

The President's Desk

TheCoconut

At the banquet in San Francisco, when I received *the* coconut from our President Dan Gregonis, I said that I wanted to be president of the CAC so I could place my name on the coconut. History recalls a time back in the early 70's when Herman Mueron, a CAC member working in Hawaii, spotted a shiny coconut on the beach and remarked how similar it was to Tony Longetti's head. He presented it to Tony who was then CAC president for the second time in 1971-72. Since that fateful day, every CAC president has had the honor of signing their name on the coconut. It contains the names of over 30 past presidents and is a remarkable piece of CAC history. This coconut brings with it a sense of sadness with the passing of Tony last year, but we remember the joy he showed every time this story is retold at the seminar banquet.

And now, the coconut has been passed on to me. I am grateful for the opportunities to not only add my name to this unique document but also



to serve as the president of the oldest forensic science society in the country. I'm glad I decided to become president when I did, as there's hardly any room left on the coconut to sign my name. I want to thank the members for your confidence in me and I look forward to my tenure as president with great anticipation.

I want to thank Dan for an outstanding year as president and I look forward to his support in his new role as the immediate past president. Also, I want to welcome our new board members: Membership Secretary Elissa Mayo, Recording Secretary Brooke Barloewen, Regional Director North Linda Jacobson, and President Elect Raymond Davis. There are a few committee posts which are vacant at the

moment, and I'm asking the members to consider filling one of these positions. They are: CCI Advisory/Training & Resources (2 positions), Endowment Committee, Ethics Committee, and Financial Review Committee.

michael

THIS COCONUT BRINGS WITH IT A SENSE OF SAD-NESS WITH THE PASSING OF TONY LAST YEAR, BUT WE REMEM-BER THE JOY EVERY TIME THIS STORY IS RETOLD



Michael J..Parigian CAC President



Third Quarter 2002



On the cover... (l-r) John DeHaan, Pres. Elect Raymond Davis, and Professor Brian Caddy confer at the 99th semiannual seminar in San Francisco. More photos inside including the text of Prof. Caddy's founder's lecture.

This page: Detail from the Palace of Fine Arts in San Francisco. Photos by J. Houde/Calico Press

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AAFS Conference for HS Science Teachers

On July 25-27, the American Academy of Forensic Science (AAFS), along with the Saigh Foundation and St. Louis University's Medical School, is offering the Forensic Science Educational Conference. The conference is directed at high school science teachers and is an attempt to help them improve science teaching. The conference is two days of overview of what is being done in forensic science (as presented by various experts in their fields) and one day of workshops. The workshops will be directed by teachers. Experts will be helping you adapt their information to the high school classroom. If you are interested, you can sign up for the class at the AAFS website, <u>aafs.org</u>. Click on conferences and choose the Forensic Science Educational Conference. There is more information on the site, including cost.

AAFS Annual Meeting in Chicago

The American Academy of Forensic Sciences annual meeting will be held February 17-22, 2003, at the Hyatt Regency Hotel in Chicago. Each year, wherever the Academy meets, 200-300 volunteers are needed to do an array of administrative and gate keeping tasks on Saturday and Sunday (February 15 & 16) before the meeting officially starts and then during the meeting Monday - Saturday (February 17-23). Volunteers who are not members of the academy receive complimentary registration to attend all sessions of the meeting (except those requiring pre-registration or fees other the basic meeting registration). Basic nonmember advance registration for the 2003 meeting will be at least \$350. Member volunteers do not receive complementary registration for volunteering. The academy does need members to volunteer; however, service to the academy is a responsibility that comes with membership and service to the academy is one of the requirements for promotion. If you wish to volunteer, please contact Dr. R.E. Gaensslen 312-996-2250, FAX 6434, E-Mail: reg@uic.edu

X-Ray Training CD Donated

Oxford Instruments rep Patrick Campos has donated a set of CDs to the CAC titled, "Theory and Practice of X-Ray Microanalysis." This two-volume set includes a richly produced interactive multimedia presentation covering the science, theory and techniques of X-Ray microanalysis. It runs on Windows machines.



DNA Technical Leader \$53,477 - \$70,117

The Ohio Bureau of Criminal Identification & Investigation's laboratory at Richfield, Ohio (near Cleveland) is seeking applicants for DNA Technical Leader. Candidates must have previous experience as a DNA Technical Leader or be eligible for DNA technical leadership as defined by the FBI Director's Quality Assurance Standards for Forensic DNA Typing Laboratories. Contact: Ohio Attorney General's Office/ BCI&I Personnel Office, P.O. Box 365, London, Ohio 43140. Please call Ms. Joan Plantz at (740) 845-2155 for information.

Criminalist II \$42,053 - \$56,275

The Monroe County Public Safety Lab in Rochester, N.Y. is looking for an experienced criminalist to provide trace analysis in a variety of subdisciplines. The laboratory is a civilian, full-service, accredited regional crime laboratory situated in the picturesque Finger Lakes Region of western New York. Minimum qualifications: graduation from a regionally accredited or New York State registered college or university with a bachelor's degree in one of the natural, physical or forensic sciences, (college course work must have covered the areas of chemistry, biology, instrumental analysis and physics) plus two years paid full time or it's part time equivalent experience in a forensic laboratory performing trace analysis, or graduation from a regionally accredited or New York State registered college or university with a master's degree in one of the natural, physical or forensic science related area. Course work must have covered the areas of chemistry, biology, instrumental analysis and physics, plus one year paid full time or it's part time equivalent experience in a forensic laboratory performing trace analysis. Open until filled. Contact : Harvey Van Hoven Assistant Administrator, Monroe County Public Safety Lab, Rm. 500 Public Safety Bldg., 150 Plymouth Ave. S., Rochester, New York 14614, Phone : 585-428-5678, Fax : 585- 428-3436, E-mail: harveyatpsl@netscape.net

Advanced Training in Forensic Human Identification

The Department of Forensic Medicine And Science, Univ. of Glasgow offers the following course & diploma: a two-week course covering different aspects of forensic human identification from the 12th—23rd of August, 2002. Attendance is also available on a daily basis for those interested in particular areas only. Some of the areas covered will include: Ethical and Legal Issues, Forensic Osteology, Mass Disaster, Investigations, Investigations of Clandestine Graves, Facial Reconstruction/ Video Superimposition/Facial Mapping, Print Analysis; Finger, Ear, Lip etc., DNA Analysis, Forensic Odontology. A certificate of attendance will be awarded to all that enroll and complete the course. Graduates will be entitled to enroll for the new diploma in forensic human identification (DFHID) offered by the Worshipful Society of the Apothecaries.

For further information please contact Dr William Goodwin, Department of Forensic Medicine and Science, University of Glasgow, <u>w.goodwin@formed.gla.ac.uk.</u> Information can also be found at <u>http://www.gla.ac.uk/departments/</u><u>forensicmedicine/.</u>

IDENTIGENE Awarded Accreditation

DNA identification testing company, IDENTIGENE, recently received accreditation for compliance with the DNA Advisory Board's (DAB) Quality Assurance Standards for Forensic DNA Testing Laboratories via the National Forensic Sci-

Jobs • Meetings • Courses

ence Testing Center (NFSTC). IDENTIGENE is now one of only 14 private laboratories that have the prestigious national accreditation. During the accreditation process, NFSTC auditors review the laboratory's policies, practices, and procedures to determine whether they are in accordance with the DAB's quality assurance standards. This includes verifying standard operating procedures, validation studies, proficiency tests, management practices, equipment calibration, and reviewing training and education records. NFSTC is an independent, nonprofit organization that provides systems support and continuing education to crime laboratories and laboratory staff. NFSTC was established by the American Society of Crime Laboratory Directors (ASCLD) in 1995 and began operating in July 1996. The organization's mission is to assist forensic science laboratories in achieving the highest standards of operations.

Forensic Materials for Schools Released

Calico Press, publisher of CRIME LAB: A Guide for Nonscientists, is developing a series of forensic related exercises suitable for high school or undergraduate students. Entitled "Classroom Exercises in Forensic Science," the series is comprised of short labs that illustrate what it's really like to work in a crime laboratory, including "Saliva Stain Mapping," Forensic Obervation," and "Receiving Evidence." The labs can each be completed in the short time usually available to science teachers, and do not involve the use of expensive or dangerous materials. The series is available online free of charge at <u>www.calicopress.com</u>.

Criminalist \$48,859 -60,677.28

The Los Angeles Police Department Criminalistics Laboratory will be hiring 6 to 8 criminalists over the next six months. The closing time for accepting applications has been extended into mid June. Testing is anticipated to start in mid-July. If you are interested in an application, call the Los Angeles City Personnel Department Application Info at (213) 847-9240 or visit lacity.org.

The new positions are in the area of DNA analysis and people with qualifications and experience in that area are encouraged to apply; however, we hire people as "criminalists" not just in a particular specialty and some of the DNA positions will be filled internally, so if you are interested in working at LAPD as a criminalist but don't meet DNA requirements, apply anyway. Current pay scales are: Criminalist I (new hires with no previous forensic experience start at step I - starting at an advanced step is possible with previous experience) \$48,859 to 60,677.28 annually. Criminalist II (Advancing from a crim I to a crim II usually occurs at 18 months following successful completion of criminalistics/field training—New hires can be started in the Criminalist II pay grade if they are experienced in crime scene processing) \$63,934 to 79,427 annually. These

CSULA is establishing an Anthony Longhetti Scholarship. Funds may be sent to the CSULA Foundation, 5151 State University Place, Los Angeles, CA 90032.

–Hiram Evans

pay scales are based on a contract that expired 7-1-01. It is anticipated that they will be increased by at least 3% following the conclusion of current negotiations. —*Greg Matheson*

Crime Scene Search Manager \$46,359 - 53,450

Charlotte-Mecklenburg Police Department-Crime Laboratory, Charlotte, North Carolina has a full time managerial and supervisory position for a 24-hour crime scene search field operation, and 8-hour forensic photography unit in a city/ county crime laboratory. Requires knowledge of all facets of crime scene search services to include: detecting, collecting, photographing, and the preservation of physical evidence found at crime scenes and the supervision and directing of 23 crime-scene search technicians including 5 shift supervisors to render this service. Requirements of work: at least 2 years experience in crime scene search work with at least a baccalaureate degree in Law Enforcement, Criminal Justice, a physical science (Chemistry, Biology, Physics, etc.) or equivalent combination of experience in course work and training equal to a baccalaureate degree in the aforementioned degree programs. Strong personnel, supervisory, and management experience pertaining to law enforcement missions. This announcement is abbreviated, for more information contact: Roger C. Thompson, Crime Laboratory Director, Charlotte-Mecklenburg Police Crime Laboratory, 601 E. Trade Street, Charlotte, N C 28202-2940, Voice: (704) 353-1100 FAX: (704) 353-0088, E-mail: rthompson@cmpd.org

Award Announced

The CAC Awards Committee announced that My Linh Phan is the winner of the 2002 Edward F. Rhodes Memorial Award.



Calling All Microcrystal Drug Chemists

We are planning a publication on the identification of drugs by microcrystal tests as a collaborative effort of the members of the CAC. This will be an easy-to-use reference guide including color photographs, the latest "designer drug" tests, and validation studies.

We are looking for individuals who wish to contribute photographs from their collection, prepare new photographs, do some research, and write sections of the paper. All contributors will be acknowledged.

Sound interesting? Contact Patricia Lough at 619-531-2460 or email <u>pkl@pd.sannet.gov</u> to get involved!

Highlights from the CAC E-News <mark>U</mark>pdate, 5/23/02

Elected: Raymond Davis- President-Elect, Linda Jacobson- Regional Director-North. Re-elected: Brooke Barloewen-Recording Secretary, Elissa Mayo-Thompson, Membership Secretary, Current Board Members: Michael Parigian-President, Dan Gregonis-Immediate Past President, Michelle Fox- Treasurer, John Simms- Editorial Secretary, Marianne Stam- Regional Director-South.

Membership Elevations and New Members. Congratulations to our members who have recently received elevations to their membership status and welcome to our newly elected members. Elevation to Life Member: Jan Bashinski BFS Bureau Chief, retired.

Elevations to Full Member: Vanora Kean, Private Consultant, Canada, George Hou, Los Angeles Co. Sheriff Crime Lab, Frank Healy, San Diego PD Crime Lab, Julie Buckenberger, Orange Co Sheriff-Coroner, Cordelia Willis, Santa Clara Co. Crime Lab.

New Provisional Members: Cheryl Anderson, Los Angeles Co. Sheriff Crime Lab, Geoff Bruton, Ventura Co. Sheriff's Dept., Laurie Crutchfield, Orange Co. Sheriff-Coroner, April Denison, Orange Co. Sheriff-Cor., Rebekah Duderstadt, Alameda Co. Crime Lab, Tharinia Dukes-Robinson, DOJ Riverside Crime Lab, Karen Fleury, El Cajon Crime Lab, Matthew Gabriel, San Mateo Co. Sheriff Crime Lab, Felicia Gardner, Orange Co. Sheriff-Cor., Jose Gonzalez, LAPD Crime Lab, Amanda Griggs, San Mateo Co. Sheriff Crime Lab, Dennis Harvey, Kern Co. Crime Lab, Tess Hemmerling, San Diego PD Crime Lab, David Johnson, Phoenix Police Department, Cristian Orrego, DOJ Berkeley Crime Lab, Jenifer Palmer, Phoenix PD, Sandra Sachs, San Francisco PD Crime Lab, Virginia Sadl, DOJ Riverside Crime Lab, Kathryn Troyer, Arizona DPS Crime Lab, Opritsa Tudoriu, Santa Clara Co. Crime Lab., Jarred Wagner, Cal State Univ., Fresno, Dept. of Chem, Eric Wahoske, LAPD Crime Lab, Bronwyn Weis, DOJ Riverside Crime Lab, Linda Welsh, Orange Co. Sheriff-Coroner, Danielle Wieland, Orange Co. Sheriff-Cor., Song Wicks, Contra Costa Co., Lois Woodworth, San Francisco PD Crime Lab, David Wu, DOJ Riverside Crime Lab.

New Corresponding Member: Allison Sedowski, Phoenix PD.

New Affiliate Members: Jeanine Aguirre CSU Channel Islands, undergrad, Frank Bianco Jr. U of New Haven grad student, Intern Sac.Co. Crime Lab, Ryan Davis UC Davis undergrad, Cortney Hayek CSU Los Angeles grad student, Kim Henderson CSU Los Angeles grad student, Michelle Madrid CSU Los Angeles grad student, Jaime Miller CSU Los Angeles grad student, Jeffrey Reineke, CSU Los Angeles undergrad, Kelly Sullivan CSU Los Angeles grad student, Ramona O'Jon CSU San Bernardino undergrad, DOJ Riverside Intern, Tharinia Dukes-Robinson, DOJ Riverside, Shannon Thompson, UC Berkeley undergrad, DOJ Berkeley Intern, Beverly Williams, CSU Sacramento undergrad.

