California Association of Criminalists

# NEWSLETTER



DECEMBER 1982

CONTENTS



This mailing includes the following items:

1. Abstracts from the Fall Seminar - Joint Meeting with the InterAmerican Congress of Forensic Sciences.
2. Bylaw Revisions.
3. 1982 Salary Survey.
4. Board Meeting Minutes, Sept. 23, 1982.
5. Hair Survey from the Forensic Science Society.

## ASSOCIATION ACTIVITIES

### Northern Section Meeting

The November dinner meeting was hosted by Ed Peterson and the Department of Treasury Bureau of Alcohol, Tobacco, and Firearms. Curtis Bartlett, a Firearms Enforcement Officer from Washington, D.C., gave an excellent talk on the history and design of submachine guns.

### Southern Section Meeting

Carol Rhodes of the Institute of Forensic Sciences hosted the meeting on Thursday, October 21, 1982. She arranged a tour of Royalty Carpet Mills in Irvine followed by dinner at a nearby Mexican restaurant. The 45 people who toured the plant were able to see the manufacturing process from the twisting and heat setting of filament yarns to the tufting, dyeing, and finishing of the carpet.

### Combined North-South Trace Study Group Meeting

Representatives from both groups met October 16-17 at Yosemite. Marty Blake and Ed Rhodes reviewed the prior meetings of their respective groups. Steve Shaffer distributed a list of abstracts on trace evidence examination; the abstract list has since been indexed by Jim White. The revised listing is available from Steve; one per laboratory please. In a second session, the group reviewed papers presented at the INTERMICRO-82 meeting held in Chicago in July; some abstracts from this meeting appear on the page facing in the Newsletter. The final session included the exchange of helpful hints and a discussion of future goals.

### Trace Study Group - North

Peter Barnett hosted a meeting on December 3. Topics included a demonstration of the Versamid embedding and cross-sectioning technique for fibres and a discussion of Barnett's trace evidence "key classification" system. Future meetings are scheduled for January 14 at Forensic Science Associates and February 25 at a yet to be designated place.

### Trace Study Group - South

The group met on November 18 at the Orange County Sheriff's Crime Laboratory. Ed Rhodes led the meeting which included a discussion of the following topics: (1) Review of the Yosemite Trace Study Group Meeting; (2) Follow-up on the analytical results of the paint samples handed out at the August meeting; (3) A discussion of methods used in the examination of building materials; and, (4) A presentation of methods of microchemistry (a la Palenik/Chamot and Mason).

## WANTED: ALIVE!

THE NORTHERN AND SOUTHERN CHAPTERS OF THE TRACE EVIDENCE STUDY GROUP ARE EAGER TO RESURRECT THE HAIR PROFICIENCY EXERCISE DESIGNED AND IMPLEMENTED BY ED BLAKE A FEW YEARS AGO. WE ARE HAVING DIFFICULY LOCATING THE SETS OF MOUNTED HAIR SLIDES WHICH WERE CIRCULATED, AND ARE HEREBY PLEADING THAT EACH LAB BE SEARCHED FOR SAME. IF A SET IS LOCATED PLEASE FORWARD IT TO MARTY BLAKE, OAKLAND POLICE DEPARTMENT, ROOM 608, OAKLAND, CA. 94607 (SEND IT ANNONYMOUSLY IF YOU LIKE, NO QUESTIONS WILL BE ASKED, BUT PLEASE SEND IT). IF ENOUGH OF THE SETS ARE RECOVERED A DUPLICATION OF MUCH EFFORT MAY BE PREVENTED. THANK YOU!

"Forensic Seed Identification and Comparison"

Norman Newlon
Wyoming Crime Laboratory
Cheyenne, Wyoming

Plant seeds (and fruits) encountered in soil fractions, clothing, and other items of forensic evidence often exhibit microscopical characteristics that allow them to be identified by family, sometimes by genus, and rarely by species and variety. These characteristics may be useful on a comparative basis and may be important in establishing geographical connections between items of forensic evidence. Microscopic features of taxonomic significance are illustrated and the practical forensic utility of seed (and fruit) identification and comparison is illustrated using actual cases.

"Darkfield Identification of Iron-Bearing Minerals in Soils"

John E. Thresher, Jr.
Thresher & Son, Inc.
Madison, Wisconsin

The color of most soils is related to the type and amount of iron-bearing minerals, especially the oxides and hydroxides, within them. These minerals are usually very fine and poorly crystalline, thus making them difficult to identify by traditional petrographic methods. The method presented utilizes standard petrographic thin sections illuminated with a dry darkfield condenser. It allows for rapid identification of these minerals in addition to the recovery of morphological and textural data.

"Characterization and Identification of Water Soluble Explosives by Light Microscopy and Microchemical Tests"

Thomas Hopen and John Kilbourn
Alabama Dept. of Forensic Sciences
Montgomery, Alabama

Water soluble inorganic explosive compounds are quickly identified by their crystal properties as they recrystallize from a drop of water on a microscope slide. If desirable, the identification can be confirmed by measuring refractive indices, birefringence, or by microchemical tests. The procedures have been applied to several cases involving explosions and explosives.

"Characterization of Cotton Dusts by Light Microscopy"

D.P. Thibodeaux and J.P. Evans
Southern Regional Research Center
New Orleans, Louisiana

Samples of cottons grown in a wide variety of locations throughout the United States have been tested to characterize their non-lint dust content. Dust extracted by ultrasonic washing of fiber tufts has been examined using both normal and polarized light microscopy. The nature and quantity of the dust is dependent on growing location. It consists of a wide variety of plant and fiber fragments as well as fungi, spores, pollens, and other small particles.

"Identification on Micro Samples of Blood by Fluorescence Microscopy Coupled with the Micro-spectrofluorometer"

Thomas A. Kubic
Nassau County Police Dept.
Mineola, New York

Ira S. DuBey
Suffolk County Medical Exam. Crime Lab
Happaugue, New York

Identification of a stain as blood can sometimes be critical to a criminal prosecution. The use of a fluorescence microscope coupled with a microspectrofluorometer is shown to be a useful technique for the identification of blood where some of the well known catalytic techniques were inadequate. This method relies on the fluorescent characteristics of hematoporph[illegible]nd the data generated with the microspectrofluorometer will [illegible]ented.

