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ADMISSIBILITY OF SCIENTIFIC EVIDENCE—AN ALTERNATIVE TO THE *Frye* RULE

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I. INTRODUCTION

The *Frye* rule¹ has different meanings for forensic scientists, prosecutors, defense attorneys, and judges. To forensic scientists and prosecutors, the *Frye* rule is an obstacle that often excludes evidence based on novel scientific techniques. Although the *Frye* rule also prevents the defendant's novel scientific evidence from reaching the jury, defense attorneys and the few forensic scientists who work with the defense bar see the rule as an ineffective barrier to unreliable prosecution evidence. The meaning of the *Frye* rule to judges is less clear. Many judges do not perceive the rule as a significant issue.²

The importance of the *Frye* rule initially was not apparent. The only unusual feature about *Frye* was that it was the first case in which the admissibility of evidence from a lie detector instrument

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1. The *Frye* rule, enunciated by the United States Court of Appeals for the District of Columbia Circuit, imposes on proponents of novel scientific evidence the burden of establishing that the scientific technique or principle in question has "gained general acceptance in the particular field in which it belongs." *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923). See *infra* notes 8-11 and accompanying text.

2. At a symposium sponsored by the National Conference of Lawyers and Scientists in April 1983, Michael Graham related his experience in dealing with trial judges at annual conferences over the past six years. He reported that, of all the topics discussed, "none was as unpopular with the judges as scientific evidence." *Symposium on Science and the Rules of Evidence*, 99 F.R.D. 187, 220 (1983) [hereinafter cited as *Symposium Report*]. He continued: "No matter how hard we tried, we could not elicit any excitement about the *Frye* test. They acted as if the issue just did not come up in their courtrooms." *Id.* at 221.

The author has had many similar experiences in discussing scientific evidence with judges. Graham's lament, "How can we expect the attorneys to be concerned about scientific evidence if the judges do not perceive it as a problem?," is a serious one. *Id.* This concern is related to the scientific illiteracy of judges and lawyers. See *infra* notes 27-54 and accompanying text.

was at issue.³ The opinion was brief and cited no authority for the rule it announced.⁴ Although the *Frye* rule did not gain immediate judicial acceptance, the rule gradually spread throughout state and federal courts and became the generally accepted legal test for the admissibility of novel scientific evidence. Since the late 1960's, courts have cited *Frye* in virtually every criminal prosecution dealing with a novel form of expert evidence.

Courts have treated the *Frye* rule as a conservative approach to deciding whether to admit test results based on novel scientific techniques or experiments.⁵ Many courts favor a conservative approach because juries may be overly impressed by experts with seemingly impressive credentials. Additionally, juries may give greater weight to expert opinions than the opinions deserve on the basis of scientific validity. Courts, therefore, have exercised considerable restraint when dealing with evidence based on principles that have not been proven sufficiently reliable, or when confronting techniques that engender results not readily replicable by others in the scientific field. By excluding evidence that fails to satisfy the *Frye* rule, courts have sought to shield jurors from the influence of testimony that might sound more impressive than it actually is.

A conservative test—one that will not permit the prosecution or the defense to use evidence based on tests of unproven reliability—is especially commendable in criminal cases, in which the technical inquiry is directed toward resolving the ultimate issue of guilt.⁶ When scientific tests purport to identify the defendant as the guilty party,⁷ courts must screen out those techniques that do not invariably point to the guilty party. Otherwise, the jury might be deceived.

This Article analyzes the *Frye* rule, and demonstrates why the

3. See *infra* text accompanying notes 8-9.

4. The brevity of the *Frye* decision belies its importance. As Professor Starrs remarked, "the creation of the world, a far less trifling affair [than *Frye*], was told in a mere 600 words." Starrs, *A Still-Life Watercolor: Frye v. United States*, 27 J. FORENSIC SCI. 684 (1982) (manuscript).