CAC Committee Positions Available. There are opportunities for involvement on the CCI Advisory, Endowment, Ethics, Financial Review, and Training and Re-

sources committees. If interested, please contact Dan Gregonis at <u>dgregonis@sanbernardinosheriff.org</u> or 909-387-2200 for further information.

Upcoming Seminars and Training Opportunities

On July 25-26, 2002 at Seaside, California on the Monterey Peninsula, there will be a two day conference following the California Conference of Arson Investigators (CCAI). This is the 2nd Joint meeting of the Northern/Southern California Fire and Explosives Study Group. Fee: Thursday \$35 CAC members/\$40 non CAC, Friday \$50 CAC members/\$60 non CAC. Thursday night with noted author Dr. John DeHaan. Friday, speakers from Farmer's Insurance, Agilent Technologies, New Jersey State Police Crime Lab, Lawrence Livermore Lab, and Restek Included is a lively roundtable discussion with analysts to discuss interesting and difficult arson and explosive cases. If you have ideas on presentations, or would like to make a presentation yourself on some aspect of fire or expolosion, please contact: Southern committee members: Krisin Rogahn (805) 654-3642, Celia Lukomski (858) 467-4633, Northern Committee members: Jim Beede (916) 874-9240, Mary Trudell (415) 383-3283 A copy of the announcement can be sent via e-mail: elissa.mayo@doj.ca.gov.

Member Vita: The membership secretary is in the process of developing a form for members to document their participation in the CAC. A similar form was used years ago by the CAC for documenting such things as offices held, committee participation, papers presented and published etc. Once filled out, it was kept in the member's membership folder.

Once the new form is developed, it will be posted on the CAC website. Filling out the form is voluntary, but highly suggested. Once filled out, a copy should be returned to the membership secretary for inclusion in your membership folder. It will be the responsibility of each member to keep the form current. The membership secretary will ask for updates to member's vita on an annual basis.

Submitting items for the Membership E-News Update: please email requests to <u>elissa.mayo@doj.ca.gov</u> for consideration and placement it in the next Update.

Over 40 e-mails were returned undeliverable from the last *E-News Update*!

Please make sure the CAC membership secretary has your current address, phone number and e-mail. Send information to: <u>elissa.mayo@doj.ca.goy</u>

Case Coordinator?

Do you have one? Should you have one?

There are always going to be nightmare cases that stretch a laboratory to the limits of its capabilities, its efficiency, and its effectiveness. In those instances, the laboratory should consider using a case coordinator to help facilitate the work, organize the demands, and to liaise between the laboratory and the investigators who obviously and understandably, want everything yesterday so they can solve the nightmare case. The case coordinator ensures that there is frequent communication among the analysts of the various units of the laboratory. The case coordinator will help maintain a sense of organization in the chaos.

What is a case coordinator?

It is my opinion the case coordinator was born out of the evolution from generalist to specialist. In the old days, one person would have performed nearly all the criminalistics functions, i.e. trace evidence analysis, serology, firearms identification. But today, those criminalistics functions are divided into specialties so that numerous criminalists are involved on a case needing several types of analyses.

A case coordinator most effectively may be a criminalist, or a supervisor, who can oversee the prioritization of the casework, help determine exactly what is to be done on the evidence, and keep the detectives from overwhelming the laboratory with a flood of either verbal or written requests. This flood may cause several criminalists to be working in different directions so that the right hand no longer knows what the left is doing.

There may be a huge number of evidence items. Work requests fly in from different directions. Who is to put into perspective all of the immediate demands of the laboratory work requests?

When is a case coordinator needed?

When the laboratory finds itself buried with a high priority case, the investigative demands are numerous and immediate. These cases capture the public's interest and the media eye. The media is knocking down your door, or is parked on the steps of the courthouse; the media may swarm the victim's family, or, as is the case of our current media circus, follow every move of a potential suspect who is under investigation.

The investigators are in a rush to get work done as soon as possible to develop a break in the case or to confirm that their possible suspect is, in fact, the right suspect.

There may be a huge number of evidence items. Work requests fly in from different directions. Who is to put into perspective all of the immediate demands of the laboratory work requests? Who is to decide what is to be done first? Who is to provide feedback to, and negotiate with, the detectives regarding their requests?

Many years ago, we created a case coordinator policy that defined the roles and responsibilities of the coordinator. The roles and responsibilities may differ in each case depending on the circumstances. But the policy provides a game plan that can be used and adapted as needed.

STAGE 1 FUNCTIONS

First, identify who the case coordinator will be. The coordinator will interface with the lab supervisors who will establish the case team members. The coordinator will share this information with the detectives.

STAGE 2 FUNCTIONS

The coordinator will establish regularly scheduled meetings with the investigators to discuss new and pending work requests. The coordinator will help to define realistic requests, and communicate expected timelines on the work being completed.

STAGE 3 FUNCTIONS

Stage 3 would then be to coordinate the laboratory analyses and meet with the case team to ensure logical progression, to keep those working on the case abreast of any changes in the work required or in the established timelines, and to establish joint decision-making procedures.

Depending on the circumstances, there may be any number of responsibilities that the case coordinator can fulfill that may not be defined in the policy. For instance, in our current high profile case, the coordinator is compiling a complete list of chain of custody transactions for every item of evidence that has been developed in the case. Also, the coordinator is compiling all the discovery materials from the analysts in the case.

The case coordinator may be actively involved in all of the defined steps or just some portion of them. The case itself will dictate how much a coordinator needs to do.

I had the occasion to serve as a coordinator some years ago on a beach area rape series. I had daily meetings with the sex crimes unit to help keep them informed of the call out personnel and the work progressing on the series of cases. That was on a relatively small scale compared to the newest high profile homicide case on which we currently have twenty laboratory analysts involved.

The case coordinator policy should be crafted to help provide organization to the work structure and communication in a high profile case. It is not a policy that needs to be invoked very often. In fact, we create it and put it up on the shelf hoping we never have to use it.

We have found tremendous value in bringing in a case coordinator for those cases involving several analysts across several units, and there are numerous items that have to be examined over an extended period of time.



John Simms CAC Editorial Secretary

FEEDBACK The *CACNews* prints letters to the editor that are of interest to its readers. We reserve the right to edit letters for brevity and clarity. All submissions to this page become the property of the *CACNews*.

I could not be nearly as effective as I am nor as

helpful to this county if I did not have

the support of the CAC.

Member to Member

How belonging to the CAC benefits your agency.

At the last seminar, a colleague mentioned to me that she had been getting "hassled" by her lab manager for spending too much time on CAC business. I recalled that when I was working for a county sheriff's department and simultaneously publishing the *CACNews*, I too received similar complaints. In an effort to not only defend myself, but also to persuade management about the benefits of CAC membership, I wrote a memo to my boss detailing what I thought were good reasons

for publishing the *CACnews* in our lab. You could practically substitute "receiving" for "publishing." I have reprinted the bulk of that memo here in hopes that if you are also being hassled, you might glean a good argument or two from some-

thing I have already written. I also invite contributions from other members who have had similar experiences and would like to share their strategy.

Scientific collaboration is required. My job is that of expert witness. By law, I must only perform testing that is "generally accepted in the relevant scientific community." That is a key part of the infamous *Kelly-Frye* decision. My participation in the CAC gives me that required access to the community of other forensic scientists, many of whom have far superior experience to mine. This means I can do my job better, and that I can pick the brains of some of the nation's best scientists when I am asked to answer a deceptively simple question such as, "*Do we have the right guy?*" I could not be nearly as effective as I am nor as helpful to this county if I did not have the support of the CAC.

County sponsorship. My membership in the CAC is and has always been paid for by the county. I feel that this is a clear statement of commitment by the department, and that they feel this membership is worthwhile.

The newsletter provides access to information. Publishing the *CACNews* means that I get access to timely information before anyone else in the business, let alone our lab. By way of recent example, there was an alert sent to me regarding the detectability of new formulations of gasoline used in arsons. This bulletin came to me weeks before anyone else saw it. Even

last week, I received advance notice of appropriate DNA evidence collection guidelines from the Calif. Dept of Justice-California Criminalistics Institute in Sacramento. This is hot stuff, as it ties in perfectly with training we recently gave the local police department as

well as our own crime scene technicians. I gave an advance copy to my supervisor before publishing it in the *CACNews*.

The CACNews is a vehicle for dissemination. The outflow of information goes through our lab as well. I am able to insert items of interest to our own lab such as job openings, and requests for additional information about difficult cases, unusual patterns, etc.

Finally, the prestige of the laboratory is increased. By publishing consistently professional and high-quality articles and graphics, the image of our crime lab is associated with a class operation. This makes us a desirable place in the minds of other members seeking jobs.

John Houde Bainbridge Island, WA

California Association of Criminalists Joint meeting with Northwest Association of Forensic Scientists April 7-11, 2003 El Dorado Hotel, Reno, NV For information, contact Suzanne Harmon

775.328.2811 sharmon@mail.co.washoe.nv.us

It's never too early to mark your calendar!

Educating and Training for a Profession

Prof. B Caddy

Introduction

As someone involved with education in the forensic sciences for nearly forty years I recognize that at the beginning of my career I, as a graduate chemist, was under the misconception that forensic science was to do with chemical analysis. This view was reinforced by a review of the forensic science literature available at that time which provided a catalogue of new methodologies for the detection of a wide range and smaller and smaller amounts of, materials. This was particularly true for my areas of immediate interest namely toxicology and drugs of abuse. I was not discouraged from this view by those who operated within the mainstream forensic science laboratory systems where the excitement seemed to lie in all the new instrumentation that had become available to them which would enable analyses to be conducted on samples that could not be previously analyzed. This excitement was understandable because prior to the 1970's there were many occasions when little could be done to provide scientific support to the legal process. This view of forensic science may well be associated with our definition of what workers in the field perceive as being "forensic science." Even today were 100 forensic scientists to be asked "what is forensic science?" it is likely that 100 different answers would be forthcoming but no doubt amongst the answers would be reference to science, investigation and the legal process for example:

> application of the laws of nature to the laws of man M J Camp 1986

...the application of the sciences to matters of the law. P R De Forest 2001

Over my formative years as a forensic scientist I came to recognize that forensic science was so much more than analysis in fact analysis may be a minor although still an important part of any forensic science investigation. I use the word investigation deliberately because this word lies at the heart of all good forensic science. Not only is forensic science concerned with the legal process but one if not the most important aspect of any forensic science investigation is its ability to help in the reconstruction of activities leading to the criminal (or civil) event. Such reconstruction's may be based upon observations at the crime scene but may also relate to physical evidence recovered from the scene or from the clothing of suspects etc.

Another important aspect of the forensic scientists' role relates to the way he or she directly interacts with the legal process through the production of reports and discussions with counsel. This is an interpretation role. Providing the forensic scientist is in possession of all the necessary information surrounding a case who is in a better position for interpreting the

This lecture was presented as the "Founder's Lecture," at the CAC 99th Seminar, San Francisco, CA, May, 2002.

scientific evidence for the court? It has been rumored that the FBI recently decided to distance their scientists from an interpretive role. If this is true then I find such a decision a complete abrogation of the responsibilities of the forensic practitioner to the legal process.

How does this all embracing view of the forensic sciences effect, stimulate, and rationalize education in this discipline?

Educating for the Forensic Sciences Undergraduate degree courses

Most older practising forensic scientists entered the profession after following an undergraduate program leading to a bachelors degree in one of the physical sciences such as chemistry, physics, biochemistry, biology, etc. In more recent times the number of disciplines has grown to include genetics and molecular biology. All these degree courses provide the fundamental grounding in the particular science such that they lay a foundation on which to build, often in a different direction to the original degree. In building this foundation such courses were meant to introduce the student to ways of thinking, the "scientific method," and to give each candidate confidence in exploring for themselves their chosen discipline by extensive reading and the acquisition of practical and manipulative skills. But is this a position that appertains today? I would venture that this is no longer the case for many students. It was always understood that the lecture notes of the academic were personal to that staff member and that in a lecture course a major role of the faculty member was to provide the theme and to highlight the major points for further exploration by the student in "a voyage of discovery and self discovery" mainly by personal directed reading. Any student today would respond in horror to such a presumption of hard work on their part and would demand copies of all lecture material. What has brought about this changed view of the relationships between staff and students and what effect has this had on the way forensic scientists may be educated?

These observations really reflect the different attitudes that have developed in our society in our relationships with work colleagues, work itself and economic status. There is also a general drift away from the idea of professional responsibility, whatever that may mean.

Universities have for some time recognized that many of the more able students are entering those professions that are more highly paid such as the law, accountancy and those activities generally associated with the business community. From a purely political and economic standpoint this may not of itself be detrimental in the short term but it may effect our manufacturing base in the long term. Additionally, sciences in general and the physical sciences in particular have a bad press. The chemical industry is seen as a polluter of the environment and physics has a problem with the atomic energy industry. Perhaps most importantly for forensic science the physical sciences are perceived as difficult study areas with high examination failure rates in comparison with such subjects as "media studies" and the arts. As a major consequence of such thinking many Universities, especially in the United Kingdom over the last 5-10 years, have turned to forensic science as a saviour for attracting students to science courses.

Media exposure has given forensic science the glamour image that it can rarely sustain in its practice. Further there is little distinction in the media between the practice of forensic science and that of forensic medicine. How often have those who work as criminalists been charged as "those people who cut up bodies?" The ignorance of the media in ascribing activities to those who are active as forensic scientists is notorious especially as it relates to multi-tasking, that is those wonders of the scientific world that are expert as DNA specialists, can examine firearms and undertake offender profiling all at the same time? Whatever we think of the media and the way it deals with forensic science it undoubtedly has a very large impact on the student body and has been a prime reason why recruitment to forensic science courses is so successful.

In the United Kingdom we now have 33 universities and colleges who are offering degrees (139) in forensic science. A few of these degrees are single honors degrees but many are joint degrees of forensic science with some other subject ranging from law to media studies. One degree that has recently been introduced by one university whose faculty were told that because they could not attract chemistry students all the staff would loose their occupation or at best be assimilated by another department, attracted 300 applications. To put this into perspective most university courses in the United Kingdom to become viable would expect to take 80-120 students into the first year of a course and perhaps 60 - 100 of these would graduate in their selected discipline.

A number of important questions arise from this explosion in forensic science degree courses:

- Does the forensic science industry have a requirement to employ graduates from such forensic science degree courses?
- What are the expectations in terms of employment from students taking such degree courses?
- Have the Universities consulted with the forensic science industry over the course content of such degrees?
- · Who best represents the forensic science industry for such consultation exercises?
- What is the quality of the University staff in terms of their ability to deliver material of forensic relevance to the student body have they ever practised as forensic scientists?

In relation to the latter is it best to take practitioners and train them to be forensic educators or is it better to take academics and train them to be forensic scientists?

- Does the University have the necessary resources in terms of staff, laboratory, computing and ancillary (e.g. library) facilities to support such courses and who is to judge this?
- What is the quality of graduates from forensic science degree courses?