"Forensic Characterization of Human Hair"

Mary Ann Strauss
Minnesota Bureau of Criminal Investigation
St. Paul, Minnesota

Published studies addressed to an attempt at determining probabilities in human scalp and pubic hair comparisons emerged on the scientific community in 1974 and 1976.

Its impact on the Court system was first realized in the U.S. in 1976 when Barry Gaudette was asked to testify in a first degree homicide case in a Minnesota State District Court.

This prompted the need for additional work on the characterization of hair utilizing the comparison microscope. This research project was designed to reflect forensic related cases. A brief explanation of the research approach, the conclusions of the study, and a discussion of the pro's and con's for the use of "probabilities" in science - law matters will be summarized.

"A Protocol for the Examination of Hair Evidence"

Stephen A. Shaffer
Fresno County Law Enforcement
Fresno, California

A protocol is described for the examination, characterization, and comparison of human hair evidence. The examination is divided into two phases. The first phase involves a complete description of the ranges of each characteristic exhibited by the evidence and exemplar samples, and a comparison of these ranges. If exclusion of a common source for the samples is not indicated, the second phase of the comparison is undertaken. Here individual hairs are directly compared in an attempt to locate positions on evidence and exemplar hairs showing nominal identity of all characteristics. The significance and importance of the two-phase approach is discussed. The protocol is designed to encourage the examiner to recognize the two distinct phases of hair comparison and to take a critical, objective, and thorough approach to the examination.

"Forensic Analysis of "Colorless" White Textile Fibers by Microspectrofluorometry"

Thomas A. Kubic
Nassau County Police Dept.
Mineola, New York

John E. King
Nassau County Police Dept.
Mineola, New York

Ira S. DuBey
Suffolk County Medical
Examiners Crime Lab

The Role of the criminalist in forensic comparison microscopy is directed not only to identification but also the subdivision of class evidence into smaller and smaller groups with the goal of achieving uniqueness.

The microscopical comparison of "colorless" white fibers present greater problems than dyed or pigmented materials.

Use of the reflected light fluorescence microscope particularly in conjunction with a microspectrofluorometer aids in further characterization of white fibers. Data obtained for a number of polyester fibers will be presented.

"Some Aspects of Forensic Fiber Microscopy"

Skip Palenik
Walter C. McCrone Associates Inc.
Chicago, Illinois

The identification of the manufacturer of a single fiber fragment can be of great value to forensic scientists and criminal lawyers as recent highly publicized court cases have shown. While identification to the genus level is a relatively trivial matter in most cases, attributing a single fiber to a specific producer can involve considerable time. The microscopical, microchemical and spectroscopic techniques employed, along with the rationale for their use are described. The use of reference material, including physical specimens and data collections, are discussed and their importance emphasized.

## UPCOMING MEETINGS

California Association of Criminalists Spring 1983

May 12-14, 1983. San Francisco, California. It will be at the Union Square Holiday Inn. Contact Debbie Wakida, San Francisco Police Department Laboratory, 850 Bryant St., San Francisco, CA 94103, (415) 553-1161.

Northwest Association of Forensic Scientists

May 4-6, 1983. Missoula, Montana. Contact Arnold Melnikoff, Office of Attorney General, Criminal Investigation Laboratory, 275 West Front St., Missoula, MT 59801.

Asian Pacific Congress on Legal Medicine and Forensic Sciences

September 18-22, 1983. Singapore. Contact Dr. Wee Keng Poh, Medico-Legal Society, 4-A College Rd., Singapore 0316.

International Association of Forensic Sciences

Summer 1984. Oxford, England. Contact IAFS, c/o Forensic Science Society, P.O. Box 41, Clarke House, Harrogate, North Yorkshire, GH1 1BX, England.

## NATIONAL AUDIOVISUAL CENTER PROGRAMS ON FORENSIC MEDICINE

**The National AudioVisual Center has recently offered 32 video programs designed to enhance the skills of medical examiners, coroners, district attorneys, and other medical detectives. The programs are available as 16 mm movies and as videocassettes. The following titles are available:**

**An Introduction to Forensic Pathology**
**Changes After Death**
**Forensic Autopsy**
**Forensic Identification**
**Asphyxia**
**Mislabeled and Unlabeled Deaths**
**Narcotism**
**Sudden Unexpected Natural Death**
**Trauma**
**Infants and Children**
**Traumatic Injuries**
**Medical Indicators of Child Abuse and Neglect**
**Physical Indicators of Abuse -- Signs of Alert**
**Sexual Abuse -- The Family**
**Investigating Cases of Child Abuse and Neglect**
**Presenting the Case**
**The Medical Witness**
**Operating Room Deaths**
**The Battered Child**

**Information may be obtained from:**

**National AudioVisual Center**
**National Archives and Records Service**
**General Services Administration**
**Order Section CM**
**Washington, D.C. 20409**

# ETHICAL DILEMMA

Peter Barnett
Forensic Science Associates

In the past several columns I have dealt with situations involving the actions of Criminalists when faced with more or less technical issues. This month I would like to diverge from that topic and address the issue that has been referred to as the "theater of the courtroom." When testifying in court, the Criminalist is faced with a difficult task: The technical evidence and issues must be explained fully and carefully so that a relatively naive jury can understand the nature and implications of the evidence; the questions which are posed by Counsel must be clear, and their implications understood by the witness, so as to avoid misleading the jury; and the Criminalist must allow Counsel an opportunity to thoroughly explore not only the opinion of the witness but the justification that the witness has for the opinion that is expressed and the qualifications of the witness to express that opinion. The witness must also allow counsel an opportunity to explore any possible bias that the witness may have. All of these are legitimate functions of the advocacy system.