5. See, e.g., *People v. Kelly*, 17 Cal. 3d 24, 549 P.2d 1240, 130 Cal. Rptr. 144 (1976).

6. Some authorities have suggested, however, that general acceptance should not be the standard for admissibility, but for taking judicial notice. See MCCORMICK'S HANDBOOK OF THE LAW OF EVIDENCE § 203 (2d ed. 1972) [hereinafter cited as MCCORMICK].

7. Evidence that purports to positively identify individuals includes fingerprint comparisons, sound spectrography, bitemark impressions, and handwriting analyses.

rule remains a significant issue. Examining a variety of problems that have arisen under the rule, the Article concludes that the rule does not adequately screen novel scientific techniques. The Article concludes, therefore, by advocating the abandonment of *Frye*, and by proposing a new procedure to determine the admissibility of novel scientific evidence.

II. THE *Frye* RULE—GENESIS, ANALYSIS, AND THE NEED FOR CHANGE

In *Frye v. United States*,⁸ the defendant attempted to introduce evidence of a novel systolic blood pressure deception test, the first of the so-called "lie detectors" and the ancestor of the modern polygraph. The defendant wanted to offer expert testimony showing that, when he was examined, he had denied truthfully any involvement in the crime for which he was charged. The trial court sustained the government's objection to the evidence and refused the defendant's request to be tested in the presence of the jury.⁹ On appeal, the United States Court of Appeals for the District of Columbia Circuit upheld the trial court's exclusion of the evidence because the defendant had not proven that the technique was reliable.¹⁰

In its opinion, the appellate court formulated a sweeping principle to guide future courts in deciding whether to admit evidence derived from new scientific processes, instruments, or techniques:

Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.¹¹

8. 293 F. 1013 (D.C. Cir. 1923).

9. *Id.* at 1014.

10. *Id.*

11. *Id.* Countless court opinions, articles, and books have quoted this passage. See, e.g., A. MOENSSENS & F. INBAU, *SCIENTIFIC EVIDENCE IN CRIMINAL CASES* § 1.03 (2d ed. 1978); Gianelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half-Century*

This principle has become known as the *Frye* rule, or the general acceptance test. The rule posits that evidence based on a new scientific investigative technique or instrumental analysis will be admitted only after the proponent has established that the field or discipline to which the technique belongs generally has accepted the technique as reliable in its results, replicable by other qualified workers in the discipline, and based upon sound scientific principles. The rule, however, is easier to state than to apply. An examination of some problems that have arisen under the rule demonstrates the difficulty and highlights the need for change.

A. Determining the Field to Which a Technique Belongs

To apply the *Frye* rule, a court first must determine the field to which a new technique belongs. In *Frye*, the court determined that the lie detector belonged to the fields of psychology and physiology.¹² Some courts have determined the proper field without difficulty, but other courts have had difficulty with this step of the analysis.¹³ Occasionally, new techniques compound the problem by combining elements of several disciplines, with no discipline claiming the novel process as its own. An imaginative expert who develops a new technique may be considered radical by his conservative peers, who may reject the technique regardless of its validity.¹⁴ Alternatively, a discipline may accept a new technique simply because the technique promotes the overall objectives of the discipline.¹⁵ The discipline might accept the new technique, therefore,

Later, 80 COLUM. L. REV. 1197, 1204-05 (1980); Graham, *Relevancy and the Exclusion of Relevant Evidence: Admissibility of Evidence of a Scientific Principle or Technique—Application of the Frye Test*, 19 CRIM. L. BULL. 51, 52 (1983); Imwinkelried, *The Standard for Admitting Scientific Evidence: A Critique from the Perspective of Juror Psychology*, 28 VILL. L. REV. 554, 556 n.18 (1983); Starrs, *supra* note 4.

12. Interestingly, neither the practitioners of psychology nor the practitioners of physiology have claimed the lie detector as appropriately belonging to their field.

