Letters to the Editor

Discussion of "Seat Belts and Human Rights: An Appraisal"

Dear Sir:

Dr. Greenberg's article entitled "Seat Belts and Human Rights: An Appraisal" (Vol. 32, No. 1, Jan. 1987) presented a thorough literature review of the types of injuries that can occur when one is restrained by a seat belt in a motor vehicle crash. He is indeed correct in implying that seat belts alone are not the total answer to occupant protection, and in stating that they are beneficial in preventing some secondary collisions between the victim and the interior structures of the vehicle and in preventing ejection of the victim from the vehicle during a crash.

Of particular importance was his discussion of injuries to the central nervous system in occupants restrained by two- and three-point shoulder belt systems. The neck can be violently hyperextended which can result in cervical vertebral injuries. It is also known that this whiplike movement causes the brain to move within the skull which can result in brain injury [*1*]. Other types of injuries that can occur which Dr. Greenberg did not mention are facial injuries. Studies have demonstrated that disfiguring facial fractures and lacerations can be sustained by belted occupants from impacts with the steering wheel, dashboard, and windshield [*2*].

What we found most disturbing and inaccurate about this article was the assertion that air bags are an impractical restraint system because they are too costly and only deploy in frontal crashes. The fact is, frontal and front angle crashes constitute the most frequent crash type in which serious injuries or fatalities occur, and account for 52% of all crashes [*3*]. Air bags provide specific protection to the brain, face, and cervical spine; and in frontal crashes would prevent brain injuries, disfiguring facial injuries, and many of the cervical spine injuries that Dr. Greenberg describes as occurring in the belted occupant. Air bags and seat belts perform optimally under different circumstances [*1*], and so are complementary restraining measures rather than mutually exclusive ones. To object to air bags because they only deploy in frontal and front angle crashes is like arguing that polio vaccine should not be given because it does not cure cancer [*4*].

With regard to the cost factor, it is important to note that the electronic air bag systems now available may be replaced by much less expensive systems such as the mechanically deployed air bag. New technology should make this restraint system truly affordable. Furthermore, several insurance companies have announced reductions in insurance premiums for air bag equipped cars which could result in a net *savings* to the consumer over the lifetime of the vehicle [*5*].

It should not be overlooked that air bags provide the most significant protection to the group at highest risk of motor vehicle crash injuries: those who do not and will not use their seat belts, even if seat belt use laws are enacted. But finally, we would like to emphasize that overall, the best motor vehicle occupant protection available today is the combined use of seat belts and air bags. Given that motor vehicle deaths are the fourth leading cause of death for all ages in the United States [*6*], all possible proven life saving measures, including air bags, must be implemented as soon as possible to curb the tragic toll of preventable deaths and injuries.

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Author's Response

Dear Sir:

Almost from its first introduction into passenger vehicles, it was apparent that seat belts did not fully meet the desired protective role for which they were intended. Initial defects in design, construction, installation, and application contributed to the relatively low life-saving potential [*1*].

Improvements in design did reduce significantly the ejection rate of victims in lateral or sideswipe collisions, but the documented bodily injury which accompanied their usage remained unabated. This was overshadowed by a forgetful or intentional disregard for seat belt use in moving vehicles, due, perhaps, to either inconvenience or discomfort.

The need for an alternative restraint system was recognized during the last decade. The salient requirement was that such a system becomes available only at the moment of greatest need. The air bag seemed to provide the long awaited answer. This device was intended to be activated at the moment of impact, most often the front end collision [*2*]. The relatively high initial expense, the cost of restoring it to working condition after deployment, and the occasional spontaneous activation, greatly hampered the introduction of this device into automobiles. The proposed reduction in insurance premiums that have been offered to some owners of air bag equipped automobiles probably would not offset the expanded initial financial demand required to purchase such a vehicle; many owners do not retain their cars for long periods of time. The markedly increasing rate of automobile accidents in all planes and directions [*3*] mandates the need for a restraining system of ideal character; one that will prevent ejection injuries in the event of rapid deceleration, but will not, itself, induce bodily damage. Above all, a system is needed which will in no way interfere with the lifestyle, movement, or memory of the driver or his passengers.

An air bag, well-designed, effective only when called into use, and easily maintained, may, indeed, point the way to future safe motoring for all.