In addition to legitimate types of questions which are allowed, and even encouraged, to fully explore the witness' opinion, lawyers are often allowed to ask questions which, while serving no legitimate purpose in furthering understanding of the issues in the trial, must nevertheless be answered by the witness. The traditional advice given to expert witnesses in books on the subject of giving testimony is that the purpose of these questions is to try to provoke the witness so that in some fashion his credibility on the witness stand will be lessened in the eyes of the jury.

Clearly, it is the responsibility of any person who agrees to be an expert witness (and there is not, except in the most unusual of circumstances, any way to force a person to be an expert witness) to answer all of the questions that are asked. This is the nature of the Oath that is taken before the testimony is given. In addition, the CAC Code of Ethics places a somewhat greater burden on the witness: In essence, the CAC Code of Ethics requires that the witness not only answer the questions asked, but assist counsel by not engaging in tactics which interfere with his right to ask any questions which are permitted under the rules of evidence. To do otherwise would clearly be to "assist...(counsel) through such tactics as will implant a false impression in the minds of the jury."

One of the favorite lunchroom and cocktail party pastimes of Criminalists is to relate "war stories" which describe the clever and subtle ways which they have in the past used to deal with attorneys who have asked embarrassing, insulting, difficult, sarcastic, or personal questions of the type that we have all come to know and love. It is a perfectly acceptable part of the "theater of the courtroom" to devise mechanisms to deal with these types of questions while recognizing that it is the right, indeed perhaps the obligation,

of the attorney to ask the questions - just as it is the obligation of the witness to answer them. This month's Ethical Dilemma deals with what may be an effort by an expert witness to prevent the attorney from asking some of the more difficult questions.

In a recent case in which the defense attorney was prepared to undertake a thorough cross examination of the Criminalist, the Criminalist employed a tactic which, while perhaps not intended to accomplish what it did, was nevertheless effective in intimidating the attorney. The witness came into court when his name was called, in full view of the Jury, leading by the hand his 4 year old daughter who was dressed in her best Sunday school clothes. He sat his daughter down in the front row of the courtroom gallery where she primly sat with her gaze affectionately fastened on her father as he was sworn in and took the witness stand.

The presence of the cherubic little girl certainly had an intimidating effect on the defense attorney: How could he engage in vigorous cross examination of the witness, the purpose of which is, at least in part, to attack the credibility of the witness, with this darling little girl sitting in the front row. Surely, the jurors would not take kindly to an attorney who would commence such an assault on someone in front of his adoring child. If he were to engage in such vigorous cross examination the jury would feel such an outpouring of sympathy for the witness and antipathy for the lawyer that the effect would be just the opposite of what the lawyer intended.

If this was the intention of the witness, is there a violation of the CAC Code of Ethics? Is this not an action which could create a false impression in the minds of the jury by preventing a thorough and complete cross examination of the witness? Would it be unethical to bring a dog trained to respond to certain types of questions either by growling menacingly at the lawyer or by whimpering and looking with sorrowful brown eyes at his master? What about those of us whose children are older so we have no one to take to court with us? Please answer these questions, and include any comments, on the reply sheet.

The replies to the last Ethical Dilemma were very few. Apparently, readers did not perceive this problem (of a defense investigator discovering physical evidence which is not turned over to the investigating agency) as an ethical one. This is interesting in light of the fact that attorneys frequently feel that the questions of what they have to provide to opposing counsel is a very difficult one. In the particular case that was discussed in the last issue the District Attorney's office seriously considered bringing charges of some type (presumably contempt of court or obstruction of justice) against the defense criminalist, and the defense attorney was cited to the State Bar for a disciplinary investigation. Criminalists apparently feel that the decision of what to do in this type of situation is best left to the attorney but the attorney is seldom faced with this type of problem and often is an unsure of the proper course of action as the criminalist.

## RESPONSES TO THE DECEMBER ETHICAL DILEMMA

The criminalist violated Section _____ of the CAC Code of Ethics.

There was no violation of the CAC Code of Ethics.

I have a small child who I would be willing to loan out for these purposes.

Comments:

Return To: Peter D. Barnett
Forensic Science Associates
P. O. Box 8313
Emeryville, Calif. 94608

# HYBRID TRAJECTORIES OF BLOOD DROPLETS DISPERSED BY WINDOW SCREEN

*David Kahane, M.P.H., and John Thornton, D. Crim.*
*Forensic Science Program*
*Department of Biomedical & Environmental Health Sciences*
*University of California*
*Berkeley, Ca., 94720*

A variety of conditions exist by which shed blood comes to rest on surfaces. A homicide involving death by stabbing was submitted to the authors' laboratory. In this case the trajectory of the blood was intercepted by a screen door. A quantity of blood barely perceptible to the unaided eye remained on the screen mesh, with the remainder assuming a series of dispersed, hybrid trajectories prior to being deposited on another vertical surface. This case raised rather unique issues relative the the interpretation of the blood spatter pattern.

Tests were conducted to determine the nature of the patterns encountered with blood and screen under a variety of conditions. The test parameters were:

1) Distance of origin (Pasteur pipette as dropper) to screen,
2) Distance of screen to final surface (craft paper),
3) Angle of screen to falling drop (varied from 0-60°), and
4) Amount of blood (1 or 2 drops).

The results of these experiments will be sketched out here rather than described in detail, since in an actual case situation test patterns would necessarily be determined empirically after attempting to duplicate the circumstances of the case, *e.g.*, the precise texture of the final surface.

A single drop of blood (which, depending on the distance and surface texture would ordinarily result in a single spot 15-19 mm in diameter) was observed to be dispersed into 20-25 separate droplets, arranged in an orderly cluster of 6 groups of 2 to 4 droplets when the screen was held parallel to the target (Figure 1). The diffraction or spacing between clusters increased with increasing origin-to-screen distance, and also with increasing screen-to-target distance. In the former, greater diffraction is presumably a function of the higher kinetic energy of the drop on impact, while in the latter case the standoff of the screen permits a greater dispersion by exploiting the angularity of the hybrid trajectories. The diffraction-like pattern deviated to an elongate pattern as the angle of the screen increased from 0° to 60° (Figure 2).