13. See, e.g., *People v. Slone*, 76 Cal. App. 3d 611, 143 Cal. Rptr. 61 (1978) (bitemark identification belongs in "the community of dentistry"); *Cornett v. State*, ___ Ind. ___, 450 N.E.2d 498 (1983) (the relevant scientific community for spectrographic voice identification should include linguists, psychologists, and engineers, in addition to the people who use voice spectrography for identification purposes).

14. Moenssens, *Requiem for the "General Acceptance" Standard in Forensic Science—Some Whimsical Thoughts on the Battle of Frye v. The Federal Rules of Evidence*, in 1982 LEGAL MED. ANN. 275, 276 (C. Wecht ed.).

15. *Id.*

without requiring objective scientific validation of the underlying postulates.¹⁶

A vivid example of a discipline's acceptance of a technique without requiring scientific validation is the development of the voiceprint technique—the revolutionary method of identifying speakers by comparing their voices with a sound spectrograph. The technique is a byproduct of radio communications and audiology. A third discipline, fingerprint identification, recognized the voiceprint as a potentially useful law enforcement tool. The three different disciplines spawned a fourth one, the entirely new field of voiceprint examination.¹⁷

The budding field of sound spectrographic voice identification illustrates the difficulty of applying the *Frye* rule. Must the technique be generally accepted by the field of radio communications, speech and audiology, fingerprint identification, or voiceprint examination? Radio communication and fingerprint identification have no direct connection with voiceprints and can be discarded as sponsor disciplines.¹⁸ Audiology and speech analysis rejected the premises on which the new technique was based,¹⁹ leaving only the new discipline of voiceprint examination.

With the exception of the professor of audiology who embraced the voiceprint after initially spurning it and the electrical engineer who first coined the name "voiceprint," the only other early examiners were law enforcement officers who lacked training in scientific inquiry and validation. After one court finally admitted

16. *Id.*

17. *Id.* For a description of the development of this new discipline and of its professional association, the International Association of Voiceprint Identification, see A. MOENSSENS & F. INBAU, *supra* note 11, § 12.08. The organization has since been dissolved and its members have been absorbed by the International Association for Identification, an association of crime laboratory specialists, primarily fingerprint experts. That association currently has a Voice Identification and Acoustic Analysis Section Certification Program, and has attracted additional scientifically inclined members. For details on the credentialing process, see IDENTIFICATION NEWS, Dec. 1982, at 5.

18. A "sponsor" discipline is one which may contribute or relate to the technique in question, but which is not the principle user of the technique.

19. Many speech and audiology specialists use the sound spectrograph in connection with their work. The majority, however, reject the underlying premise upon which the narrow field of voiceprint identification relies, voice uniqueness, because the premise has never been empirically established.

voiceprint evidence,²⁰ other appellate courts began to uphold the admission of voiceprint evidence, concluding that the technique satisfied the *Frye* test.²¹ In every case, experts testified that voiceprint identification was accurate and reliable; and each appellate decision allowed other courts to follow more comfortably the growing number of precedents. The trend in favor of admitting voiceprints continued until a group of lawyers discovered that, in each case, the same two or three experts had been the proponents who bestowed "general acceptance" on the technique.

This discovery brought the trend to a halt in *People v. Kelly*.²² In *Kelly*, the California Supreme Court declared unanimously that the reliability of voiceprint identification could not be established by proof of its acceptance among a limited group of individuals whose professional careers depended on the reliability of the process.²³ The court stated that general acceptance requires validation by disinterested scientists, and that testimony by law enforcement technicians who lacked scientific training was insufficient.²⁴ Witnesses who lack scientific training cannot "fairly and impartially assess the position of the scientific community."²⁵ Following *Kelly*, several other appellate courts reached the same conclusion,²⁶ thus

20. *United States v. Wright*, 17 C.M.A. 183, 37 C.M.R. 447 (1967).

