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Scientific Evidence - Part II

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SCIENTIFIC EVIDENCE — PART II

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In the last issue of the Reporter, the first of a two-part article on scientific evidence was published. *See Scientific Evidence — Part I,* 3 Public Defender Rptr. (Jan.-Feb. 1980). Part I examined a number of legal issues that are involved in the use of scientific evidence. This article focuses on particular scientific techniques. In an article of this scope, it is not possible to discuss all types of scientific evidence, nor is it possible to discuss any particular technique in detail. The purpose of the article is merely to highlight a number of forensic procedures that have proved controversial or are frequently encountered in criminal practice.

Knowledge of the various types of scientific evidence currently available in criminal investigations can be used in several ways by the defense; for example, it can be used to challenge the testimony of a prosecution expert and to facilitate the presentation of a defense based on scientific evidence. In addition, such knowledge often will enable the defense to question the absence of scientific evidence in the prosecution's case. If the government had the opportunity to use and present scientific evidence but failed to do so, this circumstance may be a persuasive factor in establishing reasonable doubt in the minds of the jurors.

A number of texts deal with the subject of scientific evidence. *See* A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases (2d ed. 1978); J. Richardson, Modern Scientific Evidence (2d ed. 1974); C. McCormick, Evidence ch. 20 (2d ed. 1972). The Moenssens and Inbau text is undoubtedly the best single-volume reference work in the field; it covers a wide range of scientific techniques, providing a description of each as well as a discussion of the legal developments and a bibliography.

Another book that may prove useful is the FBI Handbook of Forensic Science (Rev. 1978). This text outlines the various services that are provided by the FBI laboratory. Its importance to defense counsel lies in the fact that it sets forth the limitations of many techniques and thus provides an authoritative text (learned treatise) for the impeachment of experts who overstate the conclusions that may be drawn from these techniques.

VOICEPRINT EVIDENCE

Voiceprint identification is premised on the uniqueness of each human voice (interspeaker variability). Since a speaker will not pronounce the same word in exactly the same way twice (intraspeaker variability), voiceprint identification depends on the extent that interspeaker variability differs from intraspeaker variability. The voiceprint technique involves the use of a sound spectrograph to produce a visual display (a spectrogram) of selected words and phrases from a tape recording. The examiner then compares a spectrogram obtained from the suspect with the spectrogram produced from a tape recording involved with a crime. Like fingerprint, firearm, and handwriting comparisons, the comparison of spectrograms involves a subjective evaluation on the part of the examiner.

Judicial acceptance of voiceprint evidence has had a checkered history. A number of courts have accepted such evidence. *See* U.S. v. Williams, 583 F.2d 1194 (2d Cir. 1978), *cert. denied,* 439 U.S. 1117 (1979); U.S. v. Baller, 519 F.2d 463 (4th Cir.), *cert. denied,* 423 U.S. 1019 (1975); United States v. Franks, 511 F.2d 25 (6th Cir.), *cert. denied,* 422 U.S. 1042 (1975); State v. Williams, 388 A.2d 500 (Me. 1978); Commonwealth v. Lykus, 367 Mass. 191, 327 N.E.2d 671 (1975). On the other hand, a number of courts, including the D.C. Circuit and the Supreme Courts of California, Michigan and Pennsylvania have rejected voiceprint evidence. *See* United States v. Addison, 498 F.2d 741 (D.C. Cir. 1974); People v. Kelly, 17 Cal.3d 24, 130 Cal. Rptr. 144, 549 P.2d 1240 (1976); Reed v. State, 283 Md. 374, 391 A.2d 364 (1978); People v. Tobey, 401 Mich. 141, 257 N.W.2d 537 (1977); Commonwealth v. Topa, 471 Pa. 223, 369 A.2d 1277 (1977).

State v. Olderman

One Ohio case has considered the issue. In State v. Olderman, 44 Ohio App.2d 130, 336 N.E.2d 442 (1975), the court of appeals upheld the admissibility of voiceprint evidence. The precedential value of *Olderman,* however, is suspect for several

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reasons. First, the court purported to apply the general acceptance test which requires that an innovative scientific technique be generally accepted by the scientific community as a prerequisite to admissibility. This test has been justified on the grounds that it "assures that those most qualified to assess the general validity of a scientific method will have the determinative voice." United States v. Addison, 498 F.2d 741, 743-44 (D.C. Cir. 1974). For a discussion of the general acceptance standard, see *Scientific Evidence — Part I* at 2. The court in *Olderman,* however, did not look to the scientific community to determine whether voiceprint analysis had been generally accepted; rather, the court concluded that voiceprint evidence had satisfied the general acceptance standard solely on the basis of cases upholding the admissibility of the technique. In effect, the views of courts, not scientists, were determinative. This does not comport with the rationale underlying the general acceptance standard.

Second, even assuming that reliance on prior judicial decisions is a proper application of the general acceptance standard, the court's analysis remains troublesome. Although the court acknowledged that a number of cases had rejected voiceprint evidence, the court ignored those cases. These cases demonstrated that general acceptance has not been achieved. Moreover, several cases cited by the court as upholding voiceprint evidence did not apply the general acceptance test, *see* Worley v. State, 263 So.2d 613 (Fla. App. 1972); Alea v. State, 265 So.2d 96 (Fla. App. 1972); Trimble v. Hedman, 291 Minn. 442, 192 N.W.2d 432 (1971), and one of the cases cited as upholding the admissibility of voiceprint evidence was subsequently overturned. *See* People v. Kelly, 17 Cal.3d 24, 130 Rptr. 144, 549 P.2d 1240 (1976), *overruling* Hodo v. Superior Court, 30 Cal. App.3d 778, 106 Cal. Rptr. 547 (1973).

