The CAC News

Newsletter of the California Association of Criminalists

Summer 1992

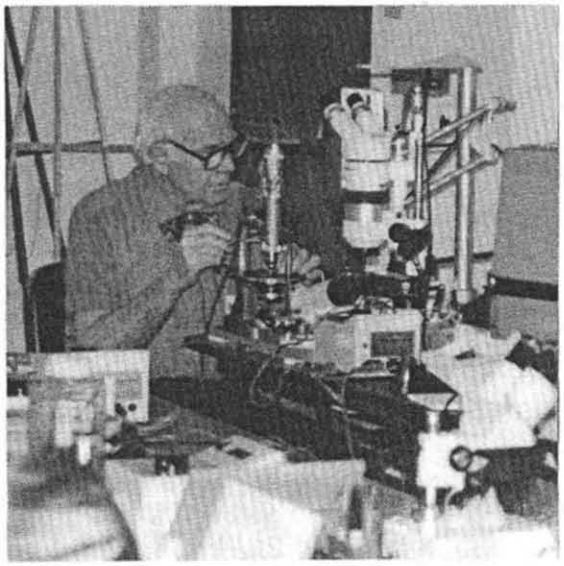
A Message From The President

If I was guaranteed to accomplish just one thing this year, it would be to infect as many people as possible with the desire to get active and involved in the CAC. For myself, involvement in the CAC has made the difference between a job and a profession. Volunteering for committees or Board positions doesn't just get you extra work, it gives you the opportunity to; expand professionally, meet and work with new people, and to feel good about yourself and your profession. And many times a little bit of fun actually sneaks in with the work.

I would like to thank all of you that have caught the bug and given of yourself during the previous years and to thank in advance all of you who are going to be working for the CAC this year.

In addition, I would like to give a special thanks to Gary Cortner and the people at DOJ Fresno for a very enjoyable and educational Spring Seminar and to John Houde, who is working with Lisa Brewer our Editorial Secretary, to bring us these new and improved newsletters. The appearance and content improve with each issue.

REMEMBER: The deadline to submit a proposal to the Reed and Virginia McLaughlin Endowment Committee is approaching.



Doing what he loves to do most, Dr. Walter C. McCrone demonstrates Basic Polarized Light Microscopy. *More on page 16.*

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MEETING Announcements

CANADIAN SOCIETY OF FORENSIC SCIENCE

August 20-25, 1992

The Annual Seminar of the Canadian Society of Forensic Science will be held at the Citadel Inn in Halifax, Nova Scotia. The theme of the conference is "Truth through Science and Integrity". The conference will include scientific sessions and a poster session. Workshops are also being planned in some of the following areas: DNA, Fire Investigation, Document Examination, Expert Witness Testimony, Drugs and Driving and Laboratory Safety. For further information, please contact: Fredricka Monti, Executive Secretary, CSFS, Suite 215 - 2660 Southvale Crescent, Ottawa, Ontario, CANADA K1B 4W5 (613) 731-2096

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The CACNews

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Notice to Contributors

This newsletter publishes material of interest to its readers and is pleased to receive manuscripts from potential authors. Meeting announcements, employment opportunities, course announcements, etc. are also solicited.

Advertisements are also accepted, although a fee is charged for their inclusion in The CAC news. The acceptance of any advertisement is at the sole discretion of the Editorial Secretary.

Because of the computerized typesetting employed in The CAC News, the Editorial Secretary requests that where possible, submissions to the News be made in the form of IBM or MS-DOS compatible files on 5.25 or 3.5 inch floppy disks (high or low density). It is preferred that text files from word processors be saved as ASCII files without formatting codes, e.g. bold, italic, etc. An accompanying hardcopy of the file may be submitted along with the disk to illustrate the author's preference for special emphasis.

Graphics, sketches, photographs, etc. can also be placed into articles. Please contact the Editorial Secretary for details. FAX submissions are also acceptable. The FAX number for the Editorial Secretary is (408) 298-7501.

The deadlines for submissions to The CAC News are: December 15, March 15, June 15 and September 15.

MEETINGS

CLANDESTINE LABORATORY INVESTIGATING CHEMISTS

September 9-12, 1992

The Second Annual Seminar of the Clandestine Laboratory Investigating Chemists will be held at the Stockyards Hotel in Fort Worth, Texas. It is being hosted by Forensic Consultant Services in Fort Worth. For further information, please contact: Max Courtney, Forensic Consultant Services, PO Box 11668, Fort Worth, TX 76100 (817) 870-1710

MIDWESTERN ASSOCIATION OF FORENSIC SCIENTISTS

October 9-14, 1993

MWAFS will be holding its 22nd Annual Fall Meeting in Madison, Wisconsin at the Holiday Inn-Southeast, October 9-14, 1993. Contact: Michael A. Haas
Local Arrangements Chairman
State Crime Laboratory - Wausau
7100 Stewart Avenue
Wausau, WI 54401-9305
Phone: (715) 845-8626
FAX: (715) 848-5833

CALIFORNIA ASSOCIATION of CRIMINALISTS

October 22-24, 1992

The 80th Semi-Annual Seminar of the CAC will be held at the DoubleTree Hotel in Ventura, CA. Members registering before Oct.2nd save $25. Scheduled workshops include: Bloodspatter interpretation, Forensic geology, the Huey Long assassination and much more! You won't want to miss this one!

As an added bonus, the first ten persons registering for the Saturday workshop on the *"Microscopic Examination of Sexual Assault Evidence"* will receive a set of prepared slides to keep following the seminar. Contact Margaret Schaeffer, Program Chair, for details.
Ventura Sheriff's Crime Lab
800S. Victoria Ave.
Ventura, CA 93009
(805) 654-2333

SOUTHWESTERN ASSOCIATION OF FORENSIC SCIENTISTS

October 27-30, 1992

The Fall 1992 Meeting of the Southwestern Association of Forensic Scientists will be held in Estes Park, Colorado. It is being hosted by the Colorado Bureau of Investigation. Program will include guest speaker and instructor, Dr. Walter McCrone. For further information, please contact: James Crippin, Colorado Bureau of Investigation, 3416 N. Elizabeth, Pueblo, CO 81001 (719) 542-1133

4TH INDO-PACIFIC CONGRESS ON LEGAL MEDICINE AND FORENSIC SCIENCES

November 2-6, 1992

The Forensic Science Association of Thailand in cooperation with INDO-PACIFIC ASSOCIATION ON LEGAL MEDICINE AND FORENSIC SCIENCE (INPALMS) is holding the 4th INDO-PACIFIC CONGRESS ON LEGAL MEDICINE AND FORENSIC SCIENCE in Bangkok at the Hyatt Central Plaza Hotel. For further information, please contact: LEGALMEDSCI 92, Institute of Forensic Medicine, Surgeon-General Office, The Royal Thai Police Department, Henry Dunant Road, Bangkok 10330, Thailand Phone: 251-2925-7, 2527115 Fax: (66-2) 2365219, 2377333

First published in the October 1991 issue of the Midwestern Association of Forensic Science newsletter, this article is reprinted with the permission of the author.