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Discussion of "Seat Belts and Human Rights: An Appraisal"

Dear Sir:

I am appalled by the unscientific nature of the article on automobile safety belts by Stephen R. Greenberg in your Jan. 1987 issue. It is based upon clinical papers reporting a few serious or fatal injuries to safety belt users. If one looked only at fatalities from any activity (swimming, hiking, taking a bath, riding in automobiles) one could conclude those activities are unsafe and should be banned. That is the approach Greenberg took.

He states (p. 159) ". . . (the article's) sole purpose is to relate that aspect of the 'seat belt story' that is left untold." He then proceeds to tell it by quoting publications that describe a few injuries from a clinical standpoint without reference to incidence of occurrence and without any indication of the injuries that would have occurred had the occupant been unrestrained. Of his 29 references, 22 are over 10 years old and 12 are over 20 years old. Thus, most of the data are not based on state-of-the-art systems. He does not even know the distinction between the different systems—in Fig. 1 he has named 2 out of the 3 systems incorrectly. Furthermore, he states "The current automotive restraining system, best exemplified by the single lap belt, . . . " which shows that he is not aware of the real world in which practically all of the driver and right front passenger restraints are of the lap and diagonal belt type (3-point which he calls 2 point). The driver and the right front passenger represent the vast majority of automobile occupants.

There are many excellent, recent publications based on sound statistics including injury incidence with and without restraints which he could have quoted to show that while serious and fatal injuries do occur with restraint usage, the benefits far outweigh the relatively few adverse situations.

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Author's Response

Dear Sir:

The data presented in this article are in no way intended to condemn the seat belt as a safety device in the automobile. There is no question that its usage has saved lives and prevented serious injury. It is also true that death and injury have accompanied its application. Statistics from all areas have established this. It is also correct to state that the benefits of the seat belt outdistance the inherent dangers, but hazards do exist in the real world. It is well

for the motoring and scientific public to be aware of this when considering the full effect of laws sometimes enacted by their legislators.

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Discussion of "The Simultaneous Separation of the Enzymes Glyoxalase I, Esterase D, and Phosphoglucomutase"

Dear Sir:

The *Journal of Forensic Sciences* published an article by Wraxall and Stolorow [*1*] concerning the development of a multisystem method for the simultaneous analysis of three polymorphic proteins of forensic science interest. The analysis of glyoxalase I (GLO), esterase D (EsD), and phosphoglucomutase-1 (PGM) in physiological fluids can be of substantial circumstantial value in the investigation and adjudication of serious crimes. In our respective laboratories, these proteins have been the subject of vigorous study from both practical and experimental perspectives. We support the application of efficacious and thoroughly tested electrophoretic methods to the analysis of serological specimens whenever appropriate. However, we do strenuously object to the publication of their paper.

There is no issue regarding the existence of the Group I method. Rather, our concerns lie in the form in which the *journal* allowed the paper's publication, the authors' failure to address the criticisms leveled at the method, and their lack of discussion regarding developments that have occurred since the introduction of the Group I method. A review of past issues of the *Journal of Forensic Sciences* and numerous other scientific journals has indicated to us that four categories of articles can be published. These include technical articles, short communications, review articles, and historical treatises. Technical articles are designed to express the detailed and current study of one or a number of recent or continuing problems, the development of useful methods on a timely basis, or the result of experiments addressing new ideas or issues. Short communications provide a vehicle for the publication of information in abbreviated form for dissemination to the interested community as soon as possible. Review articles and treatises provide the reader with historical perspectives, background material, and current directions regarding well-defined subject areas.

In the form that it is written, the technical note by Wraxall and Stolorow [*1*], which describes their "Group I" procedure, does not appropriately fit into any of these categories. The majority of the space in their paper is devoted to reporting work that was completed before 1978. Since the authors did not include any information which effectively updated the method or its application, the technical note format was inappropriate. Its publication in 1986 cannot be considered an attempt at the rapid dissemination of useful scientific information and is contrary to the spirit of scientific articles of this type. The method itself is already well known in the forensic science community and has been used successfully by a number of crime laboratories in the United States. In fact, we used and taught the Group I method from 1979 to 1986 essentially as it has been described by Wraxall and Stolorow. It appears that the paper [*1*] was submitted and published only in an attempt to satisfy criticism which has been leveled at the authors by certain factions. One of the criticisms is that the method was never properly subjected to the scrutiny of the forensic science community through its publication in a reputable scientific journal. That issue aside, we are concerned with the authors' tenor suggesting the Group I method is novel. We reason that it would have

been more appropriate for the authors to present the Group I method either in a historical or a more updated perspective.