Third, after *Olderman* was decided the National Academy of Sciences, at the request of the FBI, appointed a committee to evaluate voiceprint identifications. The committee concluded:

> The practice of voice identification rests on the assumption that intraspeaker variability is less than or different from interspeaker variability. However, at present the assumption is not adequately supported by scientific theory and data. Viewpoints about probable errors in identification decisions at present result mainly from various professional judgments and fragmentary experimental results rather than from objective data representative of results in forensic applications.
>
> The Committee concludes that the technical uncertainties concerning the present practice of voice identification are so great as to require that forensic applications be approach with great caution. National Academy of Sciences, On the Theory and Practice of Voice Identification 2 (1979).

Thus, the most recent and comprehensive study of voiceprints demonstrates that the scientific community has yet to accept the technique. In sum, the status of voiceprint evidence in Ohio is far from settled.

See generally, A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases ch. 12 (2d ed. 1978); O. Tosi, Voice Identification, Theory and Legal Applications (1979); Siegel, *Cross-Examination of a "Voiceprint" Expert: A Blueprint For Trial Lawyers,* 12 Crim. L. Bull. 509 (1976); Annot., 49 A.L.R.3d 915 (1973).

POLYGRAPH EVIDENCE

The polygraph technique is based on the assumption that psychological stress caused by the fear of detection will produce involuntary physiological responses — changes in blood pressure, pulse, respiration, and galvanic skin resistance. These responses are recorded on a chart by the polygraph machine and then evaluated by the examiner. Both the critics and proponents of polygraph evidence agree that the examiner plays the most crucial role in the technique. His expertise is critical in determining suitability of a subject for testing, formulating proper test questions, detecting attempts to mask or create chart reactions, stimulating a subject to react, and interpreting the results of the examination. For a further discussion of the polygraph technique, see J. Reid & F. Inbau, Truth and Deception (2d ed. 1977); S. Abrams, A Polygraph Handbook for Attorneys (1977); Legal Admissibility of the Polygraph (N. Ansley ed. 1975).

From 1923 when the results of a polygraph examination were rejected in Frye v. United States, 293 F. 1013 (D.C. Cir. 1923), until the early 1970s polygraph evidence was excluded in virtually every reported decision. Since 1972 a number of courts have admitted, or have recognized a trial court's discretion to admit, polygraph evidence. Cases admitting polygraph results include United States v. Ridling, 350 F. Supp. 90 (E.D. Mich. 1972); Commonwealth v. A Juvenile, 365 Mass. 421, 313 N.E.2d 120 (1974); State v. Dorsey, 88 N.M. 184, 539 P.2d 204 (1975). Cases recognizing trial discretion to admit polygraph evidence are cited in Tarlow, *Admissibility of Polygraph Evidence in 1975: An Aid in Determining Credibility In a Perjury-Plagued System,* 26 Hastings L.J. 917, 948-50 (1975). Two Ohio cases have admitted polygraph evidence notwithstanding the absence of a stipulation. *See* State v. Sims, 52 Ohio Misc. 31, 369 N.E.2d 24 (C.P.1977); State v. Hancock, 71 Ohio Ops.2d 458 (C.P. 1974). The *Sims* decision was based on the compulsory process clause. For other constitutional arguments in support of admissibility, *see* Note, *Admission of Polygraph Results: A Due Process Perspective,* 55 Ind. L.J. 157 (1979); *Scientific Evidence — Part I* at 6.

Admissibility by Stipulation

Perhaps the most important development in this area has been the growing trend to admit evidence of polygraph examinations if the parties stipulate in advance to the admissibility of the results. *See* J. Reid & F. Inbau, Truth and Deception 325-35 (2d ed. 1977); Comment, *The Admissibility of Polygraph Evidence Pursuant to Stipulation in Criminal Proceedings,* 5 Akron L. Rev. 235 (1972); Comment, *Evidence: Lie Detector Tests — Effect of Prior Stipulation on Admissibility of Results,* 18 U. Fla. L. Rev. 527 (1965); Annot., 53 A.L.R.3d 1005 (1973).

In State v. Souel, 53 Ohio St.2d 123, 372 N.E.2d 1318 (1978), the Supreme Court of Ohio held that polygraph evidence pursuant to a stipulation is admissible. In reaching this result, the Court explicitly adopted the conditions for admissibility set forth in State v. Valdez, 91 Ariz. 274, 371 P.2d 894 (1962). Those conditions include: (1) a written stipulation signed by the defendant, defense counsel and prosecutor, (2) judicial discretion to

exclude the results notwithstanding the stipulation if the trial judge is not satisfied the examiner is qualified or the test was conducted properly, (3) an opportunity for the opposing party to cross-examine the examiner regarding his qualifications, the procedures employed in conducting the examination, the limitations of the technique, the possibilities of error, as well as other pertinent matters, and (4) a jury instruction on the use and effect of polygraph evidence. *See generally,* Note, *State v. Souel: Ohio Turns the Corner on Polygraph Evidence,* 8 Cap. U.L. Rev. 287 (1978).

A defense attorney who wishes to have the results of a stipulated polygraph examination admitted in evidence faces a number of problems. First, before raising with the prosecutor the possibility of a stipulated examination, the defense attorney should arrange to have his client examined by a defense expert. The reasons for this precaution are self-evident. The client will waive the fifth amendment privilege against self-incrimination by agreeing to the examination, *see* Schmerber v. California, 384 U.S. 757, 764 (1966), and counsel should not advise such a waiver without first knowing the probable results of the examination. The pre-stipulation examination, however, may raise the problem of the "friendly polygrapher." Dr. Martin Orne has described this problem as follows:

> The guilty individual when tested by a friendly polygrapher knows that the results of the test *if he is found deceptive* will not be used against him. . . . As a consequence, the client's fears about being detected are greatly reduced. As we have been able to show in the laboratory, and as is acknowledged by all polygraph experts, a suspect's fear of detection is the major factor in assuring his augmented physiological response while lying. It is precisely this aspect of the situation which is most dramatically altered when the polygraph is employed by the defendant's attorney. Orne, *Implications of Laboratory Research for Detection of Deception,* in Legal Admissibility of the Polygraph 94, 114-15 (N. Ansley ed. 1975).