To try and answer the first question for the United Kingdom, much will depend upon what students have been told in terms of their employment prospects and whether the courses have been structured to give options that will enable the graduates to be employed in other cognate areas of science. If it is assumed that 25% of the student intake will be seeking employment as forensic scientists from 139 courses with an annual intake of say 40, this will mean that 1390 of such students will be looking for employment each year. This represents approximately half the laboratory staff of the main employer of forensic scientists in the United Kingdom, the Forensic Science Service and perhaps a third of all laboratory based forensic scientists in the United Kingdom. Even if many of the graduates find employment with police forces as crime scenes officers the supply of graduates well exceeds the employment opportunities. It must also be remembered that such graduates will be in competition with graduates from other disciplines (e.g. molecular biology/genetics) who probably have greater in depth specialist knowledge in their discipline that will in turn have a greater appeal to a particular employer. Forensic science graduates may offer an advantage in having an awareness as to how forensic science fits into the legal process and, depending upon the instruction given, may have developed a sense of the role of crime scene reconstruction for the interpretation of laboratory based work; however, all such graduates will require further training before they can fully participate in their chosen profession. Furthermore, a good graduate from a good course will often find employment but this raises the question as to what represents a good course.

This has been a question posed by many potential undergraduates who contact the Forensic Science Society offices in order that they may make a decision as to which degree courses they should enter. At present the Society and as far as I know no one else, is in a position to make any such recommendations. At present the Society suggests that it may be best to obtain a first degree in a scientific discipline allied to forensic science such as molecular biology and then to take a post graduate degree in the discipline if it is thought desirable. It was this inability of the Society to make any kind of recommendation that led to the establishment of the Academic and Education Committee. One of its major roles is to interface with the universities and to provide guidance on what constituted some kind of standards against which courses could be assessed. We are in the early stages of this work and have identified, for those Universities that offer courses in "Forensic Science" the areas of "Crime scene investigation", "Analytical Methods" and "Interpretation and presentation of Forensic Science Evidence" as standards. It was decided, because of the great variation in course design to define such standards generically and express them in terms of learning outcomes. An example of a draft of one such standard is given in Table 1.

Table 1. A Standard for the Interpretation and Presentation of Forensic Science Evidence for Undergraduate University Courses in Forensic Science (3rd Draft)

Purpose

To provide students with the skills and knowledge base to enable them to manipulate data, interpret evidence in a scientific manner and cogently present in the written and spoken word the results of such activities in a legal context.

Learning Outcomes

The student should be able to:

- Record observations and experimentation in a logical, comprehensive and contemporaneous
 manner taking into account the requirement to establish continuity of evidence and conformation
 to any quality assurance programme. This latter should record measures employed for contamination avoidance.
- Assess data from, the output from instrumentation and from physical evidence examined, using
 a series of statistical tests including Bayesian applications and to express the meanings of the
 results of such tests in a concise way such that they would be understandable to a lay audience
- Demonstrate sufficient computer skills to enable standard statistical packages to be employed for the interpretation of data
- Make use of appropriate databases
- Write comprehensible and rational reports that meet legal requirements and that would be suitable for the courts
- Demonstrate good verbal and presentational skills that would enable the student to be understandable in a court of law

Resources

The University is expected to provide sufficient evidence to demonstrate that it can support a programme of lectures, laboratories and tutorials/court appreciation, that will lead to the student body acquiring the necessary skills to produce the above outcomes. Additionally the University must demonstrate that it has the necessary infrastructure e.g. library facilities, to support such a programme. What has been discussed above is undergraduate courses in forensic science that promote the idea that they are designed to offer students an advantage in the employment race as forensic scientists, including crime scene workers, against other kinds of graduate. There is however another aspect to undergraduate courses which reflects the difficulty in recruitment into science and which is not really concerned with employment in the forensic sciences. This is the policy of using forensic science as a vehicle to teach good basic fundamental science.

I can see no objection to such courses provided the differentiation is explained to the student population before embarking on their studies. Care must be exercised that this differentiation is maintained throughout the period of study. How the wider scientific industry will view such graduates is difficult to assess but much will depend upon the quality of the course and the graduates and the skills and knowledge base that they have acquired and whether they are compatible with the specific industrial requirements. Again, the good graduate will find employment.

Postgraduate degree courses

These are probably the natural home for entry into the forensic science profession because such courses will build upon an already established knowledge base and at the same time give them additional practical skills specific to the forensic sciences. What then should be the purpose of a postgraduate degree in forensic science? I believe that there are 4 main aims of such courses:

- To teach the fundamentals of forensic science in terms of the recovery of evidence, its analysis and its interpretation.
- To understand how forensic science fits into the legal process.
- To recognize and assimilate all that is required to manage the interface between the lawyer and the scientist, the investigating (usually police) officer and the scientist and the legal-medico and the scientist.
- To develop a research mentality

To achieve these the students will require to have instruction and practical experience in:

- The recovery of evidence from crime scenes and clothing and the knowledge base and practical skills for reconstruction exercises and contamination avoidance measures
- Validation of analytical methods and procedures and their application to forensic samples
- Interpretive skills taking into account the full details of a case, the use of data bases, the scientific literature and a knowledge of statistics especially Bayesian statistics
- Development of both written and verbal communication skills and court craft
- Research methods and ways of thinking

To achieve these universities must make a serious investment in appropriately qualified staff and laboratory facilities together with all the necessary infrastructure such as computers and library facilities. In respect of such investments there is a philosophical point to be made here that relates to who are the best people to provide instruction in the forensic sciences? Is it academics or practitioners and are these mutually exclusive? Are there advantages in being first an academic who becomes involved with forensic science practice or is it better to be a forensic practitioner who develops an academic interest? I would venture that both pathways are acceptable and a combination of both faculty types would benefit any university. There is of course an alternative and that is where theory is taught by academics and practice by practitioners. I would suggest that this route can, without great care, lead to compartmentalization of ideas and theories from the practice of the discipline and may not lead to full integration.

Most of these ideas can be accommodated by an appropriately structured masters degree that contains a major element of structured lectures and laboratory work together with a research element. This should give the necessary breadth to any program while depth can be accommodated through opportunities for some specialization e.g. firearms or fire investigation. It is important that such courses have built into them a degree of flexibility but there should always be a core set of material that all students must study.

PhD degrees in forensic science do not usually provide the breadth of a masters degree unless there is a high formal structured content, say in the first year. They do however, offer great depth in a very specific area of the forensic sciences and give much greater opportunity for developing a problem solving approach to forensic science. So often students (and not only students) at all levels, lose sight of the fact that the forensic scientists role is to find a solution to a problem and not to use all the sophisticated equipment that the laboratory possesses as an exercise into who can learn most about the smallest of samples.

Whatever university course of study is undertaken should graduates take up a post in an operational laboratory they will still have to undergo a period of training to fit into that particular organization as a useful member of staff. The degree of additional training will depend upon how well that laboratory system has been able to interact with the provider of the university courses and I would advocate a close liaison between the two perhaps by establishing a joint local liaison group. Sometimes the academics may also be able to help those in practice as much as the practitioners are able to support the academics.

For those graduates in other disciplines they will clearly have to undergo an extensive period of training and most large laboratory networks have within their organizations a training facility.

Training in the Forensic Sciences

Training in the forensic sciences is different from educating in the discipline. The former indicates a limited target of expertise to be developed to attain a specific objective while the latter is the development of an extensive knowledge base and practical skills that can be adopted to the solution of a disparate group of problems. Much of the latter is usually attained through a graduate/post graduate program, not necessarily in forensic science, while the former is usually achieved through tailor made courses designed to meet the needs of an organization.

If training is to mean anything it must mean that the recipients of the training have achieved an appropriate standard. The question then arises as to what that standard is to be and how we make sure that all those being trained meet the same standard? Can we define the needs of an organization that will enable us to identify what if any standards should be composed? Clearly most managers of forensic science laboratories want their staff to be performing at the highest standards at all time in the workplace. To achieve this most laboratories have adopted a rigorous quality control/assurance system but this only monitors the processes within a laboratory. It doesn't say how well the scientist implements these processes. This latter requires a measure of performance and that monitoring must be made against a set of standards. This would suggest that any standard must be associated with workplace performance and such performances are concerned with a knowledge base, a consistent application of practical skills and an ability to make decisions based upon sound scientific practice and principles. The traditional way of assessing personnel uses written theoretical tests accompanied by some formal structured practical test. The former is valuable in testing the knowledge base but the latter only shows competence (or incompetence) on a single occasion and cannot be seen as a good test of consistently working to a standard within the working laboratory environment. The Forensic Science Sector Committee, a pseudo government body in the United Kingdom, has pondered long and hard over this problem and has now produced a basic generic professional standard of competence that can be applied to most laboratory and crime scene workers.

"Professional Standards of Competence define what forensic scientists must be able to do, to what level and in what circumstances to demonstrate competence in their work" Dr R Bramley, September 2001

The format of these standards are divided into five separate units and each unit is divided into a series of elements. The overall structure is given in Table 2.

Within each element is a list of what is required to meet the objectives of that particular element and along side this as a guide are a series of statements that identify what you will need to know and understand. An example of the latter is given in Table 3 for Element 2.5

Having set the standards it then requires a system to be put in place for assessment against such standards. These assessment processes have still to be developed but it can be anticipated that this will require the recruitment of a number of assessors who are trained in the process but whose main focus will be on assessing the personnel in the workplace as the scientist is investigating a case. Reference will also be made to past cases where what was undertaken by the candidate can be compared with the standard. Where it is not obvious the assessor should clarify what was done and why. It is by this mechanism that the knowledge base can be tested. Such a scheme does not preclude the introduction of a formally structured theory examination such as that of the American Board

Table 2. Professional standards of competence in forensic science

Unit 1	PRFPARF	T0	CARRY	OUT	FXAMINATION
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- Element 1.1 Determine case requirements
- Element 1.2 Establish the integrity of items and samples
- Element 1.3 Inspect items and samples submitted for examination

Unit 2. EXAMINE ITEMS AND SAMPLES

- Element 2.1 Monitor and maintain integrity of items and samples
- Element 2.2 Identify and recover potential evidence
- Element 2.3 Determine examinations to be undertaken
- Element 2.4 Carry out examinations
- Element 2.5 Produce laboratory notes and records
- Unit 3. UNDERTAKE SPECIALIST SCENE EXAMINATION

Element 3.1 Establish the requirements for the investigation Element 3.2 Prepare to examine the scene of the incident

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Element 3.3 Examine the scene of the incident Element 3.4 Carry out site surveys and tests
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Unit 4. INTERPRET FINDINGS

Element 4.1 Collate results of examinations Element 4.2 Interpret examination findings

Unit 5. REPORT FINDINGS

Element 5.1 Produce report

- Element 5.2 Participate in pre-trial consultation
- Element 5.3 Present oral evidence to courts and inquiries

Table 3. Example of an element

UNIT 2: EXAMINE ITEMS AND SAMPLES

Element 2.5: Produce laboratory notes and records



of Criminalists. The idea of general or core forensic knowledge being tested along with specialist knowledge is desirable for such theory assessments. In order to make sure that there is consistency across the range of personnel being assessed and across the different disciplines of forensic science, it will become necessary to use a small number of verifiers who can randomly select documentation from candidates in order to establish that the assessment process has been correctly implemented and the standards maintained. Additionally, personnel will need to be tested against these standards many times over their career in order to demonstrate that they have maintained their competency. Failure to meet these standards will usually mean a period of retraining or diversification to other laboratory roles or perhaps dismissal.

Having established a set of standards any training, whether in house or external to the organization, will require to take such standards into account. Training can be conducted on a face to face encounter but advantage should be taken of the benefits of Internet facilities and class conferencing. The use of structured documentation and observation of practical skills via the Net by academically as well as forensically qualified

Table 4. Criteria Used by CRFP for Assessing Practitioner Competence

- · Knowing the hypothesis or question to be tested
- Establishing that items submitted were suitable for the requirements of the case
- Confirming that the correct type of examination has been selected
- Confirming that the examination was carried out competently
- Recording, summarising and collating the results of the examination
- Interpreting the results in accordance with established scientific principles
- Considering alternative hypotheses
- Preparing a report on the findings
- Presenting oral evidence to court and at case conferences
- Ensuring that all documentation is fit for purpose

experts offer enormous potential in training over distances. Clearly any training for a specific area of the forensic sciences must meet the needs of the particular laboratory and this is why so many different laboratory systems develop their own training programs because of the great variation in the ways forensic science is administered. This is why nationally agreed generic standards are so important because they can be adopted to each individual laboratory system.

But having been educated and trained to a standard and assessed how can this process be used to the advantage of the practitioner and the legal process to eliminate persons from the legal process who are clearly not expert in what they claim?

The United Kingdom, with government support, have now introduced a register of competent practitioners under the auspices of the Council for the Registration of Forensic Practitioners (CRFP). Their role is a simple one of registering only those persons who can demonstrate that they are currently competent in their specific role as an expert in some aspect of the forensic sciences. This is achieved through assessment against a set of ten criteria for laboratory based forensic scientists. It should be remembered that these are criteria and not standards.

The process of registration requires that the practitioner submits a list of 60 recent cases. Recent usually means within the last 6 months or so. An assessor then selects 6 of these cases and requests full details of all the work carried out which includes all instrumental output and any report. This latter is anonymized to comply with legal requirements. These 6 cases are then assessed against the 10 criteria. Not all cases need to demonstrate all the criteria as long as they do collectively. If these cases are seen to comply then the practitioner will be registered. Re-registration is required every 4 years and if the practitioner does not continue to practice within that area of the forensic sciences for a period greater than 6 months they will be asked to undergo a repeat assessment. All candidates must sign and adhere to a code of conduct and anyone failing to meet this code can be disciplined.

While there is no perfect division of the different roles of personnel within a forensic science laboratory, the following is a list used for assessment purposes and will appear on the registration document.

Table 5. List of Laboratory Activities Used by CRFP for Assessing Practitioners

- Drugs—all areas of drug work not associated with toxicological investigations
- Firearms—ballistics, comparison microscopy, classification
- Human contact traces—DNA, body fluids, blood distribution, hairs, others (e.g. serology)
- Incident reconstruction—Fire and explosive investigation, metallurgy and material failures, traffic accident reconstruction, tyre examination, tachograph, non-metallurgic component failures

- Marks—Tools, footwear, tyre marks, packaging and manufacturing marks and any others
- Particulates and other traces—Fibres, glass, paint, explosive residues, gunshot residues, plant materials, pollutants, chemical traces and stains, any other particulate materials
- Questioned documents—Handwriting, documents and other related materials
- Toxicology—toxicology, all aspects of alcohol analysis and interpretation

The Profession?

I have written on this question before (1) but I make no excuse for repeating some of my ideas on this topic.

The educating and training of persons as forensic scientists becomes essential if the collective body of forensic scientists are to be identified as a profession. But are we a profession? We often talk of acting professionally but is this the same as being part of a profession?