BAD SCIENCE

By D.H. Garrison, Jr.
Grand Rapids Police Department
Forensic Services Unit

Forensic science is the product of an uneasy and unholy mating of Science, the objective seeker of truth and knowledge, and Forensics, the argumentative persuader of courtroom advocacy. It is not called Justice Science, Law Science or Truth Science, as many of us would like to imagine. We are a bastard child, an orphan, but still the subject of an intense child custody battle between our estranged parents, the truth seeker and the advocate. The tug-of-war goes on daily for our loyalties and confidences, each side offering candy and warm hugs. These separated parents have visitation rights. Sometimes they take our sisters and brothers away. Sometimes they don't come back.

We in forensic science like to think of ourselves as our mother's child--Mother Science, pure and incorruptible- and most of us start out this way. Some of us remain pure. Some grow up to be delinquents. The advocacy half of forensic science will not go away; it has weekday visitation rights and power-of-subpoena. It has advocate friends called prosecutors, attorneys, cops, the press and the Government. The advocates rarely understand the appeal of Mother Science, cannot fathom a search for truth in a game plan that calls for scores and trophies. They are constantly trying to persuade us to see it their way, to compromise, to bend a little. They don't realize it, but what the advocates are asking for is Bad Science.

The pressure to be a Bad Scientist, to fit in and go along, is great, and it doesn't go away unless you put your foot down and say Enough is Enough! And keep saying it to each supervisor, each detective, and each fair-haired boy from the prosecutor's office. Bad Science is what forensic science becomes when an attorney or prosecutor, who often display all the ethics of a full-grown hamster, get a forensic scientist to play ball, to get with their program and see their big picture.

There is an old Bad Science joke about a scientist who was working with an ant. The scientist would cut off one of the ant's legs and shout "Jump!" And the ant would jump. The scientist cut off a

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COMMENTARY

The WILLIAM KENNEDY SMITH *Rape Trial:*

ISN'T IT JUST COMMON SENSE? ONLY AN 'EXPERT' CAN TELL

I think we've seen the last of the experts testify at the William Kennedy Smith rape trial.

It's a good thing. The witness stand was turning into a red-light district.

Not that I blame these guys: The Hanky Man. The Sand Man. The Grass Man. The Moon Man. And Monday's grand finale...The Penis Man.

It's nice work if you can get it.

Take the Moon Man, meteorologist Herb Spiegal. The Smith defense team has paid him $2300 to essentially figure out the moonlight conditions on the morning of March 30.

Let's see. Full moon, nearly no clouds. Hmm...(meter's running at $75 per hour)...Hmm...I'll have to take more measurements...(meter's still running)...Better shoot that azimuth angle...

The Moon Man concludes: "The moon was visible, it was full and therefore would have illuminated the yard."

Amazing. A full moon would illuminate a yard! Now, you might say, "Hey, where do I sign up for a gig like this?"

It's not as easy as it sounds. To be a good expert witness, you need to bludgeon jurors with your education. You need to explain common-sense things in such a technical, convoluted way that no one really knows what you're talking about.

The Moon Man took more than an hour Monday to guide us through his heavenly testimony. Somewhere along the line, he put Smith's cousin Michael Kennedy to sleep. The bailiff had to wake him up.

The Grass Man, Dr. Robert Webster, was a master.

"I'm just a simple grass taxonomist," he told the jury.

As opposed to a cross-dressing grass taxonomist, I guess.

See, the way it works is, lawyers spend a month picking a jury. They end up, as in this case, with six people who don't have a single college degree among them, and then they bombard them with experts such as the Grass Man.

"What's a vascular plant?" defense lawyer Mark Selden asked The Grass Man.

"A plant that has vascular tissue," he answered.

Got that, sluggos?

Lawyers seem to operate by the theory that you never can insult a juror's intelligence. That's why they ask the same question five times. That's why they put on bogus testimony.

Take for example, The Hanky Man.

He's Dr. Henry Lee, a forensic scientist for the state of Connecticut. The defense wanted Lee to show that the alleged rape victim would have had grass stains on her black Ann Taylor dress if Smith had tackled her on the back lawn of the Kennedy estate.

And how did Dr. Lee go about proving it? He wiped a white handkerchief on the lawn.

You uneducated slobs may wonder: Why would you rub a white cotton handkerchief on the grass when you want to find out whether a black dress made of synthetic fiber would pick up stains?

As long as you're spending $4500 to get Hanky Man to testify, why don't you splurge for $125 and let him rub the identical black Ann Taylor dress on the lawn?

Fools. You don't know anything about expert testimony.

You may get the idea that I disapprove of experts. On the contrary, they often provide the highlights of the trial.

For example, the Grass Man was the only witness to testify in black sneakers. For the most part, these scientists provide a refreshing break from the crush of relevant and important information that seems to weigh down trials.

That's why I was really happy Monday afternoon when the defense called The Penis Man.

He's Dr. Raphael Good, who's got the medical quiniela of being a psychiatrist and a gynecologist at the same time ("So when did your father abandon you? Please slide up a little more, ma'am.")

What he's doing in this trial is anybody's guess. He's not a specialist on rape, and in 43 years of practicing medicine, he's seen 30-40 rape victims.

His last published article was titled: "Women's Attitudes Towards Douching."

Good was called-I'm not making this up-to testify that it's not likely for a man with a "partially erect penis" to have sex with an unwilling woman.

"It's like trying to put a thread through a needle," he told the jury. "As you know from common experience, you wet the end and twist it a little."

My guess is that Tony the Bartender, who testified Saturday, might have been able to opine in this area as much as the 70-year-old doctor.

But then again, it would have looked pretty silly to pay Tony $3000 to say it.

Frank Cerabino, writing for *The Palm Beach Post*, December 10, 1991, offers an outsider's view of forensic science experts.

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second leg, told the ant to jump, and again the ant jumped. And so it went, until the scientist had cut off all six of the ant's legs. This time, when told to jump, the ant did not jump. This proves it, the scientist concluded; when you chop all the legs off an ant, the ant goes deaf!

You may recognize some scenes from the following examples of Bad Science at Work. Some are laughable, others disturbing. Some simply haven't happened to you yet. I have not personally encountered all of these situations, but I know that each is true. If you haven't witnessed at least some of them, you will. If this helps you steel yourself against the onslaught of the Advocates, so be it. Finally, not all Advocates are malicious. Many, in fact, are simply not versed in the ways of good scientific method. When they ask for Bad Science, you can pity them as helpless people doing the wrong thing for the right reason. This type of Advocate needs to be taught...and watched.

MISINTERPRETATION OF TEST RESULTS

In a robbery case the victim, a bartender, testifies that the defendant had come into the tavern earlier in the night for a glass of beer. Three unwashed glasses were found at the scene and were processed for latent prints. Two of the glasses yielded prints, but these were from persons unknown, not the defendant. The prosecutor suggests that the print examiner testify that the third beer glass must have been used and wiped clean by the defendant, because the other two glasses were obviously not his. The print examiner suggests that the prosecutor look elsewhere for this kind of testimony. The prosecutor looks surprised.

MANIPULATION OF RAW DATA

An accident reconstruction expert with a computer is hired by a plaintiff's attorney to determine the speed of the defendant's vehicle in a two-car collision. The expert enters into his program the road surface drag factor, skid and yaw mark lengths, and the location and severity values of the vehicle damage. The first run of his computer program gives him an unrealistically high speed for the defendant's striking vehicle. The expert changes his drag factor estimate and tries again. The figures are still outrageous. Three program runs and several crush data changes later, the speed determination begins to look more believable. The defendant's attorney begins his attack with a subpoena for all five of the expert's computer printouts.