If Orne's theory is correct, the client may pass the defense-sponsored examination but not the examination administered pursuant to the stipulation. Thus, it may be advisable not to inform the client that the first examiner is "friendly."

Second, care should be exercised in preparing the stipulation. This requires a thorough knowledge of the polygraph technique. The stipulation should state explicitly that the examiner is not to interrogate the client. Moreover, counsel should be present during the examination to ensure that interrogation does not ensue either before or after the examination.

Admissibility in Collateral Proceedings

Inroads into the general rule excluding polygraph evidence have not been limited to the stipulation cases. A number of courts, while not willing to admit the results of polygraph examinations at trial, have admitted such evidence in other contexts. The rationale for such an approach was stated by the Michigan Supreme Court in People v. Barbara, 400 Mich. 352, 255 N.W.2d 171 (1977). In holding that polygraph evidence could be considered in ruling on a motion for a new trial, the court commented: "Since the defendant's guilt or innocence is not at issue, some procedures are permissible which would not be acceptable at trial." *Id.* at 411, 255 N.W.2d at 197. *See also* State v. Cantanese, 368 So.2d 975 (La. 1979); Note, *People v. Barbara: The Admissibility of Polygraph Test Results in Support of a Motion for New Trial,* 1978 Det. C.L. Rev. 347; Note, *Admissibility of Polygraph at Post-Conviction Hearings on Motion for New Trial,* 55 U. Det. J. Urban L. 155 (1977); Note, *Criminal Law — Polygraph Examination Results Admissible in Post-Conviction Hearings,* 56 N.C. L. Rev. 380 (1978).

In addition, polygraph evidence has been admitted in suppression and sentencing hearings. *See* People v. Cutter, 12 Crim. L. Rptr. 2133 (L.A. Super. Ct. Nov. 6, 1972); State v. Jones, 110 Ariz. 546, 521 P.2d 978 (1974); State v. Watson, 115 N.J. Super. 213, 278 A.2d 543 (1971).

GUNSHOT RESIDUE TESTS

Gunshot residue tests are used to determine whether a person recently has fired a weapon, a determination which can be important in identifying an assailant, proving or rebutting a self-defense claim, and distinguishing a suicide from a homicide. All tests are designed to detect powder or primer residues which, due to the backblast of gases which escape through crevices in the weapon, may be deposited on the hand of a person discharging a gun.

The "Paraffin Test"

The "paraffin test," which was designed to detect nitrate and nitrite residues (powder residues), was first introduced in this country in the early 1930s and was adopted quickly by law enforcement agencies. A paraffin cast is used to remove the residues from the hands at which time the cast is treated with a reagent, either diphenylamine or diphenylbenzidine. The appearance of blue specks indicates a positive reaction. The admissibility of evidence based on this test has been upheld by a number of courts. The first reported case accepting the test was Commonwealth v. Westwood, 324 Pa. 289, 188 A. 304 (1936), and cases following *Westwood* are found through the 1960s. *See* Harris v. State, 239 Ark. 771, 394 S.W.2d 135 (1965), *cert. denied*, 386 U.S. 964 (1967); State v. Hoy, 199 Kan. 340, 430 P.2d 275 (1967); People v. Simpson, 5 Mich. App. 479, 146 N.W.2d 828 (1966); State v. Fields, 434 S.W.2d 507 (Mo. 1968).

Notwithstanding judicial acceptance, the paraffin test is seriously deficient because it is nonspecific; a significant number of substances other than gunpowder residues contain nitrates and nitrites and therefore also produce a positive reaction. One study reported that a positive reaction is produced by " 'rust,' colored fingernail polishes, residue from evaporated urine, soap and tap water." Cowan & Purdon, *A Study of the "Paraffin Test," 12 J. Forensic Sci. 19, 23 (1967).* Another study found that "[t]obacco or tobacco ash, fertilizer, pharmaceuticals, leguminous plants, urine . . . ." produce a reaction. Turkel & Lipman, *Unreliability of Dermal Nitrate Test for Gunpowder,* 46 J. Crim. L., C. & P.S. 281, 282 (1955). As a result of these and other studies, a number of courts have rejected the paraffin test. *See* Brooke v. People, 139 Colo. 388, 339 P.2d 993 (1959); Born v. State, 397 P.2d 924 (Okla. Crim. 1964), *cert. denied* 379 U.S. 100 (1965); Clarke v. State, 218 Tenn. 259, 402 S.W.2d 863 (1966), *cert. denied*, 385 U.S. 942

(1966). Moreover, the FBI has ceased to use the paraffin test. *See Gunshot Residues and Shot Pattern Tests,* 39 FBI Law Enforcement Bull. 7 (Sept. 1970).

See generally, A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases 584 (2d ed. 1978); Conrad, *Evidential Implications of the Dermal Nitrate Test for Gunpowder Residues,* 44 Marq. L. Rev. 500 (1961); Midkoff, *Detection of Gunshot Residues: Modern Solutions for an Old Problem,* 3 J. Police Sci. & Ad. 77 (1975).