There are indications that the article [*1*] was not written with today's analytical expectations or issues in mind, that is, the modern forensic scientist is more sophisticated and expects more today than he/she did in 1978. First, the authors suggest that "starch gel *has* been the method of choice for separating most polymorphic enzymes" (emphasis ours). This statement does not apply in light of present-day technology. Although starch gel is still used in some electrophoretic methods, its use for thin-layer electrophoretic methods is outdated by current standards. Further, our research [*2–5*], as well as the commentary by Sensabaugh [*6*], indicates that agarose gels allow for pattern linearity and band resolution that is superior to either starch or starch-agarose gels. Wraxall and Stolorow failed to address this contraindicating information and provided no data to support their contention that starch-agarose is a superior electrophoretic media. If they had done so, the forensic science community would have benefited tremendously in light of the numerous legal assaults that have been mounted against the applications of Group I in forensic serology. Concomitantly, those still employing this method would have benefited with data supporting their analytical approach.

Second, the authors presented no empirical or citational evidence to support their claim that the addition of starch to agarose reduces electroendosmosis of the Group I system. From our practical experience and an understanding of the properties of starch, the addition of starch to the Group I system is necessary only to support the GLO assay. The mixing of starch with agarose provides no beneficial electrophoretic effect for the separation of the proteins of the Group I system.

Third, Wraxall and Stolorow [*1*] present photographs of GLO phenotypic patterns generated by the Group I method and state that "clearly resolved" patterns were obtained. We believe that the community would have been interested in data demonstrating that their method is comparable or superior to other methods currently available [*2–5, 7–10*]. This would have been particularly important in view of the development of alternative analytical approaches since 1978. Our major concern with the Group I method has been the GLO portion of the system. It has been our experience as well as the experience of others, as related to us, that the GLO system has been the least efficient and the most troublesome component of the Group I system.

Fourth, the authors missed an additional opportunity by not adequately addressing the validation issue often raised by critics of the Group I method. They could have asked for, undoubtedly received, and presented practical grouping data from numerous forensic science laboratories which have validated and effectively used the Group I system. Literally hundreds of thousands of body fluid stains have been successfully typed using the Group I method. A table showing this accumulated data would have provided strong support for their method.

In summary, we have found the Group I method to be a reliable and valid electrophoretic approach for the analysis of serological materials. However, the paper by Wraxall and Stolorow did little to strike at the heart of the criticisms confronting its use. The paper did not support their scientific claims nor the reliability and validity of the Group I method. In light of today's issues, it was a poor attempt to justify an already valid method.

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Authors' Response

Dear Sir:

We would like to thank the editor of the *journal* for the opportunity to respond to the commentary by Murch, Kearney, and Budowle. We appreciate the efforts of these gentlemen in preparing a lengthy criticism, which we are sure is well intended. We feel it is the responsibility of the Editorial Board of the *journal* to accept or reject manuscripts submitted to them.

We are gratified to see that the FBI used and taught the Group I method from 1979 to 1986 and found the method to be a reliable and valid electrophoretic approach for the analysis of serological materials. We note that the FBI has accumulated a large amount of data on the validation of the Group I system and would encourage them to contribute this data in published form which, by their own account, is long overdue.

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Discussion of "Subtyping Phosphoglucomutase-1 in Semen Stains and Bloodstains: A Report on the Method"

Dear Sir:

The article "Subtyping Phosphoglucomutase-1 in Semen Stains and Bloodstains: A Report on the Method," by Budowle et al. (Vol. 31, No. 4, Oct. 1986, pp. 1341-1348) describes

a useful method for ultrathin-layer polyacrylamide gel isoelectric focusing (ULPAGIF) with helpful suggestions on the concentration of *N*-(2-hydroxethyl)piperazine-*N*-3-propanesulfonic acid (EPPS).