JEOPARDY

As in the television game show where contestants reply in the form of a question, certain managers give their subordinates a desired answer and demand that they come up with the appropriate research questions to support it. During one police department's trial period of a 9mm pistol, a police officer wounds an assault suspect. Because the suspect is not instantly incapacitated, the police chief scraps the entire 9mm changeover program.

"Science without conscience is the death of the soul."

-Rabelais

He hears of the FBI's 10mm pistol program. One of the theories he returns with states that, by virtue of its "larger size", the 10mm is much better at striking blood vessels than the smaller 9mm bullet. The department's shooting instructor points out that an extra half-millimeter alone on each side of the 10mm bullet's diameter would not really make much difference, unless you missed a blood vessel by half a millimeter with a 9mm bullet. Then the instructor begins his litany about the training budget, that training is at least as important as hardware, but the administrator doesn't hear him, because it's time to play Double Jeopardy with the Chief.

COMPARING APPLES AND ORANGUTANS

In a product liability suit, the plaintiff's attorney finds an expert witness who will testify that, if a shotgun involved in a shooting had as safe a firing mechanism as a rivet gun, the incident may not have happened at all.

MANIPULATION OF TEST RESULTS

During a burglary trial, the prosecution produces seven latent prints recovered from inside the victim's house. The fingerprint examiner testifies that he has identified these prints as belonging to the defendant. The prosecutor suggests that the fingerprints are like seven little photographs of the burglar inside the house. Because he does not want a repeat of an earlier case lost to the burglar's defense attorney, the prosecutor calls a second examiner to the stand to verify the comparison

performed by the first. The prosecutor then states that the seven latent prints, times two print examiners, make for fourteen little photographs of the

Standing your ground means you have to get in the face of anyone who even hints at being a Bad Scientist.

defendant at the crime scene. Later, when jokingly asked way he didn't call a third examiner to up the score to 21 fingerprints, the prosecutor replies that he had simply neglected to subpoena another print examiner.

COMPULSIVE COMPUTING

A .223 Remington bullet is found lodged in a house several hundred feet to the rear of a rifle practice range at which .223 weapons are frequently fired. The investigators want to know if it is possible for a .223 bullet to fly the several hundred feet necessary to reach the house, so they ask a firearms examiner. The examiner, who had recently invested in a ballistics program for his home computer, took down the range, wind speed, bullet shape, temperature, barometric pressure, and several other pieces of data. His computer printer charted the results. Finally, his answer to the investigators was: "Yes, it's possible." As a qualified firearms examiner, he had already known that the house was well within the range of the .223 cartridge and could have given the same answer when first asked the question...without computation.

DENIAL

In many major criminal investigations it is the practice of a detective unit to offer polygraph examinations to the suspects and, in cases of questionable accusations, to the victims. While it is not admissible in court, the polygraph results are relied upon as a valid investigative tool. One day a young police officer shoots and wounds a juvenile who he claims fired at him first, although no weapon is found. The officer claims he was also struck several times about the head and shoulders with a board prior to the shooting, although he exhibits no bruises, head injuries, or defense injuries to his hands or arms. When asked about this lack of consistent injuries, a detective reports that the young officer was wearing a bullet-resistant vest. The detectives do not offer the suspect or the police officer polygraph examinations in this particular case.

ETHICAL BANKRUPTCY

In a homicide case the prosecution demonstrates a laser reconstruction of a bullet's path through a woman which indicates her husband fired a rifle from his shoulder. The husband's story is that he was cleaning the weapon while it lay on a tabletop. The defense attorney finds a firearms expert who will claim that, while the weapon was not malfunctioning before the incident, was not malfunctioning when collected from the crime scene, and is not malfunctioning now at the time of trial, it may have suddenly malfunctioned and fired all by itself as a result of a build-up of dirt and powder within the weapon's mechanism on the day of the shooting. The expert does not address the issue of the shooting reconstruction, but the jury does and returns a guilty verdict.

NO SCIENTIFIC METHODOLOGY

A city truck runs a stop sign and causes a serious collision. Instead of relying on the skidmarks, crush damage, and scene evidence, the city authorities order a traffic investigator to conduct acceleration test to determine the maximum possible speed the truck driver could have achieved in the one block distance leading to the crash. Because the truck involved was disabled in the accident, the traffic investigator uses a motorcycle to run the one-block acceleration test and reports back a peak speed of 35 miles-per-hour for the city truck.

TOO MANY COOKS SPOIL THE BROTH

A city bus rear-ends and crushes a carload of teenagers, killing four. The first traffic investigators at the scene measure the skidmarks of the bus and determine that the bus driver was speeding. A national civil rights leader says the bus driver is being made a scapegoat by the city solely because he is a minority. The follow-up investigation by city authorities reports that the

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traffic investigators, who have been abruptly removed from the case, must have been measuring tire marks tracked through melted roadway tar and that, on second thought, the city bus driver was not really speeding. A local television station gets a radar gun and reports that most drivers, including all city bus drivers, regularly exceed the speed limit on this section of roadway. Tire tracks in tar look nothing like skidmarks to the trained eye of the traffic investigator. Excessive speed aside, it is unlawful to follow another vehicle at an unsafe distance in that state.

PURSUIT OF THE INCONSEQUENTIAL

In the faked robbery of a fast food restaurant, the night manager shoots to death an employee in a walk-in cooler, hides the "stolen" money and a .357 Magnum revolver, and calls the police. The crime scene personnel notice fallen dust on a restroom floor and discover the money hidden in a ceiling panel. The revolver is found among the night manager's possessions. During the investigation, the prosecutor asks for a shooting sound test to be done inside the restaurant's cooler. This, he says, will determine whether or not the fatal shots could have been heard by a teenage girl who was having sex with a man (not her boyfriend) in the back of her boyfriend's van parked across the street from the restaurant. The girl, who incidentally had a full-length cast on her leg at the time (another mystery altogether), did not recall hearing much of anything, least of all gunfire. Her partner that night also missed the sounds. The crime scene investigator refused to participate in such an experiment, arguing that it was invalid, irrelevant and silly, and what would it prove anyway? The prosecutor suggested that the defense might use the fact that the girl had not heard the shots to argue that the time of the murder was somehow different. Then let the defense make a sound test, the investigator says, leaving. The prosecutor is insistent. After being turned down by the police firearms training and the state regional laboratory examiner, the prosecutor gets three detectives to fire the shots for the sound test. To duplicate the sounds of a .357 Magnum, they load the murder weapon with light .38 Special target loads; they fire the quieter ammunition into a sandbagged pipe inside the walk-in cooler so as not to make holes in the walls. It is several months later, and the air temperature is sixty degrees lower than the night of the murder. By the time the test begins, the noisy morning rush hour traffic has clogged the street in front of the restaurant. To duplicate the hearing of the busy girl with the cast on her leg and other things on her mind, they use the prosecutor's ears as he stands across the street. (Later there were several profane allegations about what the prosecutor had to endure to fully recreate the event.) The results of the test? "It sounded like a hand clap," said one of the detectives stationed in the dining room. So apparently, one can induce deafness by making love to a girl in a full-length leg cast, the same as one can by cutting all six legs off an ant.