Interpretation of the geometry of bloodstain distribution (MacDonell, 1971) has indicated that the nature of the target surface plays a central role in the observed pattern, and must be taken into consideration in any attempt at reconstruction. Porous *or irregular* surfaces yield higher degrees of ultimate observed spatter than nonporous or smooth surfaces due to the increased propensity for rupture of the drop as well as the subsequent capillary action of resultant droplets.

If the screen is perceived as a target surface in and of itself it is reasonable to characterize the material, *i.e.*, screen, as the ultimate, most extreme porous surface that blood might encounter. Moreover, varying the angle of the screen may be viewed as analogous to the progressing from a regular (0°) to an irregular (60°) surface, since the drop of blood will transect an increasing number of planes as the angle of impact increases.

The patterns observed support the concept of the screen as a defined surface; the conventional considerations of bloodstain distribution analysis as described by MacDonell may therefore be employed in situations of this type.

References

Herbert L. MacDonell, *Flight Characteristics and Stain Patterns of Human Blood*, U.S. Government Printing Office, Washington, D.C., 1971.


Figure 1. Screen held parallel to target plane. One drop of blood.

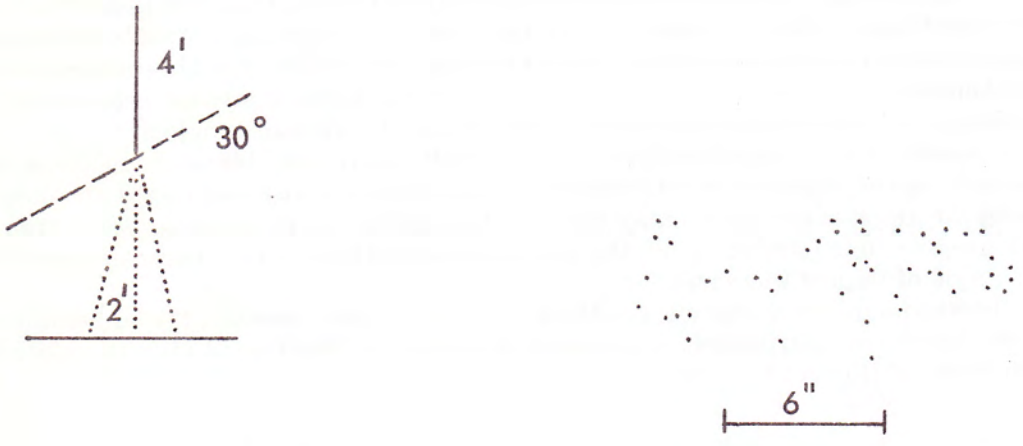



Figure 2. Screen at 30° to target plane. One drop of blood.

# THE DISTRIBUTION OF BLOOD ALCOHOL PERCENTAGE IN DWI ARRESTEES AND THE INTERCOMPARISON OF RESULTS FROM THREE CONTEMPORARY BREATH TEST INSTRUMENTS

L. Haag and R. Watkins
Phoenix, AZ

(Presented at the Fall 1981 CAC-Northwest Meeting, Lake Tahoe, Nov. 4-6, 1981)

## Introduction

In 1934 Heise writing in JAMA[1] reported the following average blood alcohol levels from a total of 216 persons injured or killed in auto accidents:

| | |
|---|---|
| single vehicle accident | 0.15% |
| single vehicle fatal | 0.24% |
| multiple vehicle collision | 0.21% |
| striking pedestrian | 0.14% |

Later in 1938 Holcomb[2] also writing in the Journal of the American Medical Association reported that 2% of the general driving public had a blood alcohol level equal to or greater than 0.10%. His conclusion was reached on the basis of tests on 270 individuals arrested for DWI and the results from 1750 randomly selected drivers in the same area.

The average blood alcohol concentration for 3300 alcohol-positive European drivers involved in accidents was 0.18% according to the report of Froentjes and Verburgt[3] in 1957.

In 1965 Birrell[4] in Australia found that blood alcohol concentrations usually do not exceed 0.08% in ordinary social drinking but the mean %BAC for DWI arrestees was 0.22% for 1715 subjects tested.

In 1972 Kempe[5] found that the average BAC of approximately 4000 DWI arrestees tested on the Breathalyzer in Tucson, Arizona during the years 1967-1971 was 0.20%. In 1969 Arizona adopted an implied consent statute which retained the previous 0.15% presumptive level then near the end of the Kempe's study the presumptive level was lowered to 0.10%. Kempe reported that the number of tests increased considerably after these events but he detected no change in the mean BACs for arrested drivers.

Nearly 10 years have elapsed since the completion of this last study during which time stronger enforcement measures (such as ASAP projects) have been instituted in many areas and "new-

generation" instruments have been introduced to replace the manually operated M900/M900A Breathalyzer. Both the intensified efforts to apprehend DWI drivers and the improved design features of the automated instruments stand to affect the statistical distribution of test results in persons suspected of driving while under the influence of alcohol.

The increased use of drugs as well as possible changes in the public's attitude about drinking and driving may also be an interelated factor in determining the average blood alcohol concentration in DWI arrestees.

As a result of these and other considerations and the availability of a substantially larger number of test results from three different types of instruments used in the same or similar areas, a compilation and comparison of data was under taken for the years 1977-1981.

## Study Considerations and Method

The numerical test results for subjects arrested for driving under the influence of intoxicating liquor were excerpted from the log books of the various instruments for periods ranging from 1 to 5 years and were tabulated on a form prepared for statistical summarization. The following computations were made for each group of data:

The total number of tests.
The percent of alcohol-positive results (.01% or greater).
The percent of subjects at and above 0.08% BAC.
The percent of subjects at and above 0.10% BAC.
The average test result (%BAC) for all alcohol-positive subjects.
The standard deviation of the average %BAC.