Budowle et al. indicate they have further studies underway in the area of mixed body fluid stains. This correspondence is to express my concern about their discussion of this topic given in "Casework Evaluation." Published reports [*1–4*] have indeed shown that there can be significant contributions of phosphoglucomutase-1 (PGM_1) from vaginal secretions. Budowle et al. have suggested this activity is generally related to menstrual or postmenstrual blood. This is only partially correct as approximately 40% of semen-free vaginal swabs tested [*3,4*] had PGM activity unrelated to menses.

It has also been shown on vaginal swabs [*4*] that the presence of semen will enhance the vaginal PGM activity to the point where the vaginal PGM masks the seminal PGM within 30 to 60 min postcoitus. Thus, it should be stressed that when typing mixed body fluid stains, especially vaginal swabs, a PGM type the same as the female's *cannot* be attributed to the semen.

Budowle et al. also imply that the lack of separation between the c− and 2+ bands is of limited significance, as PGM interpretation can be based on relative band intensities. This approach in evaluating seminal stains from casework should be used with caution, as these stains may in fact contain vaginal secretions [*5*], and thus have to be viewed as mixtures where relative band intensities may vary. The relative band intensities Budowle suggests obviously cannot be used in the interpretation of PGM_1 subtypes on such mixed body fluid stains. Therefore, separation of the c− and 2+ bands is critical.

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Authors' Response

Dear Sir:

The ability of serologists to be self-critical is a vital part of forensic science. We welcome commentaries on our work with the expectation that all will benefit. However, we feel that Ms. Garlo has misinterpreted our paper "Subtyping Phosphoglucomutase-1 in Semen Stains and Bloodstains: A Report on the Method" (Vol. 31, No. 4, Oct. 1986, pp. 1341–1348). First, Ms. Garlo contends that we attribute the contribution of phosphoglucomutase-1 (PGM_1) from vaginal secretions to be generally related to menstrual or postmenstrual blood. On p. 1346 we suggest "The PGM_1 from the vagina is *probably* due to menstrual and postmenstrual blood contamination or *cellular damage* or both." Second, regardless of Ms.

Garlo's oversight, the specific origins of vaginal PGM_1 is a moot point. The issue, for us, is that the vaginal contribution of PGM_1 must be considered when evaluating casework. As we state on p. 1346, "Published reports and our observations of (semen stains, vaginal swabs, and other) case samples have shown there can be significant contributions of PGM_1 from the vaginal secretions. This contribution has to be taken into consideration when interpreting PGM_1 subtypes from vaginal swabs." It would be foolhardy for any examiner to assume that a PGM_1 type the same as that of female might not have originated from the female.

In addition, Ms. Garlo suggests that we do not believe the separation of the c− and 2+ bands to be critical in casework evaluation. On p. 1342 we indicate that "Band intensities play a part in the interpretation of the PGM_1 subtypes. In particular, the c− band lay approximately in the same position of the gel as the 2+ band. However, the c− band was far less intense than the 1− band. Thus in a 1−2+ phenotype, the 2+ band was equal to or slightly greater in intensity than the 1− band." This simply refers to the interpretation of PGM_1 patterns obtained from the laboratory prepared bloodstains and semen stains (as described in the Material and Methods Section) and is not part of the discussion regarding evaluation of casework materials. We clearly demonstrate our concern with interpretational problems of casework materials on p. 1347 where we state "We are investigating methods for separating the c− and 2+ bands to eliminate any possible confusion with typing."

Whether it was a misinterpretation and/or oversight on Ms. Garlo's part and/or we did not communicate clearly our points, this discussion was healthy for the forensic science field. It served to reiterate important factors concerning PGM_1 subtype analyses that impact on forensic science casework interpretations.

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Training Requirements and Ethical Responsibilities of Forensic Scientists Performing Ink Dating Examinations

Dear Sir:

"A Critical Evaluation of Current Ink Dating Techniques" appears in this issue of the *Journal of Forensic Sciences*, Vol. 32, No. 6, Nov. 1987, pp. 1522–1536. As a necessary adjunct to the performance of these examinations, the authors wish to present certain important considerations, that is, training requirements and ethical responsibilities of forensic scientists performing ink dating examinations.

TRAINING REQUIREMENTS FOR FORENSIC SCIENTISTS PERFORMING INK DATING EXAMINATIONS

Laboratory techniques for dating inks are simple in terms of instrumentation and procedures used. However, as with most forensic science applications, a great deal of knowledge of the material (in this case ink) is required. It is essential to know how inks are made, what they consist of, and how they vary from company to company, formula to formula, and batch to batch. Experience in the manufacturing of inks is necessary to learn how ink formulations differ.