Examples of truly Bad Science are everywhere. So, what can one do to avoid ambush by the Bad Scientists? Three small philosophical exercises come to mind. The first is a methodological battle plan called "Ockham's Razor", named after the 14th century philosopher William of Ockham. In philosophy, it says, a problem should be stated in its basic and simplest terms. In science, according to Ockham's Razor, the theory that fits the facts of a problem with the fewest number of assumptions is the one that should be selected. This is the great-grandfather of the K.I.S.S. (Keep It Simple, Stupid) theory, and it works well against Bad Scientists.

The second tactic is termed "*reductio ad absurdum*", which is the disproof of a proposition (or stupid experiment) by showing the absurdity to which it leads when carried out to its logical conclusion. A good example of such a situation is the aforementioned case of the prosecutor who argued that seven fingerprints identified by two print examiners make a total of fourteen little traces of the burglar defendant. The *reductio ad absurdum* of that case is the notion that a third print examiner would up the ante to 21 clues, or that a dozen examiners identifying a single print would make for 12 traces of a suspect. The clues multiply like bunny rabbits. The mind boggles. Think of where the Bad Scientist is trying to lead you and look at the dark at the end of the tunnel.

The final fallback is to common sense, the bane of Bad Scientists the world over. It was Thomas Huxley who said, "Science is simply common sense at its best--that is, rigidly accurate in observation and merciless to fallacy in logic". This is where juries trod on the best laid plans of eloquent attorneys. They step back for a moment and resort to instinct, to common sense. Lawyers, especially those True Believers who do the prosecuting, are notoriously bad at feigning common sense. They are better at *reductio ad absurdum*. Cops, on the other hand, are excellent at instinct and common sense, but poor on seeing the absurdity of a proposition's logical conclusion.

Lastly, one needs to stand one's ground. And this means more than just Do Not Testify To Methods Beyond Your Expertise, or Do Not Selectively Ignore Evidence To The Contrary, or Do Not Overstate Your Qualifications. Standing your ground means you have to get in the face of anyone who even hints at being a Bad Scientist. You'll need to gently redirect the novice Bad Scientist at times, showing him the light, letting him known where you stand. With the more seasoned advocates (prosecution or defense), you may need a chain saw to carve out your turf in the Bad Scientist's officer, be it a medical examiner's office, a lawyer's office or a supervisor's office. Draw the line. Let them know when Enough is Enough. After all, you're the bastard child of both Science and Forensics. They'll expect you to be incorrigible. Don't let them down. J. Robert Oppenheimer said it best when he wrote: "The scientist is free, and must be free to ask any question, to doubt any assertion, to seek any evidence, to correct any errors".

Southern Section

On Thursday, April 2, 1992, a CAC Southern Section Dinner Meeting was held at the Szechwan Palace Restaurant in Santa Ana. The dinner meeting was hosted by the Orange County Sheriff-Coroner Forensic Science Service. The guest speaker was John Twilley of the Conservation Center of LA County Museum of Art; he spoke on Microanalysis in Art Conservation. The dinner meeting was attended by 56 individuals. The door prizes (radio, fire extinguisher) were furnished by VWR.

Southern Study Groups met on the same day and are described below.

TOXICOLOGY STUDY GROUP

Chair: Manuel Munoz, Los Angeles Co, Chief Medical Examiner-Coroner

Ten individuals attended the Toxicology Study Group meeting. Dave Anderson, LA Co Coroner's Office, presented two Coroner's cases which involved Flecainide overdoses. Both case histories were given as well as methodology. Drug interpretation was given based on reference materials. Trudy Forbes, OCSD, interjected with a Flecainide overdose case she had. Bernie Sanchez, LAPD, gave an extensive review on the National Highway Safety Traffic Administration Conference he attended in October. Certain topics and criteria were shared which created interesting discussions.

SEROLOGY STUDY GROUP

Chairs: David Hong, LASD and Don Jones, San Bernardino Co Sheriff

Twenty six individuals attended the Serology Study Group meeting. Dave Stockwell, San Bernardino Co Sheriff, gave a "Back-to-Basics" lecture on Immunology. Dan Gregonis and Patty Lough, San Bernardino Co Sheriff, reviewed the AAFS meeting papers relating to serology. These lectures were videotaped and are available through the Training and Resources Committee.

BLOOD ALCOHOL STUDY GROUP

Chair: Dan Nathan, Los Angeles Sheriff Department

This meeting was chaired by Marty Breen, Orange Co. Sheriff-Coroner. Eleven individuals attended the Blood Alcohol Study Group meeting. A report on the National Safety Council's Commission on Alcohol and Drugs was given. A review of the Department of Health Services 3/2/92 meeting on expediting method of review and other issues of concern. A discussion of current defense trends, "Tagamet". A report was given on Dr. Wayne Jones' presentation at the AAFS meeting regarding acetone and its effects on blood alcohol levels.

TRACE STUDY GROUP

Chairs: Lynne Herold, LASD; Jeff Thompson, Huntington Beach PD and Wayne Moorehead, Orange Co Sheriff-Coroner

A round table discussion on interesting and problem cases.

Northern Section

On April 9, 1992, Mary Hershey and the Contra Costa County Criminalistics Laboratory hosted a dinner meeting at The La Beau's/ Amato's Restaurant in Martinez. The guest speaker for the evening was Dr. James Meeker, Chief Toxicologist of the Institute of Forensic Science. His topic was "Potential Interpretation of Quantitative Urine Drug Results". He was a very interesting speaker and had to stay on his toes since Sasha Sulgin was in attendance. The meeting was attended by 22 individuals.

Northern Study Groups met on the same day and are described below.

SEROLOGY STUDY GROUP

Chairs: Pam Sartori, Oakland PD and Nancy Marte, San Mateo Co Sheriff

Keith Inman and Nora Rudin, DOJ-DNA, presented the papers they gave at the AAFS meeting in February 1992.

FIREARMS STUDY GROUP

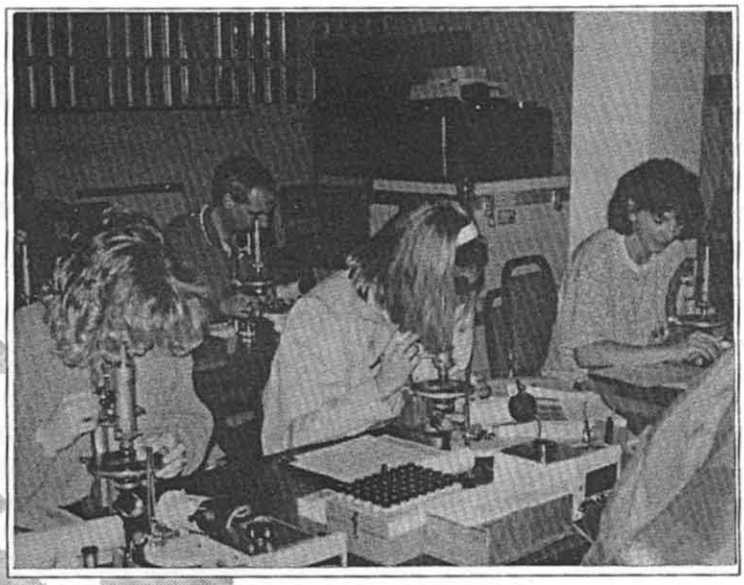
Chair: Lansing Lee, Oakland PD

The topics of discussion included the collection of court display/testimony aids, the breech face photograph project up-date and interesting cases and techniques. The group viewed the beginning of Luke Haag's firearms training video.