What do we mean by the term "professional?" Would forensic scientists wish to draw parallels with professional football players for example? They, the scientists, certainly don't command the same earning capacity as the professional football player but do they bring the same commitment and skills to their discipline? So is professionalism concerned purely with skills and commitment? The Oxford English Dictionary (OED) defines "professional" and "professionalism" respectively as: "of belonging to, connected with, a profession" and "qualities or typical features of a profession."

Such definitions don't take us very much further forward but perhaps there is a clue in the OED's definition of "profession", " a vocation or calling especially one that involves some branch of advanced learning or science." Bearing this definition in mind it may be beneficial to look to the classical professions of law, medicine and the church as models for a profession for forensic scientists.

To enter these professions one is required to undertake an appropriate course of study usually, but not always, within a university environment. This study establishes the primary knowledge base of the profession and this would be true for forensic science as discussed above. In addition, at some point, the candidate is introduced to the practical aspects of the profession. In medicine it will include practical works on physiology and anatomy and clinical assessment under the direction of a senior medic, perhaps a consultant. While for law it will be further study for post graduate diplomas and/or a period of work within a law practice under the direction of an experienced lawyer. For the church practical experiences in pastoral care under the direction of an experienced cleric would be the norm. In all three cases before a candidate can qualify they must be able to demonstrate a sound knowledge base and practical skills that meet the requirement of a mentor. Such mentors are mainly identified by their experience not necessarily their expertise. What is in place here is a kind of apprenticeship scheme where there is little if any requirement for the mentor to demonstrate that they possess the required expertise. The medical profession in the United Kingdom is only now identifying the problems of confusing experience with expertise.

How do forensic scientists, as opposed to forensic medico's, measure up to this route towards achieving professional status? All will have received an appropriate primary knowledge base either through higher education or some other training institute such as in the United Kingdom the National Training Centre for Crime Scene Officers and most will develop their forensic skills through the guidance of an experienced scientist/crime scene officer. Some larger organizations will develop specific training courses for their new recruits that should give some measure of their practical and observational skills in order to identify competence in the workplace. But what happens with the smaller organizations? Is it still a case of "learning on the job?" Moreover, for those courses provided by employers, is the standard set an appropriate one and is that standard consistent across the whole breadth of forensic activities? Additionally, can the public have confidence in such standards and is their implementation transparent?

One aspect of the classical professions, which does not yet apply to the practising forensic scientist, is that there is a statutory requirement to register with some governmental body. The General Medical Council undertakes this role for the medical profession in the United Kingdom and the Law Society for solicitors in England and Wales. An ordination of a cleric is effectively a license to practice in the Church of England. What are the implications of this and why are forensic scientists not required to register with some governmental body? Firstly, the most obvious reason for this is that there is for the United Kingdom and I also believe it to be true for the United States no governmental statutory body with which the forensic practitioner can register. It does not exist. Secondly, for any member who contravenes a proscribed code of conduct, a code which is considered to meet the need of that profession, then the possibility exists that a member may be removed from the register and may no longer be permitted to practice as a medico, a so-

How then can a practising forensic scientist achieve this professional status and at what stage in ones development as a forensic scientist does this transition from practitioner to professional take place?

licitor or a priest. That is to say a member will no longer be able to earn his/her living through practising their profession. This threat is perceived as a sufficient mechanism in preventing malpractice within these professions. One must then pose the question "does it work?" The growing number of press reports in the United Kingdom on malpractice both within the medical and legal professions not to mention the behavior of some priests would suggest that such a mechanism may not be working to the level that it should. I would suggest that the reason for this is that too much emphasis in these professions has been placed upon the guidance of experienced practitioners as opposed to expert practitioners. There are no national standards of professional competence laid down against which such "professionals" can be assessed. Properly regulated continued professional development does not seem to exist either, rather a "hodgepodge" of certification of attendance at appropriate conferences and seminars none or hardly any of which contain an element of assessment of a candidate.

But let us not as forensic practitioners become smug about

the failures of our colleagues in the classical professions because we have little to become smug about. It was the failures of the forensic science community in the 1970's in the United Kingdom and I know of similar cases in the United States that produced a tightening up in the way forensic science operated especially in regard to quality assurance and quality control. It has only been in recent times that we have begun to look at personal professional competence. That is, an ability to perform to an appropriate standard in the workplace. Even if such standards of professional competence exist there still requires a mechanism by which they can be implemented. In a partial way this exists in CRFP discussed above. But does registration with such a body make one a professional or does it merely say that someone on the register is competent as a practising forensic scientist? I would venture that the latter is the case and that being a professional forensic scientist is more than being registered with a body who can attest to ones competence. A statement by the Chief Executive of CRFP seems apposite

"...with just knowledge and skills you have a technician, or perhaps a stylist. To complete the picture, the professional needs the right attitudes. Ethical awareness, the ability to think broadly and outside the narrow confines of the task in front of you, the determination to communicate, the passion for the truth. This is professionalism."

Additionally I would venture that professionalism must include recognition by ones scientific peers that one has achieved professional status and not just conformed to a set of nationally recognized standards. But how do ones peers make such judgements? This arises by recognition of scientific worth from the quality of papers presented at both national and international conferences, by the publications one submits to scientific journals, by a willingness to organize seminars, by a commitment to the advancement of forensic science as a scientific discipline in its own right through research and discussion and the proselytizing of the role forensic science plays in the legal process. It must also include an awareness of the forensic scientists' ability as a manager, not just of people, that is very important, but also of the science he or she professes. It must also entail recognition and practice of his/her role as an expert witness as well as demonstrating an ability to build bridges between the different sectors of the forensic sciences and those involved with investigative and legal roles. Perhaps most of all professionalism is based upon an ethical standard, a set of rules against which a forensic scientist is judged and which must include a commitment to impartiality, confidentiality and an ability to restrict ones opinions to the boundaries of ones expertise. A professional must be aware of the consequences of not complying to a code of ethics. Especially for smaller organizations and particularly when working for a defendant, enormous pressures can be brought to bear on the practising forensic scientists to break such a code. A refusal to do so is the mark of a professional.

How then can a practising forensic scientist achieve this professional status and at what stage in ones development as a forensic scientist does this transition from practitioner to professional take place? Clearly, as one enters the field of forensic science it is the acquisition of basic forensic knowledge and the development of practical skills that occupy most of the forensic scientists time. As one progresses onto casework activities then one begins to accumulate some of the skills necessary to become recognized as a professional. It is here that a certain dichotomy arises; because for true professionalism there must be a commitment to publication and a research orientation (in this context much of what is undertaken in complex cases can be identified as research) but because of the way in which forensic science has become organized in recent times not all those entering the profession will have an opportunity to develop this sense of research. In this way compartmentalization of the scientists activities works against recognition of professional status. I do not believe that to carry out a series of proscribed activities identified through standard operational procedures and standard methods as devised by a professional forensic scientist makes one a professional. This is a real dilemma for the management of forensic science because good management must want all their employees to attain professional status because of the benefits in morale and the perceived advantages seen by the employees in continuous professional development. Because of a requirement to maximize output this may not always be possible and some forensic scientists may never achieve professional status under the criteria previously listed. Perhaps these criteria set too high a standard but who is to judge, the forensic science community, the legal profession or the public at large and in any case what systems or organizations are in place to help in generating a professional way forward? There is no professional body that represents forensic scientists as a collective group in the United Kingdom and I believe this to be true of the United States. So is this a role for the Forensic Science Society in the United Kingdom and the California Association of Criminalists in the United States?

Both groups were founded by like-minded individuals representing those involved in laboratory work, medics, lawyers, police officers and academics who recognized the need for a focus group on the forensic sciences and who identified a need to define forensic science as a separate and independent discipline. Is it time to explore a transference of roles from being learned societies to being professional bodies. Is it possible and indeed desirable to have both such roles?

Conclusion

From what has preceded I hope that I have been able to identify the pitfalls and problems associated with educating and training for the forensic science profession and given some guidance as to how we as a forensic profession can seek to overcome these problems. I would suggest that there is a continuing need for those active in the profession to work closely with those in universities and colleges to produce forensic practitioners who are fit for purpose. Finally, I would hope that I have stimulated all of those who claim to practice forensic science as an identifiable discipline to examine whether we are professionals and what it means to be a professional and in so doing to explore ways in which we might proselytize our role in the legal process to the benefit of all.

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Quality Assured

A while back I was reviewing my daughter's math test. She had received a good grade but had missed some answers. I looked over her worksheet to find where she had made mistakes on the problems she got wrong. On most, she had been given partial credit for her approach but, due to some simple errors resulting in the wrong answer, she did not get full credit.

In reviewing this worksheet I also found that she did not show her work for some of the problems for which she got the right answers. I asked her how she had gotten the right answers on those questions without apparently working the problems out. I wanted to see if she had used the right approach to the problems that she got right. She said she didn't have to show her work on all problems; besides, it didn't matter because she got the right answer. Hmmm. Because you got the right answer to the test question does that mean you did the problem correctly?

In forensic science our everyday casework does not normally give us direct feedback about the "correct answer." We infer the correctness of the answers based on our understanding of our science and techniques. We design protocols based on an array of samples and situations, eventually validating them for casework, with the belief that they will give the correct answer when properly applied. Scientific methods, however, may have their limitations, some of which are not immediately recognized but come to light with continuing application.

Perhaps the best opportunity for forensic scientists to become aware of this is through a quality assurance program of proficiency testing. But is getting the right answer necessarily an assurance of quality?

Proficiency testing provides both a test of the analyst and, sometimes as importantly, provides an opportunity to review the adequacy of the protocols (methods and interpretation guidelines) used by the laboratory to reach the proper conclusions. The following examples suggest that at times the right answer may be reported; however, it might not be fully justified based on the analytical approach.

In a past proficiency test (Collaborative Testing Service, 01-502) for drug identification, the test sample consisted of paramethoxyamphetamine (PMA). A number of laboratories (258 of 271; 95%) got the "correct" answer. The list of instrumental methods used included ultra-violet (UV) spectroscopy, Fourier transform infrared spectroscopy (FTIR), gas chromatography (GC), and gas chromatography / mass spectroscopy (GC/MS). In virtually every laboratory, a subset combination of these methods was used; no lab used every one.

PMA has two other positional isomers on the benzene ring, ortho- (OMA) and meta- (MMA). While some of the instrumental tests listed above may be able to identify PMA, others may give similar results for all three isomers. Consider the following scenario:

A standard of PMA is available but not for OMA or MMA. Does the analyst know how well a GC (GC/MS) separates these compounds? Does the MS library contain all three isomers? Are the spectra in the MS library complete or partial? Have FTIR spectra for all three isomers been referenced? Is the analyst aware of literature that supports assumptions which cannot be directly tested in your lab?

The answers to these questions will help in the evaluation of whether the "correct" answer was the proper answer for the tests performed. We all recognize that it is not acceptable to get the wrong answer. It is just as unacceptable to get the "correct" answer for the wrong reasons.

Another situation in forensic biology deals with the identification of human blood. Laboratories perform a variety of tests to determine if human blood is identified or indicated. What constitutes an identification of human blood? Does a positive presumptive test coupled with a recovery of human DNA suffice? What about a positive presumptive test with a precipitin (Ouchterlony) test using anti-human serum? Suppose you couple it with a Takayama or Teichmann crystal test? What about using anti-human hemoglobin serum in the precipitin test? What if you get typing results for red cell enzymes/proteins?

While proficiency tests somewhat skirt the issue by asking if the stain, "or any part" of it, is "human in origin", the



Scientific methods, however, may have their limitations, some of which are not immediately recognized but come to light with continuing application.

summary reports contain conclusion statements which show the interpretations made by the analyst. These conclusions may contain wording such as "identification", "indication", or "consistent with." The test provider may have drawn the blood directly from an individual (human) but the "correctness" of the analyst's response should be reviewed in the context of the limitations of the test(s) performed, irrespective of whether the right answer was reported.

In summary, simply getting the right answer is not enough. An initial comparison of a proficiency test result to see if the answer is correct may lead to the appearance that all is right. However, a more in-depth look at the basis for the answer (notes, worksheets, interpretation protocols) may uncover subtle inadequacies that should be addressed. It is here that one can determine if the appropriate methods were used and if the proper interpretive statements were made based on these methods. Showing all your work is essential in evaluating the correctness of the answer. This can also lead to necessary corrective actions which will improve protocols.

Paraphrasing the New Merriam-Webster Dictionary "Quality Assurance" is "to make certain the attainment of" a "degree of excellence." While getting the correct answer may be construed to imply a "degree of excellence" but how do we "make certain" we can do it every time? We do because 1) we have an understanding of the science and limitations of our testing procedures and 2) we constantly review the interpretations of our results to ensure proper conclusions are reported.

—Don Jones San Bernardino

San Francisco Spring 99th Semiannual Seminar

Spring has definitely sprung in San Francisco where 130 or so members and friends gathered to enjoy the 99th semiannual CAC seminar. Only steps from Fisherman's Wharf, Ghirardelli Square and more, the meeting included lively discussions spanning a wide range of forensic topics, from WTC recovery efforts to forensic "pizza."



(*lower left, facing page*) Greg Halstead, Full Spectrum Analytics Inc. shows off the latest technique. (*bottom*) Gemma Escott from the Forensic Science Society visits with Brian Caddy. Dr. Escott received the Joint President's Award, and Professor Caddy delivered the Founder's Lecture. (*middle right*) Departing President Dan Gregonis gets ready for the board meeting.





















A TIme of Interaction and Information

(*lower left, facing page*) SFPD Lab Director Martha Blake prepares to introduce Seminar Chair Bonnie Cheng, (*upper right, facing page*) Sam Blittman practices interviewing techniques in the NFSTC Internal Auditor workshop, (*below left*) CAC Merchandise Chair Curtis Smith shows his wares, (*below right*) Keith Inman signs books at the author party. (*bottom right*) Author Mark Hawthorne reviews his book with Bonnie.



The essence of a CAC seminar is the personal interaction that occurs. Whether it's networking with colleagues or just catching up with old friends, there's nothing like it the ordinary workday. If you haven't been to a seminar, why not make the 100th, in Huntington Beach, your first?

(*below left*) Presidential candidates Pennie Laferty and Raymond Davis discuss election results, (*below right*) Lowell Bradford relaxes before his lecture, (*bottom left*) John makes a point with Tom, (*bottom right*) recently retired, and new CAC Life Member Jan Bashinski visits with Greg Matheson. (*facing, left*) Peter Barnett explains how a forensic investigation is like a pizza, and (*facing bottom*) the freshly elected CAC board of directors gathers around Secretary Brooke Barloewen for their first official act.





norah rudin & keith inman • the proceedings of lunch

The Transfer of Evidence and Back Again

The conversation for this issue's POL began over lunch almost exactly a year ago in a rustic pub in Lausanne, Switzerland. Keith and I had the honor and good fortune to be invited to lecture at the Institut de Police Scientifique et de Criminologie at the University of Lausanne. Professor Pierre Margot was our main host, but we also took advantage of the many opportunities to discuss topics of mutual interest with the other faculty and students at the Institute. Among those who joined us for lunch this particular day was Professor Franco Taroni. We were certainly familiar with his name through his many publications on evidence interpretation topics, and immediately challenged him with several of our favorite conundrums, including reciprocal transfer (cross-transfer), absence of evidence, and opinions of source. Our week in Switzerland was over all too soon, but we promised to keep in contact. When we approached Franco about expanding our conversation about reciprocal transfer for this column through the wonders of e-mail, he responded with his usual enthusiasm for collegial debate. With the memory of our Swiss lunch fading fast, we were relegated to spilling coffee and scattering cracker crumbs in our keyboards for the rest of this discussion.