Harrison-Gilroy Test

In 1959 a new method of gunshot residue detection was reported by Harold Harrison and Robert Gilroy. *See* Harrison & Gilroy, *Firearms Discharge Residues*, 4 J. Forensic Sci. 184 (1959). Unlike the paraffin test, the Harrison-Gilroy test was designed to detect primer, rather than powder, residues — the elements antimony, barium, and lead. Thus, the nonspecificity problem associated with the paraffin test was obviated. Nevertheless, the Harrison-Gilroy test was not adopted widely because of its marginal sensitivity. *See* Pillay, *New Method for the Collection and Analysis of Gunshot Residues as Forensic Evidence*, 19 J. Forensic Sci. 769 (1974).

There have been few reported decisions involving this test. In Commonwealth v. Farrior, 446 Pa. 31, 284 A.2d 684 (1971), the Pennsylvania Supreme Court upheld the admissiblity of the Harrison-Gilroy test. The court, however, cited *Commonwealth v. Westwood*, a paraffin test case, as authority for its holding, apparently believing that the two tests were identical. In State v. Smith, 50 Ohio App.2d 183, 362 N.E.2d 1239 (1976), a police officer claimed to have used a modified version of the Harrison-Gilroy test to detect residues on the defendant's hand. The test was rejected on appeal. According to the appellate court, the evidence in the record failed to establish that the officer was qualified "either to testify as to the theoretical basis of a new test for determining the presence of gunshot residue or to give expert testimony that such a test was generally accepted in the scientific community." *Id.* at 193, 362 N.E.2d at 1246.

Instrumental Analysis

Currently, a variety of instrumental techniques are used to detect gunshot residues. Perhaps the most common is neutron activation analysis. This method of analysis is discussed *infra.* In addition, atomic absorption spectrometry has been used in several cases. Like the Harrison-Gilroy test and activation analysis, this method is designed to detect the primer residues antimony and barium. The technique is described in Watkins & Watkins, *Identification of Substances by Instrumental Analysis*, 22 AM. JUR. Proof of Facts 385, 476-87 (1969); Midkiff, *Detection of Gunshot Residues: Modern Solutions for an Old Problem*, 3 J. Police Sci. & Ad. 77 (1975). Several cases have accepted atomic absorption as a method of gunshot residue detection. *See* Chatom v. State, 48 So.2d 828 (Ala. Crim. Ap.), *rev'd* 348 So.2d 838 (Ala.), *acq.* 348 So.2d 843 (Ala. Crim. App. 1977); State v. Crowder, 285 N.C. 42, 203 S.E.2d 38 (1974), *modified on other grounds*, 428 U.S. 903 (1976); State v. Chatman, 156 N.J. Super. 35, 383 A.2d 440 (1978).

One other method of detection has received judicial consideration. In People v. Palmer, 80 Cal. App.3d 239, 145 Cal. Rptr. 466 (1978), the court upheld the detection of gunshot residues by scanning electron microscopic analysis. *See generally*, Anrasko & Maehly, *Detection of Gunshot Residues on Hands by Scanning Electron Microscopy*, 22 J. Forensic Sci. 279 (1977); Matricardi & Kilty, *Detection of Gunshot Residue Particles from the Hands of a Shooter*, 22 J. Forensic Sci. 725 (1977).

NEUTRON ACTIVATION ANALYSIS

Neutron Activation Analysis (NAA) is a qualitative and quantitative method for determining the elemental composition of substances. A sample is first subjected to neutron bombardment in a nuclear reactor under controlled conditions. Once removed from the reactor, the irradiated substance tends to return to a stable atomic state (radioactive decay) during which time subatomic particles are emitted from the sample. One type of particle, gamma rays, is then detected and counted by means of gamma ray spectrometry. Since each element has a characteristic energy level of gamma radiation and a known rate of decay (half-life), these two indicia are used to determine the elemental composition of the sample.

NAA is forensically applied in two types of examinations. First, it is used in situations in which only the presence or absence of one or more elements is significant. For example, in the detection of gunshot residues, NAA is used to detect the presence and quantity of the elements antimony and barium on the hands of a person suspected of discharging a weapon. These elements are the primer constituents of most American-manufactured ammunition and their presence in certain concentrations is indicative of a recent discharge of a firearm. Second, NAA is used for comparative purposes. Trace elements in hair, blood, paint, soil, glass, bullets, drugs, and other substances discovered at a crime scene can be compared with similar items obtained from a suspect.

Because NAA is extremely sensitive, minute samples such as a single hair or paint chip can be analyzed. In some cases NAA is nondestructive, and therefore the evidence can be re-examined or introduced undamaged at trial. Nevertheless, the expense associated with operating a nuclear reactor is a disadvantage; only the major government, university, and industrial laboratories have the capability to conduct this type of analysis.

Admissibility of NAA Evidence

The theory of NAA is well accepted by the scientific community. Moreover, the technique — the use of a nuclear reactor irradiation and gamma ray spectrometry for detection — is recognized as an accurate analytical method of detection for many elements. Thus, it is not surprising that most courts that have considered NAA evidence have upheld its admissibility. *E.g.*, U.S. v. Stifel, 433 F.2d 431 (6th Cir. 1970), *cert. denied*, 401 U.S. 994 (1971) (analysis of bomb debris); People v. Collins, 43 Mich. App. 259, 204 N.W.2d 290 (1972), *aff'd*, 391 Mich. 798 (1974), *cert. denied*, 419 U.S. 866 (1974) (hair analysis); State v. Spencer, 298 Minn. 456, 216 N.W. 2d 131 (1974) (gunshot residue); State v. Coolidge, 109 N.H. 403, 260 A.2d 547 (1969), *rev'd on other grounds*, 403 U.S. 443 (1971) (particle analysis); State v. Krummacher, 523 P.2d 1009 (Ore.

1974) (bullet analysis). *See also* Annot., 50 A.L.R.3d 117 (1973).