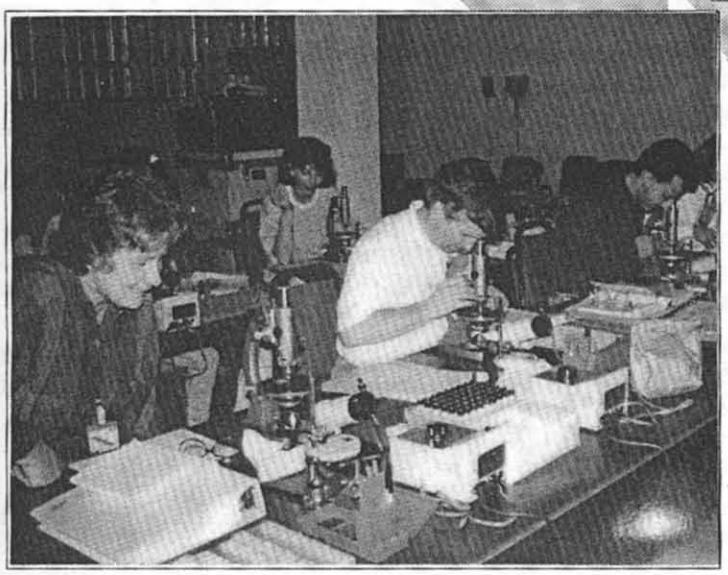
DRUG STUDY GROUP

Chairs: Diane Bowman and Mary Trudell, Oakland PD

(No Report.)



The first Training and Resources/Endowment Funded class was a great success. CAC members are very grateful for the Reed McLaughlin Endowment Fund supplementing the tuition costs. This first class was Dr. McCrone's "Basic Polarized Light Microscopy." There were eighteen students, seventeen of which were CAC members. Although tuition for McCrone Forensic Microscopy courses is typically $650, CAC member's tuition was $300; the additional $35 was covered by the Endowment Fund money awarded the Training and Resources Committee for 1991-92.



Thanks to Pat Huck, DOJ Santa Rosa Criminalist and class student, here are some snapshots capturing the student diligence and enthusiasm. Oh -and yes- they all passed!

--Carol Hunter

The Scientific Investigation Unit of the Huntington Beach Police Department will be hosting "Tests for BAC in Highway Safety Programs - Supervision and Expert Testimony" October 25th through 30th, 1992. The course will be taught at HBPD and will emphasize the scientific aspects of Forensic Alcohol Analysis. This is fundamentally the Indiana University course put on by Robert Borkenstein, D.Sc., modified for California. Specific topics will include: breath alcohol analysis (8 hrs), urine as a sample medium (4+ hrs), physiology of HGN, pharmacology and retrograde extrapolation. Some of the instructors confirmed include Robert Borkenstein, D.Sc., Kurt Dubowski, Ph.D., Robert Forney, Sr., Ph.D. and Alan Wayne Jones, Ph.D..

For more information, please contact:

Jeff Thompson, Supervising Criminalist
Huntington Beach Police Department
Scientific Investigation Unit
2000 Main Street
Huntington Beach, CA 92648

Jobs Offered

Forensic Arson Chemist
Austin Texas

The Texas Commission on Fire Protection is seeking applicants for two positions of Forensic Arson Chemist, to help create a new, statewide arson lab. Minimum qualifications include B.S. degree in an approved physical science, and three years forensic laboratory experience in gas chromatograph-mass spectrometer, gas chromatograph, and compound microscope. Must have experience as an expert witness and have excellent communication skills. The salary range is $2,451 to $3,088 per mo. State benefits include health insurance, 84 hours of annual leave (w/no prior state employment), 96 hrs. of paid annual sick leave, state holidays.

One position will be filled in July, the other in September.

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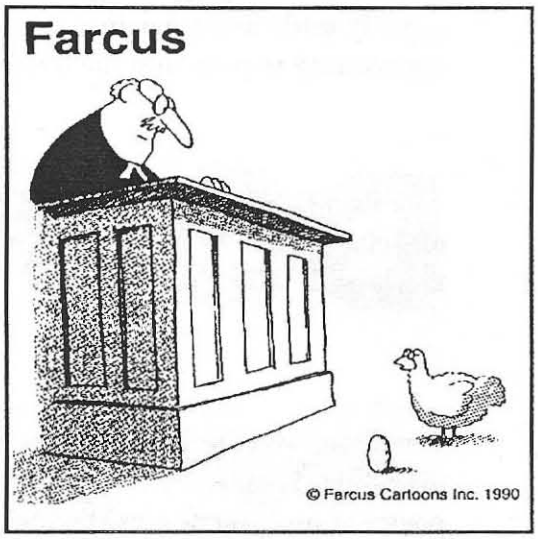

"Excuse me your honor, but I believe I was here first."

Luke Haag will be presenting his findings in the much publicized re-examination of the assassination of Huey Long. Luke is well known in the CAC for his very professional presentation and enjoyable style. We know you'll want to hear this paper.

James O. Pex will be travelling all the way from Coos Bay, Oregon. Jim is a Lieutenant (criminalist) with the Oregon State Police. His presentation will enhance our delicious banquet at the DoubleTree Hotel. His work on the infamous Diane Downs murder case, which was subsequently made into a movie and bestselling non-fiction book, "Small Sacrifices" will provide a fine opportunity to peek into the intricasies of an intensly scrutinized trial.

Paul Dougherty has pursued his personal interest in the historical aspects of criminalistics, especially where firearms are concerned. His presentation on Calvin Goddard is sure to dovetail nicely with Luke's paper.

Frank Cassidy is perhaps our best known author. He has published literally dozens of papers, everything from tips to full research articles. This time, it will be "Frank's Greatest Hits", a potpourri of his favorite tips and techniques which benefit everyone in the laboratory.

Gary Knowles is also travelling from Oregon to share his expertise. Gary is also a criminalist with the Oregon State Police Crime Lab, and will be presenting a lecture on bloodspatter interpretation. For those special twenty registrants, he will offer an actual hands-on workshop in the same subject. Register Early!

Ed Jones has prepared the finest course handout materials one could ask for at any seminar workshop. Plan to stay 'til Saturday and take full advantage of his work. Even though there are only so many microscopes to go around, he'll take anyone and everyone who'll share and enjoy learning more about the examination of sexual assault evidence under the microscope.

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Louis A. Maucieri[1] *and Jamie W. Monk*[2]

ENHANCEMENT OF FAINT AND DILUTE BLOODSTAINS WITH FLUORESCENCE REAGENTS

ABSTRACT: This paper describes experiments with bloodstain detection reagents that fluoresce. The intended application was for field use on faint, obliterated, or otherwise latent bloodstains. We sprayed various test reagents on faint stains dried upon several surfaces (made by serial dilution). Many of these tests produced reactions resulting from the heme-peroxide catalyzed oxidation of the reagent. Resulting complexes fluoresced with irradiation from a handheld ultraviolet (UV) lamp or visible light. The dye fluorescin exhibited good sensitivity and ease of application to visualize faint or dilute bloodstains.