We began by recalling a part of Edmund Locard's famous quote, the historical basis for thinking about transfer in a forensic context:

"...either the offender has left signs at the scene of the crime, or, on the other hand, has taken away with him—on his person or clothes—indications of where he has been or what he has done." Locard (1920)

We note that, by use of the word "or", Locard explicitly acknowledged the possibility of transfer in either direction. Franco confirms that this is true in the original French:

"... tantôt le malfaiteur a laissé sur les lieux les marques de son passage, tantôt, par une action inverse, il a emporté sur son corps ou sur ses vêtements, les indices de son séjour ou de son geste." Locard (1920)

Franco also reminds us that Locard reiterated the idea using different words in 1929:

"Les débris microscopiques qui recouvrent nos habits et notre corps sont les témoins muets, assurés et fidèles de chacun de nos gestes



et de chacune de nos rencontres." Locard (1929)

or, in English:

"Traces are witnesses of every action we do and of every meeting we have."

Keith is convinced that in both of these examples, Locard

The ultimate two-way transfer?

was making practical observations, not stating an immutable law. The years have endowed this phrase with the sanctity of a scientific theory, with little or no challenge or testing of its veracity. While in no way belittling the brilliance of Locard, Keith believes that the field is obligated to reduce Locard's general statement to an hypothesis for testing and refinement. If it can't be tested, then we should make sure that we state it as axiomatic—accepted without proof. He is unwilling to accept this without challenging the best minds in the profession to test it.

Is reciprocal transfer predictive?

Interestingly, in all of Locard's writings, he never specifically discusses the idea of reciprocal transfer or "cross-transfer." Nevertheless, we all agree that the idea of reciprocal transfer permeates Locard's writings, even if he never explicitly expressed it. One must eventually ask, however, if traces from Object 1 are found on Object 2, should we *expect* to detect traces from Object 2 on Object 1? In other words, is reciprocal transfer predictive? Should we have expectations? How can we quantify them? If so, what is the interpretative consequence when those expectations are not met (absence of evidence)? We pause to take a short time-out for language clarifications. In Europe, any kind of physical evidence is called a "trace." As it is quite a nice way to put it, and best if we all agree on terminology, we shall use "trace" throughout this discussion.

Franco, having thought much more deeply about the subject than we have and, in fact, having already contributed to papers on cross-transfer (Aitken *at al.*, 2002; Champod and Taroni, 1999), is convinced that such a situation is, in fact, predictive. He further argues that two recovered traces (or sets of traces) must be considered as dependent; if a transfer has occurred in one direction (for example, from the victim to the perpetrator), and the expert has recovered traces characterizing this transfer from a suspect, then the expert would generally expect to find trace evidence characterizing the transfer in the other direction (from the suspect, if he is the true perpetrator, to the victim). Franco is convinced that detecting transfer in one direction predicts transfer in the opposite direction.

While Norah agrees that this is a nice academic theory, she is concerned that the practical application is both more complicated and more nebulous than it appears on its face. In typical Keith and Norah fashion, she reframes the question: Assuming we can agree that reciprocal transfer should theoretically occur at least on some level, the relevant practical question is, would we always detect such a transfer? Obviously there are many facts and assumptions that might bear on these questions and modulate our expectations. These generate questions of their own, specifically about the classic trace evidence triumvirate of transferability, persistence, and detectability.

Franco offers that, to make predictions about transfer, we must also define the nature of the contact, specifically its "intensity" or force. Another important consideration is the time between the alleged offense and collection of the evidence from any of the people or places involved. Norah not only agrees that these are critical factors in assessing the expectation of transfer, but further notes the inherent ambiguity in assigning reliable estimates to variables such as contact force or time of the crime event. As a statistician, Franco fails to see any problem in making statements involving uncertainty – he simply quantifies the uncertainty!

Keith wants to make sure that we do not limit reciprocal transfer to like kinds of physical evidence. Locard talked about the offender having "...left signs at the scene...or taken away with him indications..." We should not insist that reciprocal transfer involve only fibers from both individuals, as an example, but perhaps fibers from the perpetrator on the victim and blood from the victim on the perpetrator. A demonstration of reciprocal transfer is more likely to be found if the analyst looks for a broad spectrum of physical evidence types. Norah reiterates that all transfer evidence, whether biological or nonbiological, suffers from the limitations imposed by the non-discrete factors of transferability, persistence, and detectability.

Absence of evidence

Norah then wonders about the interpretational consequences when expectations of reciprocal transfer are not met. Said another way, this brings us to the great continuing debate regarding "absence of evidence". As a community, we are divided about whether the failure to find something should be actively interpreted in one direction, never mind two! Franco reminds us that reciprocal transfer ultimately concerns the evaluation of an activity during which contact has taken place (Cook et al., 1998; Inman and Rudin, 2001 Chap. 7); consequently, the absence of recovered material should be as important as its presence (Schum, 1994, Cook et al., 1999). In fact, with Christoph Champod (Champod & Taroni, 1999), he has studied the quantitative assessment of a failure to observe stains or traces. While Norah agrees that it should be possible in theory to quantitatively assess expectations of transfer, she again comes back to the practical application. She points out several weaknesses in evaluating expectations of transfer (either one-way or in the second direction if transfer in the first direction is observed). 1) Relatively little experimental work has been done. 2) Each situation is so individual that experiments need to be done for each case to provide any real assistance. 3) So many possible scenarios and assumptions exist that it is difficult, if not impossible, to test all of them. Continuous variables such as transfer pressure (force of contact) are particularly problematic to incorporate, especially in a quantitative fashion. Some of these concerns can be addressed by making sure to explicitly state the assumptions (of which there may be many!). There will always be limitations, however, to our expectations based on experimental results or lack thereof.

Franco clarifies his position on this issue. He also considers it critical to specify assumptions and hypotheses. These are used with other tools to assess the evidence that is found, as well as evidence that is not found. He does not pretend that the resulting probability estimates represent reality, but he maintains that they are probably a good approximation. Perhaps his most important clarification, however, is that the assumptions are closely tied to the case information. If not enough information exists or perhaps is not very reliable, then the analyst is obliged to limit hypotheses to the level of source, rather than trying to make any statements about contact (activity). Keith and Norah agree that this is a reasonable limitation (Rudin and Inman, 1997).

Keith suggests that we can help ourselves by enlarging our view of relevant items to encompass the crime event, not just contact between two individuals. He defines the crime event as a confluence of people, things, and places at a particular time (Inman and Rudin, 2001). Locard is fairly expansive about what "things" he believes can transfer; "...left signs of the scene of the crime..." and "...indications of where he has been or what he has done..." Keith reads "signs" and "indications" as broadly inclusive, and says that his experience supports this. If we need or want or insist on detecting two-way transfer, then we need to look at the scene, the victim, the perpetrator, the witnesses, and any other tangible item that may have been involved in the crime event.

Returning to the easier problem of direct primary transfer, Franco laments that the evaluation of any physical evidence (e.g. glass and paint fragments, fibers, DNA) recovered during the investigation of criminal cases is commonly approached without properly considering the phenomenon of reciprocal transfer between the two parties (or a person and an object) involved in the action (for example, the victim and the perpetrator). He suggests that this occurs for several reasons, not the least of which might be lack of any obvious or perceptible reciprocal transfer. For example, a bloodstain recovered on a victim's garment is simply compared with the a suspect reference sample; actively looking for traces on the suspect to compare with the victim is not often considered. While most analysts may, at least in their own minds if not formally, consider that finding transfers in both directions increases the strength of the evidence for the proposition (contact), most are less willing to actively consider a failure to find transfer in their formal conclusion. Franco is convinced that this is misguided and provides an example:

Purple wool fibers are found on a victim's orange wool sweater. She says that a suspect wearing a purple sweater grabbed her and they struggled, indicating a rather violent contact. A suspect is arrested five minutes later. As wool fibers transfer relatively easily and are quite persistent, there is a reasonable expectation of finding lots of orange wool fibers on the perpetrator. If no orange fibers are found upon examination of the suspect, the probability in favor of contact is greatly reduced. Therefore, if you see transfer in one direction and fail to detect it in the other direction after searching (your expectation is not met), you are more convinced that there was no contact – the purple fibers may have gotten on the victim by accident or coincidence.

He goes on to explain that the expectation of reciprocal transfer is conditioned (dependant) on the initial detection of one-way transfer. He also introduces the important point that any expectation of transfer, either simple or reciprocal, must incorporate the probability of coincidental transfer of like fibers from the environment. An estimation of this probability, of course, depends on the collection of data about the frequency of such fibers in the relevant environment. Norah points out that this is an intrinsically weak point in determining the strength of any trace evidence. Because the populations of fibers and particles are quite fluid through space and time, and with regard to geographical distribution, it is difficult to obtain an accurate estimate. By its very nature, the confidence interval must be quite large. She wonders if this is incorporated into the modeling and if there is a point at which the uncertainty associated with the population frequency assessment (or any of the other variables) is so large as to render any conclusions meaningless. Franco insists that these factors can be assessed by controlled experiments or modeling techniques. He continues with his example:

Imagine that no orange fibers have been detected on the suspect's sweater. We must consider two possibilities: 1) the two individuals had contact and no orange fibers were trans-

ferred or 2) the two individuals had no contact and therefore no orange fibers were transferred. The comparison of these possibilities can be formalized using a likelihood ratio (LR). (*for a simple explanation of LRs, see Sidebar*)

The denominator approaches 1, modulated only by the coincidental transfer of environmental fibers. The numerator is conditioned on reciprocal transfer expectations; if there was

The probability of finding no orange fibers on the suspect if he is the true perpetrator, given the detection of purple fibers on the victim

The probability of finding no orange fibers on the suspect if he is not the true perpetrator, given the detection of purple fibers on the victim

This can be written more concisely as:

contact there should have been some transfer of fibers. Because none are observed, the numerator approaches 0. Numerically, then, the LR is

This supports the proposition of no contact over the proposition of contact.

Having actually done this work for more time than either

$$\frac{A \text{ very small number less than 1}}{Approximately 1} = A \text{ very small number less than 1}$$

Franco or Norah, Keith suggests a more practical approach. The analyst is sitting at her lab bench confronting 8 bags of evidence from a single crime event. She knows the circumstances of the case, and has been asked to establish a link between the victim and an identified suspect. Depending on her expertise, she will generally opt to look for the most obvious and strongest piece of physical evidence that could associate a source to a target. Given the press of time, caseload, and the mountain of evidence before her, she will usually make a conscious or subconscious decision to look for transfer in one direction only. In other words, we must consider that a primary reason for the failure to detect transfer in both directions is that the analyst typically only looks for transfer in one direction. The failure is in the mindset, not the evidence. It is critical to understand that the reduction of the LR in Franco's analysis is only meaningful when the analyst aggressively searches for such evidence, and the search yields nothing.

Franco gives another couple of examples of how case context might influence evaluation of the evidence.

Case 1. A rape has been reported. According to the female victim, there was vaginal penetration and ejaculation. The DNA recovered from the sperm fraction of the vaginal swab shows a foreign male profile. In this example, a high probability exists that vaginal fluid was also transferred to the perpetrator. However, recovery of that evidence is clearly dependant on the passage of time and the personal hygiene of the perpetrator.

Case 2. An assault has been reported. The victim has been killed with a knife and there is no evidence of a fight. In this case, the probability of a transfer of blood from the perpetrator to the victim is low. The probability of a transfer of blood from the victim to the perpetrator is high.

Norah observes that criminalists (and detectives) use this kind of information all the time in deciding where to look for evidence (investigation) and ascertaining the relevant questions (what evidence to examine). Scientists are less comfortable, however, using the same information to interpret the results of physical evidence examination. Keith gives an even more extreme example:

Case 3: A shooting has been reported. The victim has been killed by a bullet shot by the perpetrator from a distance. There was no direct physical contact between the victim and the perpetrator.

If we consider the crime event, then we might look for different kinds of traces on the victim and perpetrator to associate them with the crime event, rather than strictly to each other. In this example, the weapon might eject a cartridge case at the scene that is recovered, and through the miracle of the database is matched to a weapon, which in turn leads to a suspect. Putting the weapon in the hands of the perpetrator is another matter; fingerprints or DNA might yield useful information. Because the victim was found at the scene, from which the perpetrator has long since fled, any association between the victim and suspect can only be inferential. A critical point, made by all of us in different ways, is that forensic science is an inferential process, combining facts and assumptions into a conclusion. The more tenuous the relevance of an item of evidence to the case (numerically, less than 1) the greater the number of assumptions that are required to complete the inference. Stoney has found a way to incorporate different assumptions of relevance into the LR (Stoney, 1994), and Keith believes that this is one fruitful way to handle the uncertainties in our examinations and interpretations.

Quantitating the dependence of reciprocal transfer

Getting back to reciprocal transfer, which is really the main point of this discussion, Norah would like to further explore the quantitative dependence of reciprocal transfer events. We all seem to agree that some degree of dependence exists - the probability of transfer depends on whether or not there has been transfer in the other direction - but that the dependence is incomplete. If the events are not 100% independent or 100% dependent, how do we calculate "somewhere in between?" Franco has worked with other colleagues to create a graphical modelling system for reciprocal transfer evidence. In these papers, they demonstrate that a simple multiplication of the LRs for each direction of transfer (i.e., assuming complete independence) is invalid and in Aitken at al. (2002) they describe a solution to the problem. A preview of the paper looks impressive, although the casual reader should be cautioned that mathematical equations do appear. Keith and Norah are at least grateful that *someone* is willing and able to address these important forensic science questions.

While the discussion is clearly far from finished, our keyboards no longer function properly because of the transfer evidence proving unequivocally that writing this column required much caffeine and carbohydrates. We eagerly approach this cleaning task in anticipation of future stimulating discussion.

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Likelihood Ratios

The following (slightly redacted) excerpt from *Principles and Practice of Criminalistics: The Profession of Forensic Science* provides a simple review of Bayes' Theorem and likelihood ratios.

A scientist should approach the examination of physical evidence with at least two hypotheses in mind: **Hypothesis 1**: The suspected source is the true source of the evidence. —or— **Hypothesis 2**: Another source is the true source of the evidence.