Several courts, however, have held NAA evidence inadmissible for a variety of reasons. In U.S. v. Kelly, 420 F.2d 26 (2d Cir. 1969), the Second Circuit reversed the defendant's conviction for drug offenses because the prosecution failed to provide the defendant with adequate notice of activation analysis of the drugs. In State v. Coolidge, 109 N.H. 403, 260 A.2d 547 (1969), *rev'd on other grounds*, 403 U.S. 443 (1971), the court upheld the admissibility of activation analysis of particles but rejected NAA of hair samples. According to the court, hair analysis "would not be acceptable to scientists in the field" and thus would not satisfy the general acceptance standard. *Id.* at 420, 260 A.2d at 560. In State v. Stout, 478 S.W.2d 368 (Mo. 1972), the court rejected NAA of blood because this type of analysis also had not gained general acceptance in the scientific community. *Id.* at 371.

The Ohio Supreme Court considered the admissibility of NAA in State v. Holt, 17 Ohio St. 2d 81, 246 N.E. 365 (1969). The Court held that the results of activation analysis of hair was inadmissible. The Court, however, did not challenge directly the reliability of the technique; instead, the Court reversed because the NAA expert testified that the hair samples were *likely* to have come (rather than *probably* came) from the same source.

Interpretation Problems

The major problem associated with NAA evidence involves the interpretation of the results of activation analysis and not the validity of the technique. For example, in the detection of gunshot residues, NAA is used to detect the presence and quantity of the elements antimony and barium on the hands of a person suspected of firing a weapon. In State v. Spencer, 298 Minn. 456, 216 N.W.2d 131 (1974), a government expert testified that NAA revealed the presence of 1.67 micrograms of barium and 1.33 micrograms of antimony on the defendant's hands, thus conclusively establishing, in the expert's opinion, that the defendant recently had fired a gun.

The presence and quantity of antimony and barium, however, have no probative value unless the detected amounts differ from normal concentrations of these elements in the general population. The relevance of this type of information, therefore, depends on the validity of background studies of the general population and the proper correlation of these studies with the data derived from the analysis in a particular case. In short, NAA involves a problem of statistical probability. See Comment, *The Evidentiary Uses of Neutron Activation Analysis*, 59 Cal. L. Rev. 997 (1971). Thus, one commentator has suggested that the defense stipulate to the test results, and thereby focus the jury's attention on the interpretation issue. *Id.* at 1035-36. This tactic also would focus attention on the expert's qualifications because expertise in statistics, not chemistry, is critical. Finally, concentrating on the interpretative aspects of NAA may expose the exaggerated claims of some experts, such as statements that NAA is "as infallible as that of fingerprints." State v. Coolidge, 109 N.H. 403, 420, 260 A.2d 547, 560 (1969), *rev'd on other grounds*, 403 U.S. 443 (1971). *See also* State v. Spencer, 298 Minn. 456, 461, 216 N.W.2d 131, 134 (1974) ("We are concerned . . . about the sweeping and unqualified manner in which [the NAA expert's] testimony was offered.").

See also Watkins & Watkins, *Identification of Substances by Neutron Activation Analysis*, 15 AM. JUR. Proof of Facts 115 (1964); A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases ch. 9 (2d ed. 1978).

TRACE METAL DETECTION TECHNIQUE

Closely associated with gunshot residue tests, is the trace metal detection technique (TMDT). This test, however, is not used to establish that a person recently has fired a gun; it is used to establish that a person has *handled* a metal object, which may have been a gun. TMDT was developed pursuant to a grant by the Law Enforcement Assistance Administration. *See* LEAA, Trace Metal Detection Technique in Law Enforcement (Oct. 1970). According to that study, "[r]esearch has determined that metal objects leave traces on skin and clothing surfaces in characteristic patterns with intensities proportional to the interaction of weight, friction, or duration of contact with metal objects. The Trace Metal Detection Technique (TMDT) makes such metal trace patterns visible when skin or clothing is treated with a test solution and then is illuminated by ultraviolet light." *Id.* at 1. The pattern is photographed once it becomes visible. *Id.* at 6.

Three reported cases, including one from Ohio, have considered the admissibility of TMDT evidence. In two of these cases, State v. Daniels, 37 Ohio App.2d 4, 305 N.E.2d 497 (1973), and Reid v. State, 267 Ind. 555, 372 N.E.2d 1149 (1978), admissibility was upheld. Nevertheless, both cases present problems. *Daniels*, the first reported case involving TMDT, illustrates these problems. First, in that case evidence derived from TMDT was based on the testimony of a "ballistics expert." Although TMDT is designed to connect a person with the handling of a gun, the expertise needed to conduct this test is in no way related to the expertise of a firearms identification ("ballistics") examiner. Second, even if the police officer who testified was qualified to perform the test, he was not a scientist and therefore was not qualified to testify about the validity of the underlying theory of TMDT. Third, the court in *Daniels* did not apply the general acceptance test for the admissibility of novel scientific evidence. This test has been accepted by the Ohio courts of appeal. *See Scientific Evidence — Part I* at 2.

The *Reid* decision raises similar problems. In that case the expert testified that "his knowledge concerning TMDT came from a seminar presented by the manufacturer of the chemical solution, written instructions that accompanied the chemical and his personal experience in conducting such tests upon approximately fifteen occasions. He admitted that he had no understanding of the reason for the reaction that occurred when such test was administered." 267 Ind. at 559, 372 N.E.2d at 1152. Nevertheless, the court admitted the evidence. In support of its decision, the court offered only a barren and unadorned conclusion — "we believe [TMDT] is generally recognized as reliable." *Id.* In contrast, TMDT evidence was rejected in People v. Lauro, 91 Misc.2d 706, 398 N.Y.S.2d 503 (1977), because there was "absolutely no testimony before the Court as to this test having been received in any court or in the literature of forensic

science; nor is there any scientific data presented to show the reliability of this test." *Id.* at 712, 398 N.Y.S.2d at 507.