The frequency of occurrence for each 2-digit blood alcohol percentage point was converted to a relative frequency value so that the various sizes of data banks could be plotted on a common graph.

Sources of data were selected on several basis:

(1) two types of instruments in concurrent use in the same locale,
(2) the same instrument used in areas of differing demographic nature,
(3) results from the same jurisdiction collected several years apart and
(4) results for accident-involved subjects.

## Results

Breathalyzer results from various small towns and rural areas of Arizona collected over a 5 year period from 1976 to 1981 invariably yielded average BACs of .16% to .17%. Comparable results were

obtained from various areas of Phoenix Arizona when the test results for a single year (1977) were tabulated. Similar distributions were also found when all of the statewide results were graphed and compared to a similar number (ca. 7000 each) of Phoenix results. These results which are summarized in Table I were obtained from Model 900 and 900A Breathalyzers which had been personally checked for proper function and calibration by the authors.

Table I

BREATHALYZER RESULTS

| Year | Source | Total # of Results | % Alcohol-Positive | % at .08 and above | % at .10 and above | Ave.% BAC | S.D. |
|---|---|---|---|---|---|---|---|
| 1976-1981 | State-wide | 7592 | 98.9 | 94.6 | 91.1 | .167% | .058% |
| 1977 | Phoenix AZ | 6510 | 98.6 | 94.5 | 91.0 | .171% | .058% |

In 1978 the Mark IV Gas Chromatograph Intoximeter replaced the Breathalyzer in the City of Phoenix. Citywide results for the first full year of the new program and for the year 1980 show no significant change to have occurred either as the result of the change in the instrumental system or as a result of the passage of time.

Table II

Mk. IV G.C.I. RESULTS
Phoenix, AZ

| Year | Total # of Results | % Alcohol-Positive | % at .08 and above | % at .10 and above | Ave.% BAC | S.D. |
|---|---|---|---|---|---|---|
| 1978 | 6899 | 97.7 | 94.5 | 90.3 | .174% | .061% |
| 1980 | 8901 | 98.0 | 95.2 | 91.3 | .174% | .059% |

Intoxilyzer results from model 4011A and 4011AS (all with slope detection electronic processors) from metropolitan areas such as Scottsdale, suburban and rural areas adjacent to Phoenix and several distant county locations were collected over the period from 1979 to fall 1981. Each source gave comparable mean BACs as reported above. Table III on the next page summarizes the Intoxilyzer results for 3368 test results.

INTOXILYZER RESULTS

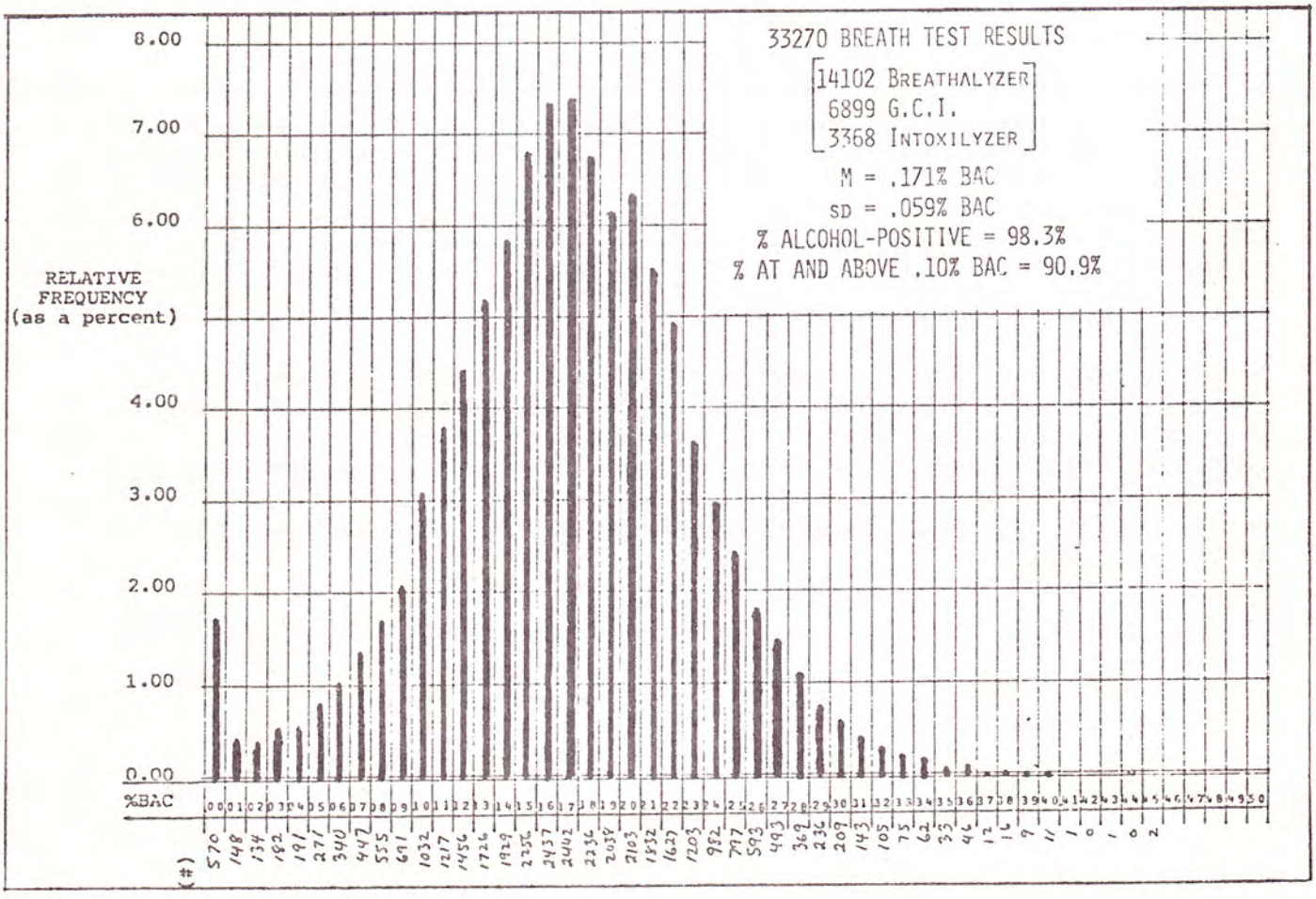
| Year | Total # of Results | % Alcohol-Positive | % at .08 and above | % at .10 and above | Ave. % BAC | S.D. |
|---|---|---|---|---|---|---|
| 1979-1981 | 3368 | 98.3 | 95.1 | 91.2 | .172% | .059% |

The graph below reflects the frequency distribution for the combined results of 33270 breath tests over the range of 0.00% to 0.50%BAC at 0.01% intervals. The handwritten numbers below the BAC percentages represent the actual number of entries for that particular interval.