At the conclusion of testing, the analyst evaluates the strength of the evidence in light of these alternative hypotheses. Likelihood ratios are particularly suited to this logic. While the use of likelihood ratios is common in many fields, it is only within the last 25-30 years that careful study and development of mathematical models have emerged for evaluating forensic evidence. [Taroni, 1998] It is our view that likelihood ratios offer a more elegant and complete picture of the strength of the evidence than frequency estimates alone¹.

A likelihood ratio (LR) is typically written in the following way:

$$LR = \frac{P(E \mid H_1, I)}{P(E \mid H_2, I)}$$

Where:

P = probability

E =evidence of common source

H =hypothesis— H_1 and H_2 are the two hypotheses under consideration

I =information—This refers to other knowledge we have about circumstances surrounding the analysis.

The symbol " | " means "given that", or "assuming"; the parentheses are translated as "of". Under the hypothesis proposed above, the numerator of the likelihood ratio is read, "The probability of *evidence of a common source*, assuming that the putative source is the true source." In the same way, the denominator is read, "The probability of *evidence of a common source* assuming that an alternate source is the true source."

When examining physical evidence, we cannot know the probability of common source given the evidence that we see, but we can calculate the probability of finding this evidence if we assume the proposition to be either true or false. If we assume that the evidence is from the putative source, then the probability of our test showing similar results to the reference is 1 (one); that is, we are certain that the test results of the evidence and the reference will be concordant. If we assume that the evidence is from some other source, then the probability of seeing concordant results is the chance of encountering this evidence at random. In this situation, a frequency calculation provides a useful approximation of this probability. This logic can easily be extended to compare hypotheses at the level of contact.

By convention, LRs used in forensic science have been presented with H_1 as the "prosecution hypothesis" (H_2) and H_2 as the "defense hy-

pothesis" (H_d). This nomenclature has had the unfortunate consequence of alienating many criminalists at first blush. The scientist immediately recoils at the thought of proposing adversarial hypotheses, and some dismiss the utility of LRs without exploring them further. In fact, this nomenclature is completely extraneous to the mathematical reasoning. The scientist may simply use the LR as a tool to compare any number of reasonable hypotheses, without considering which side might advance them. A simple change in nomenclature to $[H_1, H_2, ...]$ makes LRs much more palatable to the scientist.

Likelihood ratios in Bayes theorem

From the foregoing discussion, we have learned that likelihood ratios answer the question of the probability of the evidence assuming, alternatively, this source or another source. This will be a good time to step back and consider LRs in the context of Bayes theorem. Bayes theorem provides a general model for updating our certainty about any proposition.

Using words, the expression of Bayes theorem looks like this:

Prior odds x LR = Posterior odds

This may be read: However likely you think a proposition (prior odds), change your judgement (posterior odds) by this additional evidence (LR).

Using symbols, the expression takes this form:

$$\frac{P(H_1|I)}{P(H_1|I)} X \frac{P(E|H_1,I)}{P(E|H_1,I)} = \frac{P(H_1|E,I)}{P(H_1|E,I)}$$

Note several important points. The prior odds are simply the *hypothesis* given some *information*. We have some idea about the probability of an event or hypothesis. Ideally, this is supported by numerical data, but it could also be subjective. (Taroni, et al., 2001)

Either way, it must be expressed as a quantity. This initial estimate is updated by multiplying it by the LR. Calculation of a likelihood ratio in light of new *evidence* provides a way to modify the prior odds. This results in posterior odds. The addition of the "E" term to the expression of posterior odds reflects the integration of the new evidence.

Analysts are sometimes concerned about expressing their results in terms of a likelihood ratio because they believe they will be forced to define prior odds. In fact, at the level of source determination, or even the level of contact, the analytical results can be expressed using only the LR term. Any information about the samples that directly affects analytical results can be incorporated into either the numerator or denominator of the LR, as appropriate. The strength of the inference about the source of the evidence or an inference of contact can be expressed wholly by the LR. Any interested party can then pose prior odds to be modified by the inference resulting from the physical evidence examination. In some cases, the criminalist may wish to assist by pointing out information to be considered as part of the prior odds; in any case, prior odds provide a perfect vehicle for each advocate to proffer the hypothesis that best supports her case. The Bayesian framework provides a way to integrate the physical evidence results into the rest of the case. In the final analysis, the posterior odds do address the question of guilt or innocence. Happily, both scientists and jurists agree that the ultimate question of guilt or innocence should only be addressed by the trier of fact.

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 $^1\,\mathrm{We}$ caution the reader to remember that this approach should be viewed as a tool, not a religion.

The Identification Of Kava

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Introduction

Kava, also known as kava-kava, is defined [1] as the "dried rhizome and roots of *Piper methysticum* Forst., *Piperaceae. Habit.* Polynesia." The same source also notes that "Kava is also the popular name for the intoxicating drink prepared from the plant's roots." Additional information about kava may be found at the website: <u>www.erowid.org/plants/kava/</u>.

Although kava is not currently listed as a controlled substance in the United States, it may be encountered in submissions of suspected drugs. The identification of kava may also be requested related to either criminal charges involving DUI, or civil suits where one side claims that kava intoxication was a contributory factor in a vehicle accident [2-5]. Kava extract may be found in the herbal supplement section of a major discount chain (Target). The bottle label indicates one should not operate heavy machinery or drive after consumption of kava. Kava was identified in a recent submission to NCISRFL-San Diego of approximately 200g of a tan powdery substance obtained during the search of a vehicle attempting to enter a military reservation.

Examination by polarized light microscopy (PLM) showed the powder consisted of a vegetable material dominated by starch grains. A small quantity of the powder was placed on a glass microscope slide with a drop or two of distilled water, and a coverslip was added. Under crossed polars (Figure 1) the kava starch grains show distinct polarization crosses (Maltese crosses). The morphology of the kava starch grains (Figure 2) may be seen under uncrossed polars. The more common forensic science microscopy reference materials [6 – 9] that picture and/or describe various starches do not include kava.

The kava starch grains are colorless, transparent, subspherical individual grains with an occasional compound grain, e.g., 2 grains together with a common straight, flattened surface, resembling a pharmaceutical capsule that, when broken into two grains, resembles handleless cups or kettles. The subspherical grains range in size from 5 μ m to 50 μ m with the common size range from 9 μ m to 25 μ m. The dual, capsule shaped grains are 15 μ m to 50 μ m in length. When present, the hilum, an internal air bubble characteristic of starch, is often round to oval, but triangular and irregular cleft were also observed. Between crossed polars the grains appear gray but approach white in the larger grains, with well-defined black crosses. Starch from the plant comes agglomerated but breaks into individual (or capsule shape) grains on the microscope slide with tapping and sliding of the coverslip.

Confirmation that the grains are starch can be made by allowing a few drops of a dilute aqueous KI/I_2 reagent to flow underneath the coverslip. Under uncrossed polars the starch grains will be stained purple (Figure 3 and 4). So that the characteristic morphology can still be seen in the purple grains, it is important that the aqueous KI/I_2 reagent be very dilute. With a more concentrated reagent, the grains will be stained so dark that they appear black and are totally opaque.

Methods for the analysis of kava resin [10] and identification of the urinary metabolites of kava by methane chemical ionization gas chromatography-mass spectrometry have been published by Duffield, et al [11]. A method for the assay of kavalactones by HPLC may be found on the internet [12]. At the 2002 meeting of the American Academy of Forensic Sciences the poster, "Analysis of Herbal Preparations for the Presence of Kavalactones", was presented by Rick Morehead of Restek Corporation, 110 Benner Circle, Bellefonte, PA 16823 and Erin Skoda of Juniata College, 1700 Moore Street, Huntington, PA 16652 [13]. The method of Morehead and Skoda could be used for isolation and quantitation of kavalactones from various herbal preparations, including teas, capsules, and extracts. Water was added to weighed quantities of the various products and the samples were heated and stirred on a hot plate for 10 minutes at 80°C. An extraction procedure involving 6 mL Resprep C18 solid phase extraction tubes (Restek Corporation, Bellefonte, PA) was then described. The various kavalactones were identified and quantitated (compared to standard solutions made from purchased kavalactone standards) using GC/ MS. Although not published, reprints of this poster can likely be obtained from Restek Corporation.



Figure 1. Kava starch grains at 100x, crossed polars.



Figure 2. Kava starch grains at 100x, brightfield.



Figure 3. Gradual staining of kava starch grains with dilute KI/I, (100*x*)

However, if quantitation isn't required, kava in powder form may be identified by GC-MS of a basic extract into chloroform. According to Merck [1] the most important constituents of kava are: kawain (in some sources it is spelled *"kavain"*), dihydrokawain, methysticin, dihydromethysticin, and yangonin. The mass spectra of these five major constituents together in a characteristic GC-MS total ion chromatogram (TIC) are sufficient to characterize kava.

Materials

Chloroform was analytical grade and was purchased from EM Science. Sodium bicarbonate was analytical reagent grade and was purchased from Mallinckrodt. Sodium bicarbonate was added to distilled water to make a saturated solution.

The stock solution of aqueous KI/I_2 reagent consisted of 0.25g of iodine and 0.5g potassium iodide dissolved in 25mL of deionized water [14].

Method

Equipment

GC/MS Instrument: Hewlett Packard (Agilent) 6890 GC/5973 MSD; Column: J & W Scientific, DB-5MS, 30 m x 0.25 mm x 0.25 m; Injection: 1 μ L, manual, pulsed split injection, 50:1 split ratio (helium); Temp. Program: 70^qC 2 min. then 20^qC/ min. up to 300^qC, hold for 15 min.

Procedure

A small amount of the unknown powder (tip of a spatula) was added to a 6 x 50 mm disposable glass test tube, covered with three drops of saturated sodium bicarbonate, three drops of chloroform were added, the mixture was vortexed for a few seconds, and then centrifuged. One microliter of the chloroform extract was injected into the GC/MS.

Results and Discussion

The TIC (Figure 5) produced three major peaks followed by a fourth that is split into a doublet. The mass spectra for the five main constituents of kava may be seen in Figure 6a-e.



Figure 4. Gradual staining of kava starch grains with dilute KI/I, (400*x*)



Figure 5. Total ion chromatogram (TIC) of $CHCl_3$ extract of kava powder from saturated sodium bicarbonate. Peak 1 = dihydrokawain; Peak 2 = kawain; Peak 3 = dihydromethysticin; Peak 4 = yangonin; Peak 5 = methysticin





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Abstracts from the 99th Semiannual Seminar May, 2002 San Francisco

Culinary Forensics—An Investigation is [Like A] Pizza

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A multidisciplinary investigation can be compared with a good pizza dinner. A good pizza requires quality raw ingredients, proper equipment, and skilled cooks. But with only those ingredients the dinner could easily end up being a plateful of red-sauce-covered, gooey dough, with too many anchovies, no pepperoni, and the whole mess cold in the center-not a meal that is inclined to make the discriminating diner leave a big tip and come back a second time. What the good pizza requires is a good chef-the person who has an understanding of what the final pizza should look and taste like, can select the raw ingredients, can combine them appropriately to make the dough, the sauce, and the cheese. From the long list of available ingredients, anchovies to zucchini and goat to gorgonzola, the chef must select which ones will go together to make an acceptable final result. The chef may assign certain tasks to subordinates-pot scrubbers, sous chefs, or even ingredient suppliers-but the chef bears the ultimate responsibility for the final product. A not uncommon mistake is to give all of the credit, or the blame, to the food server-which is akin to blaming the UPS driver when your mail order shoes don't fit.

A modern, multidisciplinary forensic science investigation is not different except for the fact that the forensic equivalent of the chef is a lawyer who is generally unable to recognize quality ingredients or appropriate combinations, but is more or less adept at convincing the diners(the jurors) that the shapeless, soggy mess on their platter is convincing proof of a defendant's guilt or innocence. Just as a pizza parlor requires the direction of a good chef to produce good pizza, and a forensic science investigation requires the direction of a good scientist to produce a good result. Producing either a good pizza or a good investigation requires a person, the chef or the forensic scientist, who is knowledgeable in all phases of the process. Without that person, the best that one can hope for is a mess that no one will buy. At worst one might expect a pizza or investigation that could make someone dead. Combining reality with allegory, the forensic investigation of a pizza will be presented. This presentation will demonstrate that the forensic investigation of a pizza can be just as complicated, involve just as many types of evidence, and require just a broad a range of skills and abilities as any forensic investigation. The complexities of a forensic investigation of a pizza can involve a variety of disciplines and different types of evidence - more, perhaps, that the ingredients of the pizza itself. The importance of the forensic scientist in conducting the investigation is no less than the importance of the chef in the preparation of the pizza.

Koality Assurance

Martha Blake

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On December 30, 2000, two male juveniles were arrested for grand theft of animals (two koala bears) from the San Francisco Zoo. Fortunately, the marsupials were recovered, scared but safe. One of the two juveniles confessed to the burglary but the other juvenile was not as cooperative. The black wool jacket worn by this juvenile was examined for the presence of foreign hairs. Numerous wavy gray hairs were recovered from this jacket and examined. These hairs were microscopically compared to koala bear hairs submitted by the zookeeper and to other marsupial hairs for comparison.

Numerous hairs removed from the jacket were identified morphologically as koala bear hairs. Of particular significance is the scale pattern of these hairs. Koala bear hairs have unique identifying features, and unless you are a zookeeper, it is hard to explain why these hairs are on your clothing.

Crime Lab Teamwork

Lowell W. Bradford

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Describes a firearms homicide with an unusual combination of investigative procedure coupled with laboratory coordination involving firearms and document evidence, resulting in a determinative identification of the assailant.

Inexpensive, Sensitive, Rapid and Selective Detection of GHB (4-hydroxybutyrate)

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The objective was to develop an inexpensive, sensitive, rapid and selective color test for GHB (4-hydroxybutyrate). The test should not produce false positive or negative results from a wide range of sample types. Such a test would provide means by which (i) people can protect themselves from unknowingly ingesting GHB, (ii) law enforcement can obtain probable cause to detain persons possessing GHB, (iii) forensic laboratories can screen suspect samples before definitive testing, and (iv) emergency rooms can screen bodily fluid for rapid diagnosis.

The enzyme GHB dehydrogenase reacts GHB with the cofactor NAD⁺ to produce NADH. Dehydrogenase was cloned from *Ralstonia eutropha* and expressed in *Escherichia coli* as a readily purified fusion protein. The commercial enzyme diaphorase reacts NADH with colorless tetrazolium prodye to form a strong dye. This reaction coupled to the dehydrogenase reac-

tion produces intense color when GHB is present; however, ethanol is an alternative substrate of the dehydrogenase, and it can produce a false positive with untainted alcoholic drinks. Nevertheless, ethanol binds 200-fold more weakly to the enzyme; this provides a theoretical basis to detect GHB preferentially. Filter paper carrying covalently bound fusion protein and a large excess of diaphorase (so dehydrogenase controls the rate of color formation), NAD⁺ and tetrazolium prodye rapidly becomes intensely colored in 176 mg GHB/ml (2 mM) but not in aqueous ethanol. False positives can be avoided more economically by evaporation of the suspect sample to remove ethanol before testing. Evaporation of very small volumes of twentyfive common bar drinks and urine on filter paper followed by application of test reagents to the paper detected as little as 8.8 mg GHB/ml (0.1 mM). Inexpensive, sensitive, rapid and selective color tests for GHB in a wide range of sample types have been developed.