In addition, a study of TMDT has revealed several major problems with the technique. *See* Stevens & Messler, *The Trace Metal Detection Technique (TMDT): A Report Outlining a Procedure for Photographing Results in Color, and Some Factors Influencing the Results in Controlled Laboratory Tests*, 19 J. Forensic Sci. 496 (1974). First, that study "quickly disclosed the inadequacy of relying solely upon black-and-white photographs . . . ." *Id.* at 498. Second, "it is far better, whenever possible, to have the actual weapon involved available in order to directly compare any patterns observed on the suspect and the pattern known to result from handling that particular gun. There is always the possibility that the particular gun or tool used in the commission of a crime might impart a pattern sufficiently unique as to make a positive connection between the instrument and suspect possible. In any event, we strongly suggest that prospective users of the technique give some consideration to establishing a policy of routinely refusing requests to perform examinations unless the gun is available for direct comparison, at least until the observer has acquired considerable experience and familiarity with the various patterns." *Id.* at 500. This statement suggests that objects other than a gun may produce a pattern that may appear consistent with a gun pattern. Third, the utility of the test varies between subjects: "Some individuals always seemed to be good subjects for the tests, while others consistently displayed indistinct or moderately intense patterns." *Id.* at 501. Finally, the utility of the test varies depending on the object; the test "is influenced greatly by factors concerning the surface conditions of the object material. Indeed, some guns failed to produce any patterns under any conditions." *Id.*

See also Goldman & Thornton, *A New Trace Ferrous Metal Detection Reagent*, 21 J. Forensic Sci. 625 (1976); Glass & Grais, *A New Trace Metal Detection Reagent*, 26 J. Forensic Sci. 247 (1979).

BITE MARK COMPARISONS

In recent years a number of courts have admitted expert testimony concerning the comparison of bite mark impressions found on a homicide victim's body with impressions of a defendant's dentition. *E.g.*, People v. Marx, 54 Cal. App.3d 100, 126 Cal. Rptr. 350 (1975); People v. Slone, 76 Cal. App.3d 611, 143 Cal. Rptr. 61 (1978); People v. Milone, 43 Ill. App.3d 385, 356 N.E.2d 1350 (1976). *See also* Annot., 77 A.L.R.3d 1122 (1977).

The principal problem with bite mark evidence involves the interpretation of the comparative analysis. For example, in *Slone* the expert testified that "it is very highly probable that the bite mark on the victim was perpetrated by teeth belonging to the defendant." *Id.* at 621, 143 Cal. Rptr. at 67. In State v. Garrison, 120 Ariz. 255, 585 P.2d 563 (1978), the expert went much further, testifying, "that there is an eight in one million probability that the teeth marks found on the deceased breasts were not made by appellant." *Id.* at 258, 585 P.2d at 566. Such testimony overstates the conclusions that may be drawn from bite mark comparisons. Dr. Irvin Sopher has written:

> The problem of specificity in the bite mark analysis results from the lack of a scientific core of basic data for comparison. The results of the bite mark comparison may indicate a perfect or reasonably perfect fit between the bite mark and a suspect's dentition; however, how can one be absolutely or even perhaps reasonably certain that no other individual could have produced a particular bite? Classified bite mark charcteristics on large segments of the population are unavailable; therefore, an absolute scientific estimation of specificity regarding the particular bite mark/suspect comparison is not possible. The situation is comparable to the point in the distant past when the 100th set of fingerprints was classified. At that time, it was known that the set of prints did not match the ninety-nine others previously recorded, but it was not known if the set of prints were specific for only the one individual fingerprinted. I. Sopher, Forensic Dentistry 140 (1976).

Although it is highly unlikely that a positive identification can be made by bite mark comparison, often it is possible to eliminate a suspect through this technique. If the comparison shows that the defendant's dentition is inconsistent with the bite mark, it follows that the defendant's teeth could not have made the mark. *See* Dinkel, *The Use of Bite Mark Evidence as an Investigative Aid*, 19 J. Forensic Sci. 535 (1974) ("Currently, the major contribution of bite mark evidence is the elimination of suspects since the establishment of a positive identification is rare.")

See also A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases ch. 16 (2d ed. 1978); Note, *The Admissibility of Bite-Mark Evidence*, 51 S. Cal. L. Rev. 309 (1978).

FINGERPRINT EVIDENCE

Fingerprint identification evidence frequently is used to connect a suspect with a crime scene. There are only a few ways to challenge fingerprint evidence. First, "[o]ne of the limiting factors in fingerprint identification is that from a study of a latent fingerprint alone it cannot be determined at what time or date the impression was made." A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases 389 (2d ed. 1978). Therefore, if it can be shown that the defendant had innocent access to the place where the print was discovered, the probative value of the evidence becomes marginal.

In State v. Miller, 49 Ohio St.2d 198, 361 N.E.2d 419 (1977), the Ohio Supreme Court considered the sufficiency of fingerprint evidence. The Court stated:

> In determining the sufficiency of the fingerprint evidence, a reviewing court must examine this evidence on a case-by-case basis. The crucial issue is whether attendant circumstances, such as the location of the accused's alleged fingerprint, the character of the premises where the print was found, and the accessibility of the general public to the object on which the print was impressed are sufficient to justify the trier of fact to conclude not only that the accused was at the scene of the crime when it was committed, but also that the accused was the criminal agent. *Id.* at 202-03, 361 N.E.2d at 422-23.

Second, in cases of marginal ridge detail experts may disagree on whether fingerprint evidence is conclusive. There are a number of factors that may account for this disagreement: "A

ridge count between two characteristics may be erroneous if dirt or dust has caused a ridge to appear as one or two islands; . . . variation in pressure may cause discrepancies between prints such as a bifurcation being registered in another print as an ending ridge; . . . excess pressure in an inked print may squeeze several ridges together so that they may appear as one ridge; . . . powder used to develop prints may stick between ridges, indicating the presence of a ridge characteristic where there is none. . . ." A. Moenssens & F. Inbau, *supra*, at 392.