There are a number of interesting observations to be made from this distribution. Like Kempe's graph of approximately 4000 Tucson Arizona results nearly 10 years earlier, the distribution is bimodal with peaks at .17% and .20%BAC suggesting two populations of DWI drivers.

A rapid rise in the number of subjects arrested for DWI begins at about 0.06%BAC and is clearly evident by 0.08%BAC which would support the findings of Professor Borkenstein[6] in his comprehensive 1964 study in which he found 0.08%BAC to be a clear threshold level for alcohol impairment of driving skills.

Graph I



## Summary/Discussion

If one takes Professor Borkenstein's view and the subsequent 1972 recommendation of the NSC's Committee of Alcohol and Drugs that 0.08%BAC be set as the threshold level for alcohol impairment of driving skills, then officers are correct about 95% of the time assuming that the test result is representative of the subject's BAC at the time of the driving. If the usual statutory limit of 0.10%BAC is used then these results would indicate that officers are "correct" 91% of the time.

The intercomparison of results between different instruments in the same area and the same type of instrument in different demographic areas of Arizona showed no substantial difference in the average BAC or the distribution of results with the exception of the degree of involvement of women in DWI arrests. While their average BAC was also nominally .17%, a higher percentage of women were arrested for DWI in areas of higher socio-economic status than in lower class areas of the city (ca. 13% vs. 8% respectively according to instrument logbook entries from various areas of Phoenix).

Results for a 10 year period in the City of Phoenix indicate that approximately 10% of arrested individuals refuse to submit to a blood or breath test. [Note: In Arizona the law enforcement agency chooses the test the arrestee will be given and breath is the most frequent choice for ambulatory subjects.]

No distinction could be found between results from any of the three types of breath testing instruments (Breathalyzer, Intoxilyzer and GCI) and their .17% average BAC compares favorably with the .18% average BAC for several year's blood alcohol sample results for DWI suspects tested by the State Crime Laboratory[7].

## Future Studies/Considerations

The recent passage of Per Se laws in California and Arizona together with the creation of special DWI teams and the improved FSTs being developed and employed stand to have an impact on the distribution of DWI test results. One would expect for example that the average BAC for subjects apprehended by specially trained DWI teams would be lower than the .17% found in this study if their ability to recognize the impaired driver (rather than the obviously intoxicated driver) is superior to the average officer on the road.

In Arizona defendants have the option of having their own breath-alcohol sample retained for their own independent analysis after November of 1979. During the first 6 months after this decision approximately 15% of arrested subjects in Phoenix chose to have such samples collected. How the results of these retained samples compare with the officer's test result and the nature of the BAC distribution for individuals having such samples analyzed will be addressed in a future report by Haag.

References

1. JAMA 103:739 (1934)

2. JAMA 111:1076 (1938)

3. Froentjes, W. and J.W. Verburgt, Tijdschrift voor Strafecht 71:225 (1962)

4. Birrell, J.H.W., "Blood Alcohol Levels in Drunk Drivers, Drunk and Disorderly Subjects and Moderate Social Drinkers," Medical Jour. of Australia 2:949 (1965)

5. Kempe, C.R., "Blood Alcohol Concentrations in Drinking Drivers in Tucson, Arizona, 1967-1971" Jour. For. Sci. 17:4 (Oct. 1972)

6. Borkenstein, R.F. et.al., The Role of the Drinking Driver in Traffic Accidents, Indiana University Press (1964)

7. personal communication with E. Adler- Az. DPS Crime Laboratory

# UPDATE ON FOREIGN AND DOMESTIC AUTOMOBILE PAINT

Marty Blake, Oakland Police Department

(Presented at CAC/Interamerican Congress Sacramento, Nov. 4, 1982)

The purpose of this paper is to summarize certain trends that have been occurring in the automobile paint industry over the last several years due to environmental legislation and economic considerations. I have not conducted exhaustive research to determine the types of paint used on all automobiles, foreign and domestic, which would be a rather awesome task considering the complexity of the paint industry. Rather, I have focussed upon emerging patterns in the manufacture and application of primers and topcoats used on foreign and domestic automobiles.

Since 1966, when Los Angeles County passed Rule 66, the domestic industrial coatings market has experienced a dramatic shift in product emphasis. Rule 66, which is now Rule 442, restricts usage of aromatic volatile solvents in paints to 20%. A variety of local and state air-pollution regulations have been passed especially after the Federal Clean Air Act of 1967, and because the automobile industry is the largest single outlet for industrial coatings these regulations most affect coatings applied to automobiles. The coatings forensic scientists are most concerned with are the primer coats and the topcoats used to finish exterior steel, chrome, aluminum, rubber and plastic.

The history of automobile finishes used worldwide reflects the paint industries continued research aimed at providing the automobile industry with cost-efficient coatings of integrity with reduced industrial exposure of the volatile portions of the paint. It is no small task to formulate a combination of resins, pigments, and other components which will result in a paint film that is resistant to water, salt, acids and bases, solvents, (e.g. gasoline); resistant to stress and impact, and is color fast.

In America, unlike other industrial coating markets there are relatively few, (approximately ten) paint manufacturers that supply automakers with primers and topcoats. The vast majority of paint used is supplied by five of these, namely, Dupont, PPG, Inmont, Celanese, and Cook. This situation is similar in foreign automobile production.