Once knowledge of inks is gained, one must become experienced in the laboratory procedures used for dating inks as well as the constraints of examining dried ink on questioned documents in micro quantities. Then there are problems associated with the effects of paper, storage conditions, and age of the ink to be examined on questioned documents.

Most of the pitfalls described in this paper using the different ink dating methods can be prevented by proper training of the forensic science examiner. This section lists guidelines for the major training requirements for forensic scientists desiring to do ink dating examinations. The purpose here is to provide useful information to the ink examiners and supervisors of ink examiners to ensure adequate training is obtained before attempting this kind of work on actual cases. The list also serves as a checklist for attorneys when they are required to conduct direct or cross examinations of experts in this field.

Minimum Training Requirements

Academic—A bachelors degree in the physical or biological sciences; the chemistry taken should include analytical chemistry, instrumental analysis, organic chemistry, and physical chemistry. This training will provide the background to understand the chemistry of ink and the analytical methodology used to examine inks.

Formal Training—A one semester course on Introduction to Questioned Document Examination. Ink dating examinations are nearly always performed on questioned documents, and they are done in conjunction with handwriting and other types of examinations performed by document analysts. This training is necessary to understand the work done by document analysts so that together the ink examiner and the document analyst can get the most information from the evidence. (An alternative could be to train under a qualified document examiner for approximately one month.)

Informal Training—Visits to each of the various types of writing ink manufacturers. This training is required to gain knowledge of ink manufacturing practices, composition of inks, quality control, frequency of formulation changes, how ink formulations records are maintained, and other information available from the ink manufacturer.

On-the-Job Training—Sufficient time of on-the-job full-time laboratory training, for example, 6 months to a year, devoted strictly to the analysis and dating of inks. This training should include the examination of at least 50 ink dating cases (practice cases, not actual investigations). Also, at least 1000 different ink formulations (including ballpoint inks and nonballpoint inks such as porous tip, rolling ball, and fountain pen inks) should be examined with thin-layer chromatography. This training will provide the knowledge needed regarding the composition of different ink formulations. Working the 50 cases will provide experience in applying the different ink dating techniques under actual case situations.

In addition, practice in the use of the following laboratory instruments should be given so the trainee can become proficient in the use of these techniques when using them on actual ink cases:

- thin-layer chromatography (TLC),
- gas chromatography (GC),
- high performance liquid chromatography (HPLC),
- Fourier transform infrared spectroscopy (FTIR),
- TLC densitometry, and
- fluorescence spectroscopy.

All of the training should be done under the supervision of a qualified forensic ink chemist.

Required Reading—The trainee should conduct a comprehensive literature search of all relevant scientific publications on ink analysis and ink dating. To gain a perspective on development in this field, articles should be studied dating from about 1900 to the present. The

trainee should become totally familiar with the articles listed as references in this letter, because these articles discuss the methods now in use. All written legal opinions involving ink analysis should be studied to gain an understanding of the court admissibility of ink dating techniques. For a complete listing of relevant references, the trainee should refer to the references cited by Brunelle and Reed [*1*].

Proficiency Testing—Forensic scientists should not attempt to examine actual criminal or civil cases until they have been tested.

Proficiency testing demonstrates the competency of the examiner's work. The testing should evaluate the accuracy of the ink identifications/ink dating examinations and the scientific soundness of conclusions reached on the basis of laboratory examinations. The trainee should be given at least ten different ink formulations written on documents to identify and date.

All of the above considerations pertain to the performance of ink dating examinations. Less requirements are needed if a forensic chemist is just performing ink comparisons for the purpose of determining differences or similarities. This still requires considerable experience in analyzing a large number of different ink formulations using at least thin-layer chromatography. Knowledge of ink making and experience with identifying inks by matching with standards is valuable for determining what is meant when two inks being compared cannot be distinguished.

ETHICAL RESPONSIBILITIES OF FORENSIC SCIENTISTS PERFORMING INK DATING EXAMINATIONS

Most professional organizations have codes of ethics that govern the professional and personal conduct of its members. Sections 1 and 2 of the Code of Ethics of the American Academy of Forensic Sciences [*2*] describe the guiding principles for its members.