A Multi-Disciplinary Approach to Identifying Panama's Disappeared

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A decade after U.S. Armed Forces had dismantled Panama's military apparatus and many Panamanians had decided to move forward instead of looking back, the specter of the dictatorship was summoned by the exhumation of two sets of skeletal remains at a former military barracks in September 1999. A little more than a year later, excavations at the same site yielded two additional sets of remains, placing the period of military rule squarely in the crosshairs of a national debate. In part influenced by these events, President Mireya Moscoso announced in early January 2001 that she would be creating a truth commission that would examine gross human rights abuses committed by the military regime during their 21-year reign. On January 18, 2001, Moscoso's presidential decree brought into being la Comisión de la Verdad de Panamá (CVP), or Truth Commission of Panama.

Vanishing Without a Trace?

Dianne Burns

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The future of forensic DNA technology is as secure and untouchable as a Van Gogh in a Swiss bank vault. On a global scale, police, politicians, and prosecutors, maintain a ferocious appetite for the individualizing capabilities of our genetic blueprint. The brilliant accomplishments of the DNA revolution have forced other forensic specialties to consider justifying their value to the criminal justice system or accept playing a smaller game. On both sides of the Atlantic trace evidence practitioners are asking the same question: "What is the value of trace evidence in a DNA world?" That is the question this presentation will explore.

The Characterization of Photocopy Toners Using Fourier Transform Infrared Spectroscopy Goldie Chopra

PM 17, Bhupinder Nagar Road, Near Railway Crossing No. 22, *Patiala (Punjab) - 147001 INDIA*

A structural diagnosis of chemical constituents in black photocopier toners used in India.

The paper deals with the chemical analysis and classification of toners used in photocopying processes by FTIR. The purpose of the work is to: 1) determine if the spectrum of the toner extracted from a photocopy and measered by FTIR is consistent with the corresponding spectrum of the raw toner powder. 2) determine whether IR spectra obtained for raw and processed toner can be differentiated from spectra obtained from toners used in other models of same brand and also from other machines of different brands. 3) if the above is true, then it is possible to devise a classification scheme for classifying toners used in photocopying machines on the basis of characteristic absorption bands in the IR spectra.

The Most Expensive Criminal Prosecution In The History Of California

Lloyd Cunningham

Forensic Document Examiner, 67 Oak Meadow Court, Alamo, CA 94507

Mass killings in 1980's at a Calaveras county cabin. Suspects Leonard Lake and Charles Ng. This presentation will cover the document trail that suspects Leonard Lake and Charles Ng left behind. Forensic document examinations revealed evidence that tied Lake and Ng to the grisly murders, which include identity theft, burial sites, murder plans and after the fact cartoons that depict knowledge of the murders.

Cross-examing An Expert Witness: What To Do, What Not To Do

Lloyd Cunningham

Forensic Document Examiner, 67 Oak Meadow Court, Alamo, CA 94507

This presentation deals with the subject of how trial attorneys *prepare-prepare-prepare* to cross-examine an expert witness. A "moot court" session was held at the 2001 American Bar Association's litigation section national meeting, where this speaker, serving as an expert witness, was subjected to vigorous cross-examination by four of the top trial attorneys in the country.

As part of the "moot court" program, a paper entitled "Cross Examining an Expert Witness: What to Do, What Not to Do" was provided to all attendees. This paper was designed to attack the credibility of all expert witnesses.

Excerpts from this paper will be discussed and they will certainly disclose the agenda that is in place to make your visit to the witness stand a very memorable one.

Automation of Forensic Mitochondrial Dna Analysis in Response to the Identification of Victims From the World Trade Center

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The City of New York Office of Chief Medical Examiner has orchestrated a team of scientists using DNA technology to identify the victims of the World Trade Center. Applied Biosystems and Celera have been asked to conduct mitochondrial DNA (mtDNA) sequence analysis from extracted DNA from the family reference specimens and the evidentiary material recovered from this disaster site. Mitochondrial DNA analysis is a valuable tool for human remains identification. Due to its high copy number, mtDNA analysis is especially useful when the DNA is highly degraded or when only small sample sizes are available. Additionally, due to its maternal inheritance, mtDNA analysis is a valuable resource when reference standards or close relatives are not available for comparison. Implementation of and advancements in automation for forensic mtDNA analysis in advanced laboratory robotics, multicapillary electrophoretic systems, and data analysis will be presented in light of the World Trade Center Disaster. Data analysis is the largest challenge for mtDNA testing of this magnitude. Clearly, automation in the laboratory has exceeded the automation for data analysis. Efforts to reduce the time for data analysis will be presented. A prototype system to analyze and align the sequence data with algorithms designed to be consistent with current base calling practices in the forensic community will be presented.

Essentials In Criminalistics – Bridging In Two Dimensions

Peter R. De Forest

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The meeting theme of "bridging" is an appropriate one. The meeting venue gives it extra symbolism. Two of the World's major bridges are here. They span two dimensions. One, a single span suspension bridge, once the longest in the world, extends north-south over the Golden Gate entrance to San Francisco Bay connecting San Francisco to Marin County and points north. The other, a combination double-span suspension bridge connecting to a cantilevered section east of Yerba Buena Island, extends generally east-west across the San Francisco Bay. Both bridges are well over sixty years old and are essential to the Bay Area economy. The north-south and east-west directions spanned by these bridges represent two dimensions. Figurative bridges spanning two dimensions are also needed in criminalistics. As is the case in the literal example, a conceptual bridge ties together and unifies separate or scattered entities.

To fully exploit the physical evidence in any but the simplest cases there is certainly a need for a bridge spanning the wide range of disciplines within criminalistics. The need for spanning disciplines is really the need to span a wide range of physical evidence problems that may be encountered in a given case. Practitioners in these disciplines cannot operate in complete isolation.

The other dimension to be spanned can be thought of as time. This time span is the life of the case. Alternatively this dimension can be thought of as spanning the stages in case development. It extends from "front end" assessment during the initial crime scene investigation to the "back end" interpretation designed to assist with the adjudication of the case. Between these is the continuum that includes evidence recognition, laboratory assessment, prioritization, analysis, interpretation, integration, reporting, explanation, and expert testimony. There is a need for at least one scientifically trained and experienced mind to have oversight over the entire physical evidence situation from beginning to end. This scientist must serve as a bridge for physical evidence and physical evidence derived data from the Crime Scene to the Courtroom. Bridging in the other dimension, across disciplines, is also essential simultaneously. It is necessary for at least one generalist-criminalist to view the case as a whole rather than having a narrow focus of specific evidence items or tests. It is also better if more than one scientist has this overview so that a sharing of ideas can take place as the approach to the case is being designed and executed.

Case examples will be used. Most will describe situations where bridging was underutilized or absent initially, but where, fortuitously, some aspects of bridging could be taken advantage of later and the case solved. These cases are useful for illustrating the need for bridging. In effect there is a built-in negative control. In each the wrong conclusion or no conclusion was reached initially. It was only after the totality of the physical evidence picture was considered by a generalist-criminalist that the case was solved months or years later. Of course, in many cases where conceptual bridging is not taken advantage of, there is no "second bite at the apple" and the opportunity is lost. There is no substitute for doing it right the first time.

A New Experimental Model for Evaluating Mechanisms of Gunshot Spatter

Peter J. Diaczuk., Zvi Herschman, Peter A. Pizzola and Peter R. De Forest Department of Sciences, John Jay College of Criminal Justice, CUNY, New York, NY 10019

Casework experience and theoretical considerations have suggested that widely accepted beliefs about bloodspatter resulting from gunshot wounds are simplistic and often simply wrong. We have observed "expert" testimony founded on such false premises, which may have led to miscarriages of justice. These concerns prompted our research. In an earlier paper by some of us, it was our contention that bullets passing through portions of tissue supplied solely by capillaries would produce no bloodspatter. We asserted that special conditions needed to be satisfied in order for either forward spatter or back spatter to result from a bullet wound. Although we were able to cite casework examples and discuss theoretical reasons why no bloodspatter should result in many circumstances, we lacked a good experimental model to demonstrate our thesis. It was clear that models such as blood-soaked sponges, which have been used by others, are grossly inappropriate as a simulation of capillary supplied tissue. Saturated open-cell foam has a vastly higher blood loading on a volumetric basis than would capillary supplied tissue. Further, the blood would be much more finely divided in uninjured living tissue. In our earlier experiments we attempted to use models based on blood-perfused sheep brains and ballistic gelatin containing numerous small blood-filled channels. For reasons to be discussed, these were not satisfactory. Our new model is based on the use of arrays of blood-filled hollow fibers comprising dialysis cartridges. Work with these cartridges has supported our thesis. This thesis will be illustrated with casework examples and experimental results.

Wtc Recovery Efforts at Fresh Kills Landfill

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September 11th, 2001 left many of us fearful for our futures. In our despair at a moment of great vulnerability it was the desperation to help out in anyway we could that brought us hope and strength. On January 5th 2002, a small group of volunteers from the Department of Justice DNA Laboratory in Berkeley set out to do just this. Without knowing how well we would be received, we braved the unmarked roads of New Jersey, and set forth to find Fresh Kills Landfill to aid with recovery efforts. Finding the landfill, merely by smell alone, we were given the opportunity to help out as much as we could. We spent 8 long hours a day at the largest crime scene in the history of the United States shoveling mud, sifting through debris, and walking through mounds of rebar and twisted metal in search of remains and personal effects. For such arduous labor, those 8 hours were one of the most emotionally profound and rewarding moments of our lives. We were there to aid in the recovery of remains and personal effects to give some closure, some finality to families, while helping the heroes of September 11th take a brief moment of rest and to hear their stories.

Trace Evidence Resource Center

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The Sacramento County District Attorney's Laboratory of Forensic Services is pleased to announce that the development of the Trace Evidence Resource Center is currently underway. Funded through California's Office of Criminal Justice Planning - Local Forensic Laboratory Improvement Program, the Trace Evidence Resource Center will support and maintain sophisticated analytical instrumentation to resolve complex trace evidence cases that may otherwise go unsolved.

Over the next 18 months, the Trace Evidence Resource Center will install advanced analytical instrumentation, such as: Inductively Coupled Plasma Mass Spectrometer (ICP/MS), Scanning Electron Microscope with Energy Dispersive Spectrometer (SEM/EDS), Liquid Chromatograph Tandem Mass Spectrometer (LC/MS), FT-Raman Spectrometer, UV-Vis Microspectrophotometer.

The Center will develop cooperative working agreements with California state and local crime laboratories to provide assistance in the analysis and interpretation of trace evidence casework. As part of this service, the Center will provide a centralized repository of trace evidence reference and exemplar materials. A visiting scientist program for research and procedure validation is also being considered.

Case Example: Truck vs. Pedestrian Hit and Run

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This case presentation is a combination of observations and documentation via photographs of a face impression that was left in the hood of a truck suspected in a felony hit and run. Although an impression in a hood is not necessarily remarkable, the detail observed and documented clearly demonstrates that the suspect did not hit a deer as he claimed. We will discuss the examination of the subject vehicle and the follow-up laboratory trace work and headlamp examination that was performed. The evidence presented in the criminal trial will be reviewed including an alternate theory proposed by the defense. We will show that seemingly powerful physical evidence does not always guarantee a conviction.

Forensics and Innocence: Physical Evidence and Postconviction Claims of Actual Innocence

Mary Likins

Northern California Innocence Project, Santa Clara University School of Law, 874 Lafayette Street, Santa Clara, CA 95050

Participant will understand the history of Innocence Projects in general and NCIP in particular. Participant will be able to relate the criteria for NCIP cases, the investigation process, and the types of physical evidence involved. Participant will also gain understanding of the current and proposed legislation in Sacramento related to post-conviction DNA testing, appointment of counsel, preservation of evidence and discovery.

Participant will also hear anecdotal information about cases in which the evaluation of physical evidence has become an important aspect of the case, either to support or refute the inmate's claim of innocence.

As Innocence Project cases progress, the need for experienced multi-discipline criminalists becomes ever more clear. The majority of cases handled by NCIP are not simply "up-ordown DNA" cases, but may require evaluation from crime scene investigators, coroners, trace evidence experts and others skilled in not simply performing tests but assessing the relevance of the material tested as well as the results.

PTM—A New Way to Image Surfaces

Tom Malzbender, Susan Morton

Hewlett-Packard Laboratories, 1501 *Page Mill road, ms 3u-4, Palo Alto, CA 94304,* San Francisco Police Crime Lab, 850 Bryant Street, San Francisco, CA 94103

Polynomial Texture Mapping, or PTM, was developed by Tom Malzbender and Dan Gelb of the Hewlett-Packard Laboratories as a way to create critically clear images of surfaces. Its initial purpose was to enhance computer graphics, but it was soon used by archeologists to render eroded clay cuneiform tablets legible. Its success in doing that has inspired inquiries from other fields such as dermatology and engineering. Our purpose in this presentation is to describe the method to forensic scientists in hopes that more applications may be discovered.

A Halloween Homicide

Charlene Marie

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The victim "repeatedly screamed for help while her husband allegedly beat her to death". She died of "blunt force trauma to her head and asphyxiation." Both the victim and her attacker were bleeding. This presentation is a reconstruction of the bloodstain evidence used to show the various locations of the attack; and, what could and what could not be said about the struggle. Her assailant was known; the pivotal issue was whether this was a case of 1st degree, 2nd degree or manslaughter.

The Measurement of Writing Style

Gerald R. McMenamin

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To demonstrate that the measurement of variation in written language strengthens the descriptive analysis of style in cases of questioned authorship, and to respond to recent judicial specifications that evidence in forensic stylistics reflect appropriate quantification of language data in questioned authorship cases.

The Robert Nawi Case: Forensic Disciplines Bridged

Susan Morton

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In the summer of 2001, Robert Nawi was tried and convicted of the first degree murder of Virginia Lowery in San Francisco. It was a case that would never have been solved much less brought to trial without three branches of forensic science.

A fingerprint was lifted at the scene from a water heater near the body. At autopsy, the Medical Examiner noted and preserved foreign tissue under Mrs. Lowery's fingernails. The fingerprint was searched through AFIS databases, but no match was made.

Ten years after the murder, a repeat AFIS search did result in a match to the fingerprint of one Robert Nawi. Mr. Nawi was an associate of William Lowery, but was not so lucky in his dealings with the law. He had pled guilty in federal court to drug dealing and had spent most of the intervening ten years in federal prison.

Robert Nawi's DNA matched that under the victim's fingernails. Based on that evidence and the fingerprint identification, Nawi was brought to trial on murder charges. His defense was an alibi. He supplied affidavits from William Lowery, now living in Mexico and in poor health, and other then associates to the effect that he was in Mexico with them at the time of the murder and for some time before and after. The defense then attacked the fingerprint and DNA evidence.