The history of automobile paint systems in America and abroad is really three separate but associated histories -- the primer history, the development of topcoat resins and the development of pigments used in primers and topcoats. There are of course a variety of other additives in automobile paint but this discussion will be restricted to these three components.

The following comments are restricted to domestic paints; Table 1 lists a brief history of these components. The first component to be considered is the primer used to prepare surfaces for topcoats.

## PRIMERS

The most important advancement in primer painting is the nearly complete switch from anodic to cathodic electrodeposition. This has occurred from about 1977 to present. In cathodic electrodeposition the material to be primed acts as the cathode and attracts the paint by reversal of the electrical circuit. In the U.S. sixty-three of the sixty-four electrodeposition tanks in operation are cathodic.

TABLE 1

SUMMARY OF AUTOMOBILE PAINT HISTORY * (DATES ARE APPROXIMATE)

I. PRIMERS

| | |
|---|---|
| 1963: | Anodic electrodeposition first used on automobiles (Ford) |
| 1972: | Water-thinned spray primers based on anionic type alkyd or epoxy ester vehicles |
| 1978: | Most electrodeposition tanks worldwide switched from anodic to cathodic operation |

II. TOPCOAT RESIN SYSTEMS

| | |
|---|---|
| 1922: | Nitrocellulose lacquers introduced |
| 1930: | Alkyd resins (baking enamels cross-linked with urea formaldehyde) |
| 1946: | Melamine-formaldehyde resins |
| 1956: | Nondrying-oil alkyd high-melamine formaldehyde resin baking enamel |
| 1957: | Acrylic lacquers (thermoplastic acrylics) |
| 1962: | Acrylic enamels (thermosetting acrylic baking enamels) |
| 1967-1968: | Nonaqueous dispersion (NAD) lacquers and enamels |
| 1974: | Water-thinned thermosetting acrylic enamels used (CA) |
| 1977: | Clear coat on base coat began in U.S. |

III. PIGMENTS

| | |
|---|---|
| 1925: | Anatase Titanium Dioxide (high-hiding white pigment) |
| 1933: | Quinacridone (reds) |
| 1935: | Phthalocyanine blue; rise in metallics (aluminum flake) |
| 1938: | Phthalocyanine green and rutile Titanium Dioxide (better hiding and chalk resistance than antase type) |
| 1954: | Organic yellow, orange, red, maroon and violet pigments of improved lightfast, nonbleed qualities |
| 1973-present: | Ceramic pigments (combination of metallic and nonmetallic pigments, experimental). |

* Williams, Ralph A. Automotive Finishes. Federation Series on Coatings Technology, Unit 25, 1977, and other sources.

The advantages of this type of electrodeposition include increased corrosion resistance, more penetration and more control over the thickness of the layer deposited. Indeed this method has the potential of eliminating the second primer layer. This will have a profound effect on attempts to identify make and model based upon primer/topcoat sequences. Many of the resin systems previously used in the anodic process are also applied to the cathodic process. The cathodic process requires acid soluble polymers and conditions which favor crosslinking to produce a highly basic film. As in the anodic procedure, the most common resins are epoxides where water dispersability is typically introduced with amine salts or quartenary ammonium salts. The epoxy resins produced will provide coatings of outstanding corrosion resistance. Other possible cationic polymers are epoxies crosslinked with blocked isocyanates which unblock at baking temperature. The pigments used in cathodic electrodeposition tanks are subject to, by and large, the same considerations and constraints of anodic systems and common pigments still include carbon black, $TIO_2$ and iron oxide; barytes and clays are used as inert fillers.

TOPCOATS

The single most important trend in topcoat formulation is to higher-solids nonaqueous dispersion formulas (NAD), whether lacquers or enamels. The lacquers are primarily composed of long straight chains of methacrylate, while the acrylic enamels are typically crosslinked with butylated melamine formaldehyde or in the case of the water-borne enamels, crosslinked with hexamethoxy methyl melamine. There has been a steady decline in the use of solution lacquers and enamels as opposed to the NAD lacquers and enamels where the resin is suspended as fine particles since the latter allows higher solids application so that fewer coats need be applied. The second important trend is increased frequency of the clear coat applied over the base coat which is much more of a domestic trend than foreign one since clear coats have been used for some time abroad.

With regard to domestic topcoats, Table 2 outlines the current types of paint being used on domestic automobiles -- some notable points are General Motor's exceptions to the lacquers used on most vehicles and the fact that the use of waterborne enamels has not spread as expected. This is due in part to the high cost of installation of a facility to use waterborne paints and also to the cost of maintenance and difficulty of spot repair. It would appear therefore that the paint industry is attempting to meet emission requirements via the high solids avenue instead of the costlier conversion avenue. With the polymer systems currently in use however there is a limit to the percent of solids possible before a decline in performance characteristics, especially film durability results. Another expected trend which has not been realized in the automobile paint industry is the use of powder coatings, where the resin, without solvent, is sprayed as an aerosol onto a hot metal surface and melts into a film. There are technical difficulties in formulating and applying powder paints and the equipment costs are considerable so these paints may not be used for some time in the automobile industry.

CLEARCOAT TREND: Originally the clearcoat (typically a urethane) was formulated to protect the topcoat. In the U.S. the clearcoat has evolved as an effort to copy the European look so popular here. The use of the clearcoat over the basecoat also permits thinner basecoats to be applied but this coat is difficult to spot repair due to color and gloss matching problems. Despite this difficulty a Dupont representative estimates that by the 1990's most American automobiles will have clearcoats.

TABLE 2

DOMESTIC AUTOMOBILE TOPCOAT RESIN SYSTEMS (DATES ARE APPROXIMATE)

GENERAL MOTORS

1965-1968: Switched from alkyd resins to thermoplastic acrylic lacquers (TPA). Majority of paint supplied by DuPont.