A problem that exists in any discussion of ethics in the forensic sciences involves whether a forensic scientist knowingly violates acceptable conduct. In many situations it is possible that what appears to be unethical may well be lack of knowledge or incompetency of the forensic scientist.

One solution to this problem lies with the establishment of standard training requirements for forensic scientists, like those previously described. If a person has completed the standard training requirements and still gives misleading conclusions or misrepresents data, then one should probably interpret this as unethical behavior.

On the other hand, in the absence of adequate training, this same behavior could be interpreted as incompetency. This clearly suggests that there is little difference between unethical behavior and incompetency for the forensic scientist. To quote a cliche, "ignorance of the law is no excuse." Neither unethical behavior nor incompetency is acceptable in the justice system.

Using the Code of Ethics of the AAFS and their guiding principles as a reference, this section lists specific guidelines for behavior which is considered unethical with respect to ink dating examinations and conclusions.

AAFS Code of Ethics and Guiding Principles [2]

1. Every member of the AAFS shall refrain from any material misrepresentation of education, training, experience, or area of expertise.

2. Every member of AAFS shall refrain from any material misrepresentation of data upon which an expert opinion or conclusion is based.

   a. The forensic scientist should maintain his professional competency through existing programs of continuing education.

   b. The forensic scientist should render technically correct statements in all written or

oral reports, testimony, public addresses, or publications and should avoid any misleading or inaccurate claims.

c. The forensic scientist should act in an impartial manner and do nothing which would imply partisanship or any interest in a case except the proof of the facts and their correct interpretation.

Unethical Behavior with Respect to Ink Dating Examination and Conclusions

1. Ink dating examinations, reports, and testimony on the basis of ink examinations by forensic scientists that have not successfully completed training requirements such as those described in this paper. Without adequate training, these actions would be unethical and in violation of AAFS ethical guidelines. This is because without training, there is no basis for rendering an expert opinion or conclusion. Any opinion offered would be material misrepresentation of data.

2. Conclusions as to the age of ink by any technique where the accuracy, reproducibility, and experimental error have not been scientifically established. Here, the basis for determining unethical behavior according to AAFS guidelines pertains to the requirement to render technically correct statements in all written or oral reports or testimony and the requirement to avoid misleading claims. If accuracy, reproducibility, and experimental error are not known, conclusions will be misleading.

3. Conclusions on the basis of data that are within or even close to the range of experimental error of the procedure used. These conclusions would be based on misrepresentation of data and would be technically incorrect. Conclusions of this type also suggest partisanship or special interest in a case. All of the above violate ethical guidelines.

4. Identification of inks without one or more confirmatory tests. Since this action is contrary to acceptable scientific practice, it falls into the category of being technically incorrect. It also misrepresents the significance of the results of only one test.

5. Conclusions that state or infer absolute identification of an ink formulation. Identification of a specific ink formulation with 100% certainty is usually impossible. If an examiner reports absolute identification without sufficient proof this is material misrepresentation of results and a technically incorrect statement. It also implies partisanship or special interest in a case.

6. Conclusions that state or infer the absolute age of an ink without sufficient proof. The reasons for unethical behavior here are the same as above.

7. Testimony involving ink dating that does not clearly state the significance of results obtained and the limitations of what can be concluded from the results of examination. The testimony would be unethical according to AAFS guidelines because it would be misleading.

8. Conclusions made on the age of inks on different documents unless the effects of different paper have been proven to have no effect on the age determination.

The authors are not singling out ink dating as the primary field where unethical behavior could be or is a problem. We do believe it is important to address this as a potential problem because the advantages and limitations of ink dating techniques are not widely known.

The guidelines for unethical behavior listed should be obvious to any professional scientist. For this reason we do not suggest the guidelines are original. If nothing else, maybe these guidelines will be memory refreshers and force ink dating chemists and other forensic scientists to be conscious of their ethical responsibilities as professionals in this field.

