisher of natural history and geological products and books, Thomas Murby and Sons. Some of these were used to illustrate parts of the third edition of Henry Milner's *Sedimentary Petrology*, which is well-known to all scientists who study and identify heavy minerals. This brief talk will present the results of our study of the items in this collection to date.

Differences of Refractive Index Measurements Between External Surfaces and the Bulk of Container Glass — A Preliminary Study

Joseph Insana and Patrick Buzzini — West Virginia University, Department of Forensic and Investigative Science

Refractive index (RI) is known to be a highly discriminatory property used in forensic comparative examinations of glass. A critical aspect of RI measurements is the evaluation of intra-source variation. Indeed, RI is known to vary in different locations on a given glass object. In addition to spatial heterogeneity, previous studies indicate that differences in RI measurements could be observed between the external surface and the bulk of a glass object. Considering the improvements of modern glass manufacturing processes, this study aims to compare RI data from the external surfaces of glass containers to those collected from their bulk in order to determine if a significant difference exists. This study intends to provide objective information to glass examiners concerned with the understanding of RI variation that could be expected between the bulk and external surface of container glass. These results are valuable when examin-

ers interpret potential differences observed during comparative examinations or when they attempt to explain the dispersion of RI data as a consequence of a sampling method. The body areas of eight glass containers were selected as initial samples for this study. A novel methodology was developed to isolate the surface layer of glass fragments from their bulk; 560 measurements were carried out using a Foster + Freeman Glass Refractive Index Measurement (GRIM 3) system.

Teaching Forensic Microscopy from the Trace Evidence Instructor Perspective

Wayne Moorehead — Pennsylvania State University Forensic Science Program

This presentation will provide an overview from the instructor's perspective of the "Trace and Impression Evidence" course offered by the Pennsylvania State University Forensic Science Program. The course involves the teaching of polarized light microscopy, which is stressed for the identification of unknown particles. Because the course is about forensic microscopy, appropriate emphasis is placed on proper packaging and sealing, chain of custody, class and individual characteristics, note-taking acceptable for accreditation, and written reports understandable for an investigator or attorney, while retaining sufficient detail for a scientist to understand the methods used to reach the conclusions. The step-wise progression of theory integrated with practical exercises will be discussed.

A Student Perspective on Learning Forensic Microscopy

Catherine Cantolina and Kathryn Mantz — Pennsylvania State University Forensic Science Program

This presentation will provide an overview from the students' perspective of the "Trace and Impression Evidence" course offered by the Pennsylvania State University Forensic Science Program. The course is one of three core courses required for students to advance in the program, along with courses in biological evidence and crime-scene investigation. Each course is taught by

an instructor with 15 or more years of experience working in state or county labs in their respective area of criminalistics. Although each of us is pursuing a different degree emphasis, one biology and the other chemistry, we both find forensic microscopy — an integration of biology and chemistry — to be fascinating and incredibly beneficial, especially the handling of small particles as evidence. The practical application of the theories of light, chemistry and biology to separate and identify small particles using stereomicroscopy and/or polarized light microscopy provides us with an advantage over other students without similar knowledge or skills. Our presentation will discuss the joys and frustrations we experienced while taking this course.

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