1975: Majority plants use nonaqueous dispersion (NAD) lacquer except three plants (Southgate, CA., Van Nuys, CA. and Oklahoma City, OK.) use water-borne enamel (hexamethoxy methyl melamine); some plants use solution lacquers.

Exceptions: Corvette (fiber-reinforced plastic body) painted with enamel, then enamel clear-coat applied.

Norwood, Ohio plant uses high solids enamel on Firebirds and Camaros.

Trends: possible conversion to acrylic enamel systems in years to come

increased use of higher solids NAD and clear coats

probably no more conversion to water-borne systems due to installation costs, maintenance expense and difficulty of spot repair

FORD

1964: Switched from alkyd resins to acrylic enamels (solution and NAD)

Majority of paint supplied by Paint and Vinyl Operations of Ford Motor Co.; remainder supplied by Cook, Celanese, PPG, Alma, Mobil and DuPont (very small amount).

Trends: increased use of higher solids NAD and clear coats

CHRYSLER

1964: Switched from alkyd resins to acrylic enamels (solution and NAD).

Produces some of the paint it uses; remainder supplied by PPG, Cook and others

AMERICAN MOTORS

1965: Switched from alkyd resins to acrylic enamels (solution and NAD)

Cook is main paint supplier; Celanese, PPG and Ford (small amount) also supply.

In addition to topcoats applied to the metal portions of the automobile frame there are special "elastomeric" paints applied to the rubber bumper guards. These are following the base/clear trend where the base is formulated to allow more stretch of the film and the clearcoat is urethane.

PIGMENTS: Probably the most challenging task in topcoat formulations is control of pigmentation. Indeed, paint manufacturers are usually awarded contracts with the automakers based upon the ability to match the buyers needs since field failure would present drastic warranty problems. There are three types of automobile pigment systems although only two of these types are currently being used in topcoat formulas. The majority of topcoats, probably about 80%,are metallic, where aluminum flakes are included with organic and inorganic pigments. The amount of aluminum in the film depends upon the other pigments present and the size of the aluminum flakes may also vary. Nonmetallic paints contain $TIO_2$ alone or in combination with other inorganic or organic pigments. Some colors require thicker layers to provide hiding. The third type of pigment system is still in the experimental stage and is called ceramic pigmentation. In this system metallic and nonmetallic formulas are mixed which results in a pearl-like lustre. There is some evidence to suggest that these coatings will not chip as easily as traditionally-pigmented topcoats. The major trend in pigment production is the near elimination of lead containing pigments, e.g. lead chromate yellows and molybdate oranges which were used to achieve orange, yellow, and red topcoats. General Motors substituted azo-organic pigments for the lead pigments in 1977; Ford followed suit in 1980 and the trend has continued. Dupont, which is perhaps the largest supplier of pigments used in the automobile industry publishes an annual bulletin in which color popularity trends can be examined. This bulletin is available upon request. The typical breakdown of color popularity for both domestic and foreign automobiles shows nonmetallic white and silver metallic to be the most popular colors, followed by dark brown metallic then light blue metallic.

FOREIGN AUTOMOBILE PAINT: It is more difficult to summarize trends in the foreign market, which includes automakers of Japan, Europe, Britain, Mexico, Canada and a few other locations. The foreign automakers are in general not as "toxicity conscious" as the U.S. automakers are. Certain parallel developments between the foreign and domestic automobile industries have occurred however. As of May of 1982, 40% of European automobiles with electrodeposited primers were of the cathodic type and this trend is increasing rapidly. It is curious to note that certain trends in foreign automobile topcoats are due to the demands of the American market and vice versa. This is why in 1979 Jaquar switched from nitrocellulose lacquer to thermosetting acrylic lacquer to produce a higher gloss finish. The American buyer on the other hand likes the "sleek" look of the clear coat applied to most foreign automobiles. There are currently two foreign makers that have plants in the U.S. namely, Honda, (Ohio) which began producing Accords only in 1982, and Volkswagon (Penn). Nissan will be producing Datsuns in one U.S. plant in the almost immediate future. The paints supplied to these plants may differ from paints distributed to foreign plants due to availability, etc. Most of the foreign automakers use alkyd enamels or acrylic enamels, with the latter being predominant. In the foreign market there is not yet widespread use of NAD formulas. The practice of reduced thickness of the base coat with clearcoat applied over has already occurred on Toyota lines and results in a somewhat lower quality finish. Beginning in 1983, two red colors on Honda Civics and Preludes will be nonmetallic topcoats mixed with clear (urethane) to give rich lustre.

AFTERMARKET AUTOMOBILE PAINTS: Aftermarket automobile paints are applied to areas damaged before leaving the plant (which includes some 50% of domestic vehicles) and are applied by automobile body refinishers. Most of these paints are air-dry acrylic lacquers, since these do not require high temperatures necessary for cross-linked systems. Ease of spot repair is a main advantage of General Motors use of acrylic lacquers. In recent years the larger automobile paint suppliers, both foreign and domestic, have marketed factory package paints to the refinishing trade and a few automakers (e.g. Toyota, Jaquar, BMW and Volvo) export their own factory package paints. The size, shape and distribution of aluminum flakes in metallic topcoats may vary considerably from one refinishing formula to another. These and other factors must be considered when examining automobile paint chips for investigative lead value.

The resin systems described above may be distinguished by solubility tests. The scheme presented by Thornton in 1979 distinguishes acrylic lacquers, acrylic enamels, alkyd enamels and waterborne enamels. ("Solubility Characterization of Automotive Paints," John Thornton, Shmuel Kraus and Bruce Lerner, CAC 53rd Semi-Annual Seminar, San Diego May, 1979) Solution lacquers may be distinguished from NAD lacquers by xylene which will dissolve only the dispersion type. Various instrumental techniques such as infrared spectroscopy and pyrolysis gas-chromatography also provide information regarding resin systems.

In summary then there have been several industrial developments in the formulation and application of automobile primers and topcoats used domestically and abroad. These changes may eventually effect the amount of information available to determine the make and model of a vehicle given a chip of paint.