References

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The Need for Forensic Technology Innovation

Sir:

In principle, the most effective areas in which to utilize one's crime fighting resources are prevention and rehabilitation, and, indeed, the bulk of the U.S. forensic science research dollars are spent on what one might broadly call social studies applied to these areas. For example, the National Institute of Justice funds social studies dealing with criminal behavior, the effects of drugs and alcohol on crime, court effectiveness, victim issues, police efficiency, and so forth, at an annual level of millions of dollars. The National Science Foundations's Law and Social Science Program, which addresses the scientific understanding of law and legal process, has a similar annual budget. In comparison, spending by these agencies on physical science research, that is, innovation in technology for examination of physical evidence, has so far been essentially nil. A modest forensic science and criminal justice technology program has just been created by the National Institute of Justice, however. In-house research is conducted by the FBI Academy, and occasional small projects are performed by agencies such as the Secret Service or Bureau of Alcohol, Tobacco and Firearms. A number of areas of criminalistics, however, are not addressed at all by these undertakings. The latent fingerprint area is an example. When it comes to the bona fide federal granting agencies, nowhere can one find an established criminalistics research support program. Biochemical and medical applications in forensic science tend to fare better, largely because advances in the respective science branches are easily adapted to forensic science purposes.

Unfortunately, the United States continues to have the far and away worst crime rate of the industrialized nations, probably of all nations, and there appears to be little prospect for any substantive diminution in the U.S. crime rate. The severity of the crime problem can be gleaned from the following figures. During 1981, almost 25 million households, nearly a third of the nation, were touched by crime (National Crime Survey). Of the present inhabitants of this country, about 1 in 130 will die by murder (nearly 20 000/year). Such horrifying figures suggest that prevention and rehabilitation, though extensively pursued, have not been overly effective. The maintenance of a reasonable measure of social order thus depends heavily on the ability to apprehend criminals and remove them from circulation. A key role here is played by criminalistics, many areas of which regrettably still use little more than 19th century technology. One can thus anticipate the emergence of a critical deficiency in the crime solving capacity of law enforcement in the years to come, unless this country's research support strategy becomes more balanced, not just within areas that deal in some way with crime, but in the overall research framework. Many billions of dollars are targeted for "Star Wars" and gargantuan elementary particle accelerators. Many millions of dollars are spent on environmental and medical research each year. Surely a few hundred thousand dollars spent on physical science research for promotion of the safety of the citizens of this country

will not severely injure these enormous programs. Hopefully, the forensic science community will in time share in a crumb of the research pie.

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Ethics—A Forensic Engineer's Viewpoint

Sir:

To most people the word "ethics" has something to do with morally correct behavior. All professional people are expected to be "ethical."

Code of Ethics

Now an engineer is a peculiar sort of professional person, and engineers tend to see the world like nobody else sees it. When engineers get together for the purpose of preparing a "Code of Ethics"[1] for engineers, the result is a detailed statement with many numbered clauses, all of which revolve around five fundamental cannons as follows:

1. First and foremost is the subject of safety. Safety is paramount—or more correctly "the safety, health, and welfare of the public is paramount." Now who but an engineer would look upon "safety" as the primary fundamental concern of "ethics." We are not just talking about one particular code of ethics, the subject of safety is considered first and foremost in pretty well every Engineering Code of Ethics throughout the world. Perhaps this tells you something about what sort of people engineers are. When we have a catastrophe, be it the tragic loss of the Ocean Ranger drilling rig off Newfoundland a few years ago, or the disastrous chemical leak at Bhopal, India, or most recently the destruction of the space shuttle flight, every engineer associated with these projects searches his soul and examines his personal ethics to consider whether he has failed the anonymous "public" by giving insufficient attention to safety. Ironically, the more safety features that engineers invent, the more carelessly the public handles the equipment they build, taking for granted that it is "engineered safe," and then, when through some obscure happenstance, the equipment fails, someone in that anonymous "public" will be quick to bring on a product liability suit.

2. The second most important item in the Engineers Code of Ethics is "competence." It is considered unethical for an engineer to tackle an assignment which is beyond his competence, unless he secures the assistance of someone who is competent to assist him with those parts of the assignment with which he is unfamiliar. The engineer himself must decide first whether or not he or she is competent to take on the assignment, and as long as nothing goes wrong, nobody will pay very much attention, but if anything does go wrong, the engineer may be called upon to explain to his peers in his profession what his real competence was at the time he did the work. If his peers do not accept his explanation, he may be declared unethical by the local licensing authority, and they may choose to remove his license to practice.