Fingerprint evidence also can be used affirmatively by the defense. For example, the discovery of crime-scene prints of a third party would assist the defense in establishing that the defendant had not committed the charged offense. The relevance of this type of evidence was recognized by the court in Corley v. State, 335 So.2d 849 (Fla. App. 1976): "On this appeal from a conviction for second degree murder, we reverse for a new trial because of the trial court's erroneous exclusion of proferred testimony that the only identifiable fingerprints on a vodka bottle found on a couch near the victim's body were those of an unidentified third person and had been made neither by the decedent nor the defendant. The evidence was plainly admissible in support of the defense that the crime was committed by someone other than the defendant . . . ." *Id.* at 850.

See generally FBI, The Science of Fingerprints (1973); A. Moenssens, Fingerprints and the Law (1969); A. Moenssens, Fingerprint Techniques (1971); *Fingerprints*, 5 AM. JUR. Proof of Facts 77 (1960).

HAIR COMPARISONS

In many crimes of violence, such as homicide and rape, there is an exchange of trace elements, such as hair and fibers, between the assailant and the victim. The admissibility of hair comparisons has proved controversial, principally because prosecution experts have overstated the conclusions that can be drawn from such a comparison. Currently, an expert cannot state, except in a rare case, that a sample of hair came from a particular person. Thus, the FBI will reach one of the following conclusions after comparing two samples:

a. Hairs match in microscopic charcteristics and originated either from same individual or from another individual of same race whose hairs exhibit the same microscopic characteristics.
b. Hairs are dissimilar and did not originate from same individual.
c. No conclusion could be reached. FBI, Handbook of Forensic Science 25 (Rev. 1978).

Obviously, the prosecution will introduce only testimony embracing the first conclusion. The probative value of this evidence depends, of course, on the number of persons "of the same race whose hairs exhibit the same microscopic characteristics." There could be a million people who fall into that category.

In order to enhance the value of such evidence, some prosecutors have attempted to introduce statistical evidence. Evidence of the probability that a sample of hair came from the defendant easily can be misunderstood and misused. For a case illustrating such misuse, *see* U.S. v. Massey, 594 F.2d 676 (8th Cir. 1979), in which the court reversed the defendant's conviction because statistical evidence of hair analysis was presented erroneously to the jury.

MISCELLANEOUS TECHNIQUES

The scope of this article does not permit the examination of all the scientific techniques currently used in criminal investigations and prosecutions. Nevertheless, the following techniques (and references) are important and therefore are noted briefly.

Forensic Pathology

In most homicide prosecutions a forensic pathologist will be able to provide important information concerning the cause and manner of death, the time of death, and the identification of the victim. There are a number of excellent texts on the subject. *See* L. Adleson, The Pathology of Homicide (1974); R. Fisher & C. Petty, A Handbook of Forensic Pathology for Non-Forensic Pathologists (1977); Gradwhol, Medicolegal Investigation of Death (1972). *See also* A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases ch. 5 (2d ed. 1978).

Blood and Semen Examinations

In many criminal investigations it is important to know whether a stain is human blood, and if human blood, the type. Moreover, the identification of a substance as semen is frequently crucial in rape prosecutions. Texts on blood and semen examinations include: A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases ch. 6 (2d ed. 1978); C. McCormick Evidence § 211 (2d ed. 1972); *Examination of Biological Fluids*, 41 FBI Law Enforcement Bull. 12 (June 1972).

Drug Analysis

Prosecutions for the possession, sale, or distribution of controlled substances inevitably involve the chemical analysis of the substance. A number of challenges to laboratory tests have been considered by the courts. *See* U.S. v. Bockius, 564 F.2d 1193 (5th Cir. 1977) (only L-cocaine proscribed by federal statute and polarimeter analysis required to detect this type of cocaine); State v. Vail, 274 N.W.2d 127 (Minn. 1979) (upholding a trial court's ruling that common laboratory tests for marihuana failed to establish identity of seized substance). A number of texts and articles treat the subject of laboratory drug tests. *See* D. Bernheim, The Defense of Narcotics Cases ch. 4 (1972); F. L. Bailey & H. Rothblatt, Handling Narcotics and Drug Cases 290-95 (1972); Shapiro, *Chemical Defenses in Drug Cases*, 2 Nat'l J. Crim. Defense 131 (Spring 1976); Shellow, *The Expert Witness in Narcotics Cases*, in ABA, Effective Criminal Trial Techniques 173 (B. George ed. 1978); Stein, Laessig & Indriksons, *An Evaluation of Drug Testing Procedures Used by Forensic Laboratories and the Qualifications of Their Analysis*, 1973 Wis. L. Rev. 727.

Firearms Identifications

Firearms identification is a well-established forensic technique. Firearms identification examiners often are referred to as "ballistics" experts; such a designation is erroneous because ballistics, the study of the motion of a projectile, has little to do with firearms identifications. In addition to comparative analysis of bullets, firearms identification experts are involved in an assortment of related techniques such as toolmark iden-

tifications, cartridge case identifications, muzzle to target distance determinations, and obliterated serial numbers restoration. In an early case, an Ohio court accepted the testimony of a firearms identification examiner. *See* Burchett v. State, 35 Ohio App. 463, 172 N.E 555 (1930). *See also* Annot., 26 A.L.R.2d 892 (1952). *See generally* A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases ch. 4 (2d ed. 1978); J. Mathews, Firearms Identification (1973); *Firearms Identification*, 29 AM. JUR. Proof of Facts 65 (1962).