INTRODUCTION:

Many reagents are known to enhance detection of blood, producing a visual reaction product. Some result in a color change through a reaction involving redox, complex formation, or protein binding with chromophores. Examples include phenolphthalein, leucomalachite green, ninhydrin, and benzidine related compounds. Several of these are widely accepted for routine laboratory use in presumptive tests for blood, the exception being benzidine because of its health hazard.

In some situations various colored background materials reduce the contrast produced with these reagents. This can be a real problem for searches of blood patterns in crime scenes. For these cases workers have applied reagents that give a luminescent or fluorescent reaction product. Perhaps the best known of these is luminol, 3-aminophthalhydrazide. It is applied as an aqueous spray with sodium carbonate and overspray with sodium perborate. Lytle [1] reported blood traces in the 10^{2} to 10^{-1} ppm range yielding a luminescence on a variety of surfaces. His study and others describe the photography of resulting patterns [2]. Although not totally specific for blood, the reaction was not promoted by various commonly encountered substances [3]. A good discussion of the reaction mechanism and efforts to make it more specific was reported by Thornton and Maloney [4].

Problems with the luminol test are that the chemiluminescence is faint [1]; copper, inorganic iron and other metals can cause an interferring reaction; the solutions have to be resprayed to offset the fading that sets in after a minute or so; the faintness requires an almost total darkness to observe and photograph; and photography is in the minutes-range and must be performed quickly and correctly. Finally luminol is suspected as a moderate toxin to the liver and kidneys [5].

With these drawbacks for luminol, we considered a search for potential alternate reagents. Various color reagents and fluorescent probes have been cited by other workers [6]. Initially our interest centered on reports of UV enhanced fluorescence of bloodstains using ANS (8-anilino-1-naphthalene sulfonic acid) and TNS (potassium 2-p-toluidinylnaphthalene-6-sulfonate). Thornton and Heye [7] used ANS and TNS in aqueous solution as fluorescent probes. In the study performed by one of us (J. Monk [8]), ANS was shown to work best on clean, nonporous surfaces. Bloodstains on porous surfaces like wood, paper or carpet did not give a reaction with ANS. Reaction with ANS was observed on dried bloodstains at dilution ranges of 10^{4}-10^{5}. TNS was found to be less sensitive (~10^{3} dilution) and less intense than ANS. More detailed work with ANS was deferred when the entire substrate began to fluoresce as the surface spray began to dry. For this and other reasons the search for additional fluorescent probes was widened. Those studied in subsequent work included various protein, amine, or iron complexing reagents. Ultimately fluorescin (reduced form of fluoresc<u>ein</u>) seemed to offer the best balance of sensitivity, ease of use, intensity, and persistence of effect. For a full report of results from these tests see the report of J. Monk [8]. Toward the end of this study we found that fluorescein was also studied by Lee [9].

METHODS AND MATERIALS

Materials

Table 1 lists the reagents evaluated as potential fluorescent probes for bloodstain detection. Reactive solutions were prepared in aqueous or organic media. Some required overspray with hydrogen peroxide as indicated.

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From a report of work done in partial fulfillment of MSc. requirement, University of Strathclyde.

Equipment/General Methods

Blood used in these experiments was donated by the MSc candidate (Monk). Serial dilutions of 1/10 to 1/1,000,000 were prepared with distilled water. These were stored in stoppered volumetric flasks in a refrigerator. Some experiments required whole blood, which was drawn immediately prior to use. Spray cans for application of chemicals were CFC filled high pressure sprays with a screw-on reservoir. All spraying was done in a fume hood. For fluorescence visualization with UV, we used a portable dual wavelength (254nm/366nm) light from UV Products Ltd., San Gabriel, CA 91778. When using this light UV protective goggles were worn at all times. All other visualization (requiring visible excitation) was done using the POLILIGHT device from Rofin Ltd., P.O. Box 38, Mordialloc, Victoria 3195, Australia. This system has a wavelength range of 340 to 530nm using a series of filters, each of which is tunable to approximately 15nm either side of the center wavelength (see table below). A flexible liquid light guide is attached for sample illumination.

Table of Polilight wavelengths :

Polilight Filter	Center Wavelength (nm)
1	White light
2	530 (yellow/green)
3	505 (green)
4	450 (blue)
5	400 (violet)
6	340 (UV)

Polilight observations were made through an orange barrier filter. The light source was tuned to give a maximum sample fluorescence and a minimum background fluorescence. All fluorescence work was carried out in a dark room with the samples placed on a non-fluorescent surface.

For photography we used a tripod mounted Olympus OM4 camera with an automatic exposure setting, and a cable shutter release. Kodak Ektachrome 400asa and 160asa slide film was used, with prints subsequently being made from these. Exposure times with 400asa film were in the 3-5 seconds range. For Polilight applications, photographs were taken through an orange barrier filter. For UV applications, photographs were taken through a Kodak 2C filter to block stray UV light. (*Ed. note*: photographic examples were not included in this issue due to space limitations.)

Reagents found most promising for this study were fluorescin, ANS, and formic acid-hydrogen peroxide. Details of their application follow:

(a) Fluorescin

Fluorescin was obtained from fluorescein by reducing the dye under alkaline conditions. The method is similar to that used in the preparation of Kastle-Meyer reagent :

1g Fluorescein (free acid)
10g Powdered zinc
100ml 10% NaOH solution

The fluorescein was dissolved in the NaOH solution in a 250ml conical flask to give a fluorescent yellow/green solution. The zinc was added and the flask placed on a stirrer hotplate and heated to boiling whilst stirring with a magnetic stirrer. The solution was boiled until the fluorescence disappeared and the colour changed to yellow/orange. The hot solution was transferred to a stoppered flask containing another 5g of zinc, and left to cool before use. If stored under refrigeration the solution will keep for 2-3 days before the fluorescin reoxidizes to such an extent that the background fluorescence becomes too high. It is preferable to make up fresh solution as needed to eliminate the background as much as possible. To make a working solution this stock can be diluted with distilled water. It was found that the extent of dilution had little effect on the results up to 1:50 (stock:water). For these experiments a 1:3 stock:water ratio was used.

The working solution was sprayed lightly onto the bloodstained area, followed by a light spraying of 10% hydrogen peroxide. If the spraying is too heavy on nonporous surfaces it will cause running, which can obscure pattern identification. On porous surfaces this is less important. In most cases we saw almost instant development of a yellow colour on the bloodstain, though this is not possible with highly diluted blood. To visualise the stains using fluorescence, the Polilight was used with the examination area in darkness. Any excitation wavelength from UV to 530nm results in fluorescence, and so excitation can be altered to eliminate any native background fluorescence. The best results were found with illumination around 450nm, this being the wavelength used for most experiments. The area should be viewed through an orange barrier filter. If any photographs are to be taken, the area should be made as dark as

possible to prevent the exposure from being affected by stray light.

(b) ANS/TNS

Both chemicals were made up in an aqueous solution with concentrations of 3.5mM (ANS) and 0.6mM (TNS) as used by Thornton and Heye [7]. This equates to 1.047g of ANS in 100ml water or 0.0199g of TNS in 100ml water. The ANS does not dissolve easily and may need a few drops of ammonium hydroxide to aid dissolution. The solutions were adjusted to pH 9 with NH_4OH, though the pH can be higher without affecting the results. The solutions should be stored in a stoppered container under refrigeration and will keep for several weeks.