None of the forensic evidence was novel or cutting edge. Alone, any one would not have carried the day. But in combination, they made a very strong case. At least the jury thought so.

Biological Evidence as Transfer Evidence: Coherence of Thought in Criminalistics

Norah Rudin

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Biological evidence, historically analyzed using conventional serology, now using DNA technology, has come to be treated as an entity separate from the rest of forensic science. It has been sequestered as a tool solely limited to answering the "who?' question that is often critical to case investigation. This limits our understanding of biological evidence and how it integrates into the case as a whole. Initially, biological evidence is transfer evidence, no different than any other trace evidence. From this perspective, the same questions can be asked of biological evidence as are typically asked of classical trace evidence: "what? where? how? when?" In fact, these questions have returned to the forefront with a vengeance as the "who" becomes almost indisputable in many cases. The Forensic Paradigm will be used as a framework to show how the interpretation of biological evidence can be reintegrated with other forensic disciplines. Practical applications will be illustrated using case examples. This type of unifying approach advances our understanding of criminalistics as coherent discipline with fundamental principles.

Multi-Disciplinary Identification of Panamanian Victims: Mitochondrial DNA Analysis

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Mitochondrial DNA analysis has been utilized in many forensic cases for the identification of victims whose bodies have been subjected to harsh and severe environments such as extremely high temperatures, humidity, and burials in shallow graves. This environment, which leads to the extreme degradation of the DNA from the bodies, has made mtDNA the method of choice for analysis of these cases.

Close to 200 individuals in Panama have been victimized during the decades of military dictatorship that ended in 1989 with the ousting of Manuel Noriega. Today, Panama is a democracy, and the country has formed a "Comision de la Verdad" (a "Truth Commission") to locate and identify the missing bodies. Extensive efforts in Panama involving canine and anthropology disciplines led to the excavation of numerous remains.

Sample processing techniques used to overcome PCR inhibitors will also be discussed. These include the use of an ultrasonic cleaner to remove any contaminating surface debris, the determination of DNA quantities and any protein contaminants or inhibitors in the sample, and the subsequent Qiagen column cleaning procedure used to rid the samples of inhibitors. Alternate PCR approaches, such as the use of mini primer sets, will be presented. Success rates of the remains will be discussed as well as rare mtDNA sequences that had never been observed in the available database beforehand. Identical sequences between remains obtained from different physical locations, and the implications of this finding, will be analyzed. Positive identifications made to date will also be discussed.

Analysis of Old Biological Samples: Impact on Body Fluid Identification and DNA Typing Tests

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In an effort to ascertain the feasibility of successfully analyzing old biological samples from cases that could be more than 10 years old in the "Cold Hit" program (a program funded to find and type biological evidence from suspectless cases in California), we requested that crime laboratories in California send us old biological samples they could spare and provide a description of each sample and how it had been stored. The samples that were analyzed in this study included blood, semen, and saliva samples and included a sample that was 49 years old. The samples were described as being held in a variety of conditions: frozen, refrigerated, room temperature and outdoors. Samples obtained from crime labs in California were extracted, quantified and amplified for Profiler Plusä loci.

On most samples, it was still possible to obtain positive body fluid identification test results using various body fluid identification tests (e.g. presumptive tests for blood and semen, immunological tests and amylase diffusion). Two semen stains (made in 1989 and 1975) did not give a positive AP or P30 test. A few of the very old bloodstains (25 years or older) gave weak or negative Hemastix test results. The most problematic test (i.e. the test producing the greatest number of false negative test results) in this study was the species test. The failure to obtain positive species results on some of the bloodstains tested was likely a result of the fact that these samples were very old and thus very insoluble. It is possible that had the stain extraction time been extended, more positive results would have been obtained.

Over-the-Counter Preliminary Alcohol Screening Devices (OTC-PASD)

Kenton S. Wong

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Two over-the-counter PASD were examined for their ability to accurately determine an individual's blood alcohol concentration (BAC).

The crime of driving under the influence (DUI) of alcohol and its effects on society have received much negative notoriety in recent years. Without a doubt, the influence of groups such as Mothers Against Drunk Driving (MADD) have had a profound effect on placing the spotlight on the far-reaching ill effects of DUI in our local communities, as well as on a national level. As a partial result of this, legal limits of BAC have decreased considerably over the years. In the past, the only information provided and available for individuals to estimate their BAC was by using charts supplied by the Department of Motor Vehicles; however, this information was very difficult for the average individual to utilize. In response, several overthe-counter PASD have recently entered the marketplace purportedly allowing an individual to accurately monitor and determine their BAC by utilizing such devices. A number of these devices can readily be obtained from local drug stores at a meager price of only \$0.99 to catalog mail-order suppliers or mall chain stores such as The Sharper Image for less than \$100.00. Two of these devices were evaluated for their ability to accurately determine an individual's BAC.

Identification of 2,3-Analogs of Methylenedioxyamphetamine (MDA) and Methylenedioxymethamphetamine (MDMA) by Mass Spectrometry and Microcrystalline Tests

Francis Woo

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GC/MS is widely used by most modern forensic laboratories for drug analyses. Since the decomposition pathways of analytes are thermodynamically controlled, certain fragment ions (m/e) are predictable. For molecules with similar structural isomers, it is important for the chemist to be able to explain and identify the variations in fragments.

Both 3,4-MDMA and 2,3-MDMA produce similar mass spectra. A mechanistic decomposition approach is employed to explain the subtle differences to definitively characterize and differentiate each compound. Furthermore, a microcrystalloscopic method for differentiating 2,3 and 3,4 analogs of MDA and MDMA is also presented.

The ABI Prism[®] 3100 Genetic Analyzer and the Use of Ampflstr[®] Kit PCR Products

Kim Bogard*, Meri Bozzini, Danielle Blecha, Yasser Daoudi, Craig Leibelt, Rhonda Roby, Ariana Wheaton, and Farideh Shadravan

Forensic DNA laboratories using the Applied Biosystems' ABI PRISM® 3100 Genetic Analyzer coupled with four-dye and/or five-dye AmpFlSTR® products can increase their throughput capabilities for short tandem repeat analyses. The four-dye technology, using three (3) dyes to label DNA fragments and a fourth dye for the internal size standard, and the five-dye technology, using four (4) dyes to label DNA fragments and a fifth dye for the internal size standard, are both wellestablished, reliable techniques for forensic DNA fragment analysis. PCR products from four-dye (e.g., AmpFlSTR® Profiler Plus[™] PCR Amplification Kit) and five-dye (e.g., AmpFlSTR[®] Identifiler[™] PCR Amplification Kit) systems have been evaluated on three (3) 3100 Genetic Analyzers. The experiments performed include an evaluation of accuracy, precision, reproducibility, sensitivity, and mixture studies. Additionally, a new data collection software package was evaluated. A summary of these experiments will be presented as well as the running parameters.

Simultaneous Calculation of STR Profile Frequencies Using More Than 130 Population Studies — Development of a Forensic Casework and Research Tool

Brian Burritt

San Diego Police Department

An excel spreadsheet that will calculate STR profile frequencies from any number of population studies has been developed. Currently, the program contains data from more than 130 population studies that contain, at a minimum, the nine Profiler Plus STR loci. The program was developed to aid the criminalist in quickly finding available population studies and performing DNA profile frequencies calculations with these studies. The compilation may be used to help demonstrate the worldwide use of STR testing. Additionally, the program can be useful as a research tool. Studies were carried out that addressed several assumptions that may be made regarding commonly used population studies. One assumption investigated, which is elluded to in NRC II, is that a DNA profile frequency estimate is likely within one order of magnitude from the "true" value. Another assumption investigated is that the presentation of Caucasian, African American, and Hispanic population frequencies gives a wide range of values that encompass the population frequencies of many of the world's populations. Population data generated with this program supports both of these assumptions. Additional population studies will be added as they become available. Copies of the program may be obtained from the presenter by email (k9b@pd.sannet.gov).

Evaluation of DNA Extraction Methods for Human Bone Samples in the Forensic Laboratory

Mindy K. Crow

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Bone samples have traditionally been problematic in terms of extraction of amplifiable DNA. The presence of PCR inhibitors, as well as significantly degraded DNA, are common problems observed with forensic bone samples. Three methods including the Dynal Dynabeads DNA DIRECT, sodium acetate/isopropanol, and QIAGEN QIAamp were compared to the commonly used phenol/chloroform extraction method in terms of their ability to extract a sufficient yield of amplifiable DNA. After DNA extraction and quantitation, the samples were carried through the protocols for the Amplitype PM + DQA1 PCR Amplification and Typing Kit. The sodium acetate/isopropanol extraction method was consistently successful at extracting DNA that amplified at all six genetic loci. The QIAGEN QIAamp method was also more effective than the phenol/chloroform method but provided slightly less consistent results than the sodium acetate/isopropanol method.

The DNA IQ [™] System

Lisa Lane

Promega Corporation, 2800 Woods Hollow Rd., Madison, WI 53711

The DNA IQ[™] System is a DNA isolation and quantitation system designed specifically for the forensic and paternity community. This system employs a novel technology with magnetic particles to prepare clean samples for short tandem repeat (STR) analysis easily and efficiently. The DNA IQ[™] System can be used to extract DNA from stains, differential extracted sperm and epithelial fractions or liquid samples such as blood or resulting DNA solutions. The system is designed for casework database and paternity applications. For database samples the eluted DNA is delivered at about 1ng/µl eliminating the need to quantitate.

The DNA IQ[™] System for small casework samples includes two steps. For biological material on solid supports, the first step provides an easy, rapid, efficient and almost universal stain extraction method. This step is unnecessary for liquid samples. The second step uses a specific magnetic resin that purifies the DNA without requiring extensive washing to remove the lysis reagent. DNA is purified using a proprietary magnetic particle that removes virtually all PCR amplification inhibitors including dyes found in blue or black denim, soil and black leather. In addition, both the sperm and epithelial fractions generated from rape kits can be input directly into the purification process. To further simplify this process, the DNA IQTM System has been tested with all Promega products and has been adapted to work on automated platforms. For paternity and database samples, the magnetic Resin captures a consistent amount of DNA. The Resin has a defined DNA capacity in the presence of excess DNA and will only bind a specific amount of DNA. This property is used to isolate approximately 100ng of DNA from a range of liquid blood, stains or swabs. The DNA is eluted into 100µl of Elution Buffer to give a DNA concentration of approximately 1ng/µl. As a result, the researcher can bypass the quantitation step typically necessary in other purification procedures.

The Impact of Body Fluid Identification and Fingerprint Reagents on PCR-Based DNA Typing Results

Theresa Spear*, Sharyl Barney, Ashlie Silva and Neda Khoshkebari

California Criminalistics Institute, 4949 Broadway, A-104, Sacramento, CA 95820

This two-part study was designed to look at the impact of reagents used to characterize body fluid stains and reagents used to develop fingerprints on the ability to obtain PCR-based DNA typing results.

Part I - Impact of Body Fluid Identification Reagents, Part II – Impact of Fingerprint Reagents

In summary, clear-cut typing results were obtained for all 14 PCR-based markers from the DNA extracted from the bloodstains treated with each of these 6 reagents. Since the bloodstains in this study were made on absorbent, cotton swabs, this study did not examine the effect of the mechanical manipulations on the possible loss of sample. This would be an important factor consider when dealing with a limited amount of blood on a non-absorbent surface (e.g. plastic/glass). Any significant loss of sample amount can negatively impact typing results.

Development of an Automated Protocol for STR Typing of Reference DNA from Buccal Samples

Mark D. Timken

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In the California DOJ Offender Databank program, reference samples are currently obtained by collecting whole blood from qualifying offenders. Although blood is an excellent source of reference DNA, its collection is invasive and expensive, and its handling exposes collectors and analysts to potential bloodborne pathogens. As an alternative that minimizes these problems, we are developing protocols that use buccal swabs as the source of reference DNA. Automated protocols have been developed using a Tecan Genesis 150 Robotic Workstation for magnetic-bead-based and FTA®-paper extraction methods. Results from these protocols will be compared, mainly with respect to their first-pass genotyping success rates.

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Courtroom Calamities

A Corrupt Judge

Passes Judgment as a Gamester does false Dice. The first Thing he takes is his Oath and his Commission, and afterwards the strongest Side and Bribes.

He gives Judgment, as the Council at the Bar are said to give Advice, when they are paid for it.

He wraps himself warm in Furs, that the cold Air may not strike his Conscience inward. . . .

[H]e takes Liberty to do what he pleases; this he maintains with Canting, of which himself being the only Judge, he can give what arbitrary Interpretation he pleases; yet is a great Enemy to arbitrary Power, because he would have no Body use it but himself. If he have Hopes of Preferment he makes all the Law run on the King's Side; if not, it always takes part against him; for as he was bred to make any Thing right or wrong between Man and Man, so he can do between King and his Subjects....He usurps unsufferable Tyranny over Words; for when he has enslaved and debased them from their original Sense, he makes them serve against themselves to support him, and their own Abuse. He is as stiff to Delinguents, and makes as harsh a noise as a new Cart-wheel, until he is greased, and then he turns about as easily. He calls all necessary and unavoidable Proceedings of State, without the punctual Formality of Law, arbitrary and illegal, but never considers, that his own Interpretations of Law are more arbitrary, and, when he pleases, illegal. He cannot be denied to be a very impartial judge; for right or wrong are all one to him. He takes Bribes, as pious Men give Alms, with so much Caution, that his right Hand never knows what his left receives.

From Samuel Butler (1612-1680) on "Varieties of malice and corruption" (as quoted in Amelie Rorty, "The Many Faces of Evil - Historical Perspectives") —Peter D. Barnett

Can't Find It?

To reduce the costs of publication, the *CACNews* may place calls for nominations and other items that were previously found in the newsletter mailing as inserts ON THE WEB. Visit www.cacnews.org to see what is offered. Content changes periodically, so visit often!

Wacky Webster

- Intaxication: Euphoria at getting a tax refund, which lasts until you realize it was your money to start with.
- 2) Reintarnation: Coming back to life as a hillbilly.
- Foreploy: Any misrepresentation about yourself for the purpose of getting laid.
- 4) Giraffiti: Vandalism spray-painted very, very high.
- 5) Sarchasm: The gulf between the author of sarcastic wit and the person who doesn't get it.
- 6) Inoculatte: To take coffee intravenously when you are running late.
- 7) Hipatitis: Terminal coolness.
- 8) Osteopornosis: A degenerate disease. (this one got extra credit)
- Karmageddon: It's like, when everybody is sending off all these really bad vibes, right? And then, like, the Earth explodes and it's like, a serious bummer.
- 10) Glibido: All talk and no action.
- 11) Dopeler effect: The tendency of stupid ideas to seem smarter when they come at you rapidly.

And, the pick of the liter(ature):

12) Ignoranus: A person who's both stupid and an asshole.

Submitted by Nancy McCombs





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