Questioned Document Examinations

Questioned document examiners frequently are encountered in criminal prosecutions, especially forgery and fraud cases. In addition to handwriting comparisons, questioned document examiners compare handprinting and typewriting as well as examine paper and watermarks. The Ohio cases are discussed in R. Markus, Handbook for Ohio Lawyers § 264 (1973). *See generally* A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases ch. 10 (2d ed. 1978); J. Conway, Evidential Documents (1959); O. Hilton, Scientific Examination of Documents (1956).

Intoxication Tests

Whether or not a defendant was intoxicated is a critical issue in driving under the influence, R.C. 4511.19, and vehicular homicide prosecutions, R.C. 2903.07. Evidence of intoxication also may be used to establish that a defendant did not possess the requisite mental state in homicide prosecutions. *See* W. LaFave & A. Scott, Criminal Law 341 (1972). The admissibility of intoxication tests is recognized by R.C. 4511.19-.191. A number of cases have considered the admissibility of various intoxication tests. *See* State v. Walker, 53 Ohio St.2d 192, 374 N.E.2d 132 (1978); State v. Steele, 52 Ohio St.2d 187, 370 N.E.2d 740 (1977); City of Columbus v. Marks, 118 Ohio App. 359, 194 N.E.2d 791 (1963). *See generally* A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases ch. 2 (2d ed. 1978); C. McCormick, Evidence § 209 (2d ed. 1972); Annot., 72 A.L.R.3d 325 (1976).

Speedmeters

Evidence of the speed of an automobile as determined by radar and VASCAR has long been accepted by the courts. In State v. Aquilera, 25 Crim. L. Rptr. 2189 (Fla. County Ct. 1979), however, a Florida trial court refused to accept radar evidence. The *Aquilera* decision has generated a nationwide debate on the reliability of radar and other types of speedmeters. *See* Schuon, *Police Radar Examined Amid Debate*, N.Y. Times, Nov. 27, 1979, § C, at 1, col. 1. Several Ohio cases have considered the admissibility of speedmeters. Most of these cases, however, were decided prior to the current controversy. *See* City of East Cleveland v. Ferell, 168 Ohio St. 298, 154 N.E.2d 630 (1958) (judicial notice of radar); State v. Shelt, 46 Ohio App.2d 115, 346 N.E.2d 345 (1976) (MR-7 radar device); State v. Wilcox, 40 Ohio App.2d 380, 319 N.E.2d 615 (1974) (radar); State v. Bonar, 40 Ohio App.2d 360, 319 N.E.2d 388 (1973) (DC-7 radar device); Tiffin v. Whitmer, 32 Ohio Misc. 169, 290 N.E.2d 198 (1970) (VASCAR); City of Akron v. Gray, 60 Misc. 68, 379 N.E.2d 429 (1979) (K-55 radar unit). *See also* State v. Boyington, 153 N.J. Super. 252, 379 A.2d 486 (1977) (Decatur Ragun); State v. Musgrave, 25 Crim. L. Rptr. 2404 (N.J. Super. Ct. 1979) (K-55 radar device).

See also A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases ch. 13 (2d ed. 1978); C. McCormick, Evidence §210 (2d ed. 1972); Annot., 47 A.L.R.3d 822 (1973).

Hypnotic Evidence

The courts generally have excluded testimony of a witness while under hypnosis. A number of courts, however, have admitted the testimony of a witness whose memory has been stimulated by hypnosis. *See* Wyller v. Fairchild Hiller Corp., 503 F.2d 506 (9th Cir. 1974); U.S. v. Narciso, 446 F. Supp. 252, 277-82 (E.D. Mich. 1977); State v. McQueen, 295 N.C. 96, 244 S.E.2d 414 (1978). *See generally* A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases 632-38 (2d ed. 1978); Spector & Foster, *Admissibility of Hypnotic Statements: Is the Law of Evidence Suspectible?*, 38 Ohio St. L.J. 567 (1977); Herman, *The Use of Hypno-Induced Statements in Criminal Cases*, 25 Ohio St. L.J. 1 (1964); Annot., 92 A.L.R.3d 442 (1979).

Psychological Stress Evaluation

The psychological stress evaluator (PSE) is an instrument that is designed to detect stress in the human voice and is used to determine whether a subject is being truthful or not. In short, it is a type of lie detector. It has not been shown, however, to be as reliable as the polygraph. The one case that considered the admissibility of PSE evidence, rejected it. *See* Smith v. State, 31 Md. App. 106, 355 A.2d 527 (1976). *See generally* A. Moenssens & F. Inbau, Scientific Evidence in Criminal Cases 638-43 (2d ed. 1978); Note, *The Psychological Stress Evaluator: Yesterday's Dream — Tomorrow's Nightmare*, 24 Cleve. St. L. Rev. 299 (1975); Note, *The Psychological Stress Evaluator: A Recent Development in Lie Detector Technology*, 7 U.C.D.L. Rev. 332 (1974).

Remote Sensing Evidence

Remote sensing evidence has been a factor in several criminal cases. *See* U.S. v. Kilgus, 571 F.2d 508 (9th Cir. 1978) (Forward Looking Infrared System used to establish the identity of aircraft held inadmissible); U.S. v. Mora-Chavez, 496 F.2d 1181 (9th Cir.), *cert. denied*, 419 U.S. 878 (1974) (ground sensors used to establish probable cause). The subject is treated exhaustively in Latin, Tannehill & White, *Remote Sensing Evidence and Environmental Law*, 64 Cal. L. Rev. 1300 (1976). *See also* 19 Santa Clara L. Rev. 491 (1979).

Photographic Evidence

The most comprehensive work on photographic evidence, is a three-volume text: C. Scott, Photographic Evidence (2d ed. 1969).