For application onto bloodstains, the ANS and TNS were sprayed *lightly* onto the surface being examined. To visualise the resulting fluorescence, the surface was illuminated with UV light at 366nm, though 254nm also gave fluorescence. For safety purposes, UV protective goggles should be worn. For photography, the area should be as dark as possible and a UV barrier filter should be used.

(c) Formic acid / Hydrogen peroxide

The reagents were prepared as dilute methanol solutions, using the method described by Fischer and Miller [10].

Formic acid : 5ml 88% formic acid in 95ml methanol
Hydrogen peroxide : 35ml 3% H_2O_2 in 65ml methanol

Both reagents were kept in stoppered flasks and stored under refrigeration.

The formic acid was sprayed first and the surface was left to dry. The peroxide was then sprayed and the surface was observed whilst still wet. Observation used the Polilight with a wavelength of between 450 and 500nm (blue to blue/green), viewing through an orange barrier filter.

RESULTS

After selected limited experiments with these materials, we felt the fluorescin reaction showed the most promise for sensitivity, specificity, and applicability to various materials (see Table 1). Therefore, a more complete study was carried out with this particular reagent.

Fluorescin, Initial Experiments

Prior to application on stains or any other work, a test tube examination was carried out to determine if a reaction was taking place, and to give an estimate of sensitivity. Dilute blood was placed in a test tube and to it was added a drop of stock solution and a drop of 10% H_2O_2. A blank was also carried out using water in place of blood. Fluorescein was found to give a bright fluoresence with blood diluted 1:10,000. The blank gave a negative result.

A second experiment was then carried out with bloodstains on a plastic substrate. Stains were made in both 1:100 and 1:1,000 blood diluted with distilled water. After the stains had dried, they were sprayed, and then examined using the Polilight.

Result: The stains exhibited a bright yellow fluorescence with a wide range of excitation wavelengths. The stain fluorescence was readily visible with the light source held several meters away, and the fluorescence remained until the stains dried. In addition, the background slowly gained in intensity, though never becoming as bright as the stains.

Sensitivity

Initial experiments showed the reagent to have a maximum sensitivity of over 1:10,000. Next, a set of stains was prepared on paper and on plastic - a porous and a nonporous surface. Diluted blood (from 1:10 to 1:1,000,000) was spotted onto each substrate and allowed to dry. Dried stains were sprayed and examined as described previously. The results are shown in TABLE 2 (overleaf). Fluorescence intensity is on a scale of 1 (barely discernable) to 5 (high).

In both cases, stains produced by blood diluted 10,000 times were readily visible. Below this level, the fluorescence was weak. Sensitivity is further discussed in later sections of this report where an attempt is made to detect bloodstains that have been cleaned up. A sensitivity level of 1:100,000 is comparable to other blood detection reagents [6].

RESULTS (continued)

Table 2– *Sensitivity of Fluorescin*

Dilution	Fluorescence Intensity Paper	Plastic
1:1,000	5	5
1:5,000	5	4
1:10,000	5	3
1:50,000	3	2
1:100,000	1	1
Blank (water)	-	-

Specificity

Since the reaction is peroxidase based, this study was centred on materials which could give a false positive by oxidation of the fluorescin. Also considered were body fluids and some common substances which leave a red/brown stain which could visually resemble a blood stain. The stains were prepared on paper including a control bloodstain (diluted 1:100). Prior to spraying, the stains were examined to check for native fluorescence.

Several 'false' positives resulted from this study (TABLE 3, below). Of these, horseradish, beetroot and grass have some native fluorescence. Blood does not exhibit this property, so any such stains may be excluded by UV light prior to examining with fluorescin. Lettuce, soil and rust also gave a positive test result, but the fluorescence was considerably less bright than that exhibited by the control blood stain. However, this could be mistaken for the fluorescence shown by a highly diluted bloodstain.

Table 3– *Specificity of Fluorescin*

Stain	Native Fluorescence	Test Result
Control Blood	-	+
Saliva	-	-
Semen	+	-
Coffee	-	-
Tea	-	-
Soil	-	+
Chocolate	+	-
Strawberry Jam	+	-
Ketchup	+	-
Cherry Juice	+	-
Horseradish	+	+
Lettuce	-	+
Beetroot	+	+
Grass	+	+
Rust (Fe_2O_3)	-	+

Effect of Substrate

Sets of bloodstains were prepared on various surfaces, using the same set of dilutions as for the sensitivity study. The stains were left to dry before spraying and observing with the Polilight. The results in TABLE 4 show the substrates and the limits of visual detection before and after spraying.

Table 4– *Effect of Substrate on Fluorescin*

Substrate	Visible Before	Visible After
White Paper	1:5,000	1:100,000
Brown Paper	1:1,000	1:5,000
Floor Tile	1:1,000	1:10,000
Ceramic	1:1,000	1:10,000 (1)
Carpet	-	1:5,000
Knife Blade	1:1,000	1:10,000 (1)
Axe Handle	1:100	1:5,000
Axe Head	1:1,000	1:1,000 (1)
Concrete	-	-
Wood	-	1:1,000 (2)
Glass	1:500	1:5,000 (1)
Polycot (White)	1:1,000	1:5,000
Cotton (White)	1:500	1:100,000 (3)

Notes : (1) Poor definition due to running
(2) Indistinct and faint
(3) Only strong up to 1:5,000

The results show that this test can be applied to almost any surface. It works considerably better on porous surfaces since there was less diffusion of the stain caused by the water in the spray. This would be important if the bloodstain pattern was of significance. On many surfaces, blood was visible at a high dilution (1:1,000 or above) without treatment. In cases such as this, the fluorescin could be used for enhancing any patterns, aiding photo- documentation and developing any very dilute stains. The carpet used was a grey/brown/red mix and the blood could not be seen at all before using the fluorescin.

Stains were next applied to various substrates and evaluated with fluorescein in several nonideal situations. These parameters included 1) effects of aging, 2) successive finger and shoemarks, 3) stained and then washed clothing, 4) simulated crime scene surfaces wiped clean with damp cloth, and 5) simulated fire scene materials (some water-soaked). The results of these tests are summarized in Table 5.

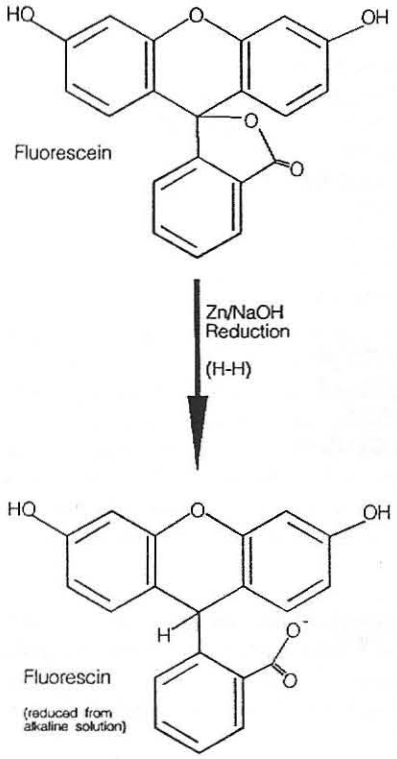
DISCUSSION

Most of the reactions for color screen tests of blood are thought to be catalyzed by the peroxidase-like activity of the heme group. In the process, a colorless reduced form of a reagent becomes oxidized to a colored product. With a fluorescent probe, the resulting complex produces a fluorescence by excitation with a UV or energetic light source. This results in the emission of light as election configurations in various excited states seek pathways to ground state. In the reaction with fluorescin, this may proceed by resonance within a radical anion form as shown in Figure 3 following.