3. The third most important concept in the Engineers Code of Ethics is that an engineer must always be "objective and truthful in all public statements." For forensic engineers, this

[1]For example, the Code of Ethics of the National Society of Professional Engineers which is headquartered in Washington, DC.

is probably the requirement of the Engineers Code of Ethics to which we must respond most frequently. According to the Code of Ethics, being objective and truthful requires that engineers shall "include all relevant and pertinent information in reports, statements or testimony," and that such statements must be "founded upon adequate knowledge of the facts and competence in the subject matter." The intent of the Code of Ethics is very clear. Here we have an idea that I think the general public will readily associate with the word "ethics" so now we fall into step with the rest of society and become ordinary people.

The remaining items of the Engineers Code of Ethics are more predictable. They are:

4. Acting as faithful agents or trustees to each employer or client.
5. Avoiding improper solicitation for professional employment.

These items, although important, are probably common to the codes of ethics of most professions, and therefore I will not dwell on them here.

Enforcement

To an engineer, the Code of Ethics is certainly not a polite set of guidelines. It is a compelling set of rules that must not be ignored. Failure to abide by these rules should inevitably produce tough sanctions up to removal of the license to practice engineering, and publication of the name of the engineer, together with pertinent facts related to the offense of the engineer, in an official publication of the licensing authority. Once a person has been expelled from one jurisdiction, it should be very difficult, if not impossible, for that person to be registered in any other jurisdiction in North America. In my view if the AAFS is serious about the subject of ethics, sanctions should definitely be imposed on any offenders, including expulsion from the organization, and publication of the name in the official journal.

Public Versus Private Investigators

Now I would like to discuss the relative difference in operation between the Government employees and those of us in private practice. There is a widely held perception that the fellow who works for the Government agency or lab is neutral, while the fellow whose services are paid for by one of the parties, is always prejudiced in favor of his client. This concept is fallacious.

All science is a search for truth, and forensic engineers are applied scientists searching for the truth, no matter whether they work for the Government or independently. A review of my office files over a six-month period led to the conclusion that in almost half of the cases that we examined, the net effect of our report was against the client that hired us; but all those cases tend to get settled long before court. Whenever a forensic engineer appears in court, you can bet that the engineer's report must be helpful to the clients position, or else why would he ask the engineer to be there? So the myth grows.

Most of my lawyer clients first met me when I appeared in court in opposition to them. It is very common for my opposition in one case to become my client in the next one. Whenever I am in court, I would not dare to overstate the case for my client, because the good people on the other side are also my clients in other cases, or else if they are not my clients now, they may well become my clients sooner or later. For me this philosophy has worked well to the extent that I began with no work 18 years ago and now my firm handles 700 cases per year, and our client list grows and grows.

Public servants do, on rare occasions, find themselves under political pressure to take a certain stance, and they have to resist that pressure. Sometimes the pressure is merely to keep silent on the certain subject. I do not suggest that anybody says anything to these people, or instructs them; the pressure is often self-induced within the individual employee. Other times it has noticeable political overtones.

The root problem is that public servants work full time for only one client, namely the Government, and their jobs depend on that one client. Therefore, they feel an unstated obligation to make their employer "look good" and sometimes this objective is contrary to the objectives of the Code of Ethics. I personally have great admiration for the way that these same public servants conduct themselves especially when they are under pressure, and I am in no way criticizing the performance of public servants, my purpose is merely to point out that there are occasions when these people have pressures on them, and those pressures do not make it easy for them to be absolutely neutral all the time.

By contrast, the forensic engineer in private practice looks upon everybody, including the Government, as a potential client, and therefore a possible source of future revenue. Any pressure that the engineer may feel from a client in the particular case, is counterbalanced by opposing pressure from these other clients and potential clients. In this situation, the engineer does not want to jeopardize his reputation and his future for the sake of a relatively small fee that he may get from one client, when his future livelihood and reputation depend on his consistent objectivity and truthfulness over a long period of time.

The inevitable conclusion for any serious forensic engineer who wants to stay in that business indefinitely, is that it makes very compelling business sense to be strictly ethical in all statements and opinions at all times. You might say that it boils down to a case of "money talks." Therefore, it is axiomatic that forensic engineers in private practice should be expected to espouse the high moral values of ethics, at least as much as their confreres in the public service.

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