For any catalytic blood detection reagent, there is always some question about risks from exposure, especially for materials applied as a spray. In these situations ingestion is more possible as the reagent is dispersed in a mist. With the fluorescein/fluorescin-based reaction, this concern should be mitigated by the knowledge that this dye is used as an opthalmic trauma indicator. Sterile solutions of 0.25% sodium fluorescein are applied at 1-2 drops per eye for removal of corneal foreign bodies and for short corneal and conjunctinal procedures [11]. The material is also impregnated on individual test strips. Moistened strips are used to touch the conjunctiva or fornix to reveal corneal injury to assist in fitting hard contact lenses. Indeed, the alkalinity of the sodium hydroxide used to keep the fluorescin reagent in solution may be the greater hazard, particularly in spray applications. Experiments with less corrosive bases, sufficient to support the reduction of fluorescein are indicated. However, none were carried out in this work.

Figure 3 — *Possible Reaction Mechanism*

3a) Heme-catalyzed oxidation of fluorescin to fluorescein



3b)

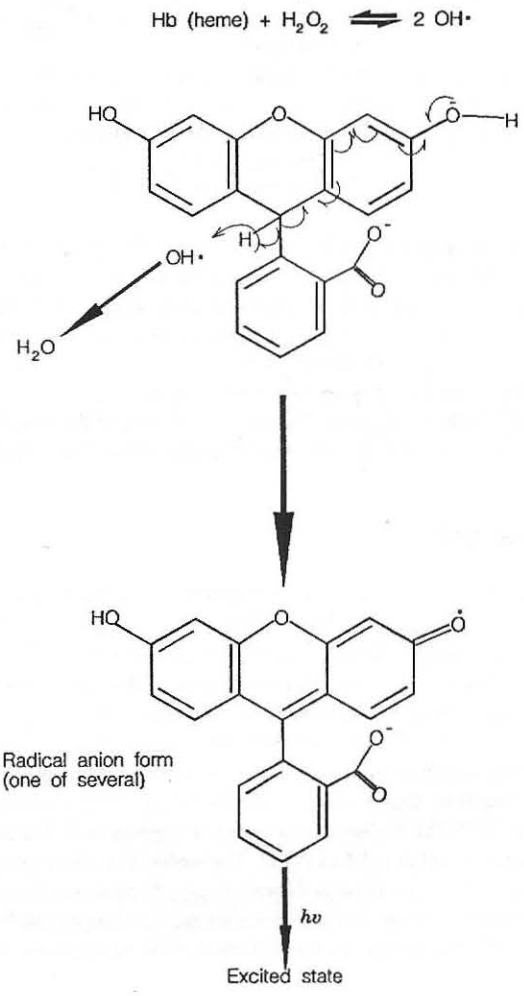


Table 1— *Comparison of Sensitivity for Reagents on Dried Bloodstains*

REAGENT	[$h\nu$ nm]	VISUAL EFFECT	BLOOD DILUTION								
			1/10	1/50	1/100	1/500	1/1000	1/5000	1/10,000	1/50,000	1/100,000
FLUORESCEIN • P (from fluorescin)	[450]	Bright Yellow					5	4	3	2	1
ANS	[254/366]	Yellow	4	5	5	5	4	3	2	2	1
TNS	[254/366]	Yellow	3	5	5	3	2	1			
FORMIC ACID • P	[450-500]	Blue-Blue/Grn	1	3	3	2	2	1			
FLUORESCAMINE	[366]	Very Dim	1	2	2	2	1	1			
DFO • 100°C/10min	[450-530]	Bright Yellow	Latent fingerprints observed; bloodstains did not react.								
DANSYL CHLORIDE	[poli]	Yellow fluores.	Acetone sol'n gives NR. 50:50 acetone:water gives fluorescent sol'n								
o-PHTHALDEHYDE• 100°C/5min (OPA)	[530]	Bright fluores.	Latent fingerprints fluoresce; bloodstains did not react.								
Bromo-Methoxy Coumarin (BMC)	[530]	NR	Acetone sol'n gives NR. After 80°C/10min, still NR.								
ACRIDINE ORANGE	[530]	NR	Aqueous								
FERROZINE, FERRENE S & 1,10-PHENANTHROLINE	[poli]	NR	All in acetone								

Notes:
1. P• Overspray with water.
2. Scale rated from 1 (barely discernable) to 5 (high-intense)
3. All reactions viewed through orange barrier filter with UV or Polilight source.

Table 5— *Fluorescin Enhancement of Nonideal Bloodstains*

AGING TEST (STAINS 1:100-1:100,000 on paper)		RESULTS
One Day	Samples aged in lab	1 day in sunlight - 1:10,000 (faint)
Two	and in car trunk (T•120•°F)	2 days in sunlight - 1: 5,000
Five	were detectable to 1:100,000	5 days in sunlight - 1: 5,000 (very faint)
Seven	dilution up to 7 days.	7 days in sunlight - 1: 1,000 (faint)
BLOOD PRINTS (Neat & 1:20)		
Six Successive Fingermarks	Marks visible on paper or plastic (weak) –little pattern visible	
20 Successive Shoemarks	All 20 on carpet easily detected. Good pattern visible. Used 1:20 blood. Intensity fall-off after 9.	
STAINED CLOTHING (Neat, 1:1,000, Washed)	Heavy marks of neat stains visible on all garments	
1. Black cotton jeans	1. 1:500 stain detectable	Washed blood detectable
2. Brown/White Polycot Shirt	2. 1:1,000 detectable	Fluor. over whole area from washing
3. Mauve Polyester Dress	3. 1:1,000 detectable	"*Washed Out* " detectable
"*CRIME SCENE CLEANUP*" (Neat-wiped clean with a damp cloth)		
1. Glass	1. Overall area Fluoresced - needs light spraying (to prevent running). No pattern visible.	
2. Carpet	2. Excellent Fluor. pattern visible	
3. Ceramic	3. Similar to glass, above	
4. Pocket Knife	4. Large area over blade	
FIRE SCENE (Neat Drops-Held over Fire)		
Glass- △ (sooted/cracked)	-Fluor. clear on sooted & clean area	
Carpet -△/60 sec (fiber melt) & washed	-Fluor. patch on carpet	
Plasterboard-△/60 sec	-Faint Fluor. on stained area when held over fire	

CONCLUSION

We found that fluorescein can be a useful fluorescent probe for detecting bloodstain patterns out to dilutions of 1:100,000 and on some washed-out stains. It offers a balance of sensitivity, workable specificity, and field applicability. Concerns about false positives from chromophores or oxidants in the substrate can be checked by a preview of the area with a UV light and a touch test with paper moistened with phenolphthalin (and no peroxide). This work also suggests fluorescein can locate nonideal stains on some crime scene materials. Disadvantages of the method are 2-3 day shelf-life of the stock solution. Also the present formulation calls for spraying with a caustic solution that requires limited application and aerosol confinement. Our studies with other reagents, such as ANS/TNS, formic acid-H_2O_2, and fluorescamine were not as productive.

ACKNOWLEDGEMENTS

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