21. *See, e.g.*, *United States 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. 1975); *United States v. Williams*, 443 F. Supp. 269 (S.D.N.Y. 1977); *Hodo v. Superior Court*, 30 Cal. App. 3d 778, 106 Cal. Rptr. 547 (1973); *Alea v. State*, 265 So. 2d 96 (Fla. Dist. Ct. App. 1972); *Worley v. State*, 263 So. 2d 613 (Fla. Dist. Ct. App. 1972); *Commonwealth v. Lykus*, 367 Mass. 191, 327 N.E.2d 671 (1975); *Trimble v. Hedman*, 291 Minn. 442, 192 N.W.2d 432 (1971); *State v. Olderman*, 44 Ohio App. 2d 130, 336 N.E.2d 442 (1975).

Not all jurisdictions, of course, found that voiceprint evidence satisfied the *Frye* test. *See, e.g.*, *United States v. McDaniel*, 538 F.2d 408 (D.C. Cir. 1976); *United States v. Addison*, 498 F.2d 741 (D.C. Cir. 1974); *People v. Law*, 40 Cal. App. 3d 69, 114 Cal. Rptr. 708 (1974); *People v. King*, 266 Cal. App. 2d 437, 72 Cal. Rptr. 478 (1968); *State v. Cary*, 49 N.J. 343, 230 A.2d 384 (1967), *aff'd*, 56 N.J. 16, 264 A.2d 209 (1970).

22. 17 Cal. 3d 24, 549 P.2d 1240, 130 Cal. Rptr. 144 (1976).

23. *Id.* at 38, 549 P.2d at 1249, 130 Cal. Rptr. at 153.

24. *Id.* at 38-39, 549 P.2d at 1249-50, 130 Cal. Rptr. at 153-54.

25. *Id.* at 38, 549 P.2d at 1249, 130 Cal. Rptr. at 153.

26. *See, e.g.*, *Cornett v. State*, ____ Ind. ____, 450 N.E.2d 498 (1983) (the relevant scientific community for spectrographic voice identification is not limited to those who use spectrography for identification purposes, but includes linguists, psychologists, and engineers); *People v. Tobey*, 401 Mich. 141, 257 N.W.2d 537 (1977) (general scientific acceptance may not be established without the testimony of disinterested and impartial experts whose livelihood was not intimately connected with the new technique); *Commonwealth v. Topa*, 471

halting the trend toward admitting voiceprint evidence.

B. Causes of False General Acceptance

Several factors may have contributed to the initial judicial acceptance of voiceprint evidence. The most important factor, however, was the ignorance of both judges and lawyers about scientific issues. Many appellate judges simply do not understand evidence based on scientific principles.²⁷ More importantly, judges frequently misunderstand the evidence by overlooking attributes of the evidence, as well as by ascribing attributes to the evidence that it lacks.

A principle announced in *Schmerber v. California*²⁸ illustrates this misunderstanding. In *Schmerber*, the police had compelled the defendant to give a blood sample following his arrest for driving under the influence of alcohol. The defendant argued that the police should have obtained a warrant before administering the blood

Pa. 223, 369 A.2d 1277 (1977) (the testimony of an expert witness, who was a law enforcement officer and who had made a career of traveling around the country testifying about the functions and acceptance of voiceprints, was insufficient to establish general acceptance).

Some courts are now beginning to accept voiceprint evidence again. *See, e.g.*, *United States v. Williams*, 583 F.2d 1194 (2d Cir. 1983); *State v. Williams*, 388 A.2d 500 (Me. 1978); *State v. Williams*, 4 Ohio St. 3d 53, 446 N.E.2d 444 (1983).

27. The lack of understanding is not limited to appellate judges, but extends to trial judges, as well as to most lawyers. *See Symposium Report, supra* note 2, at 220-21. Another symposium commentator, Professor Joseph Nicol, a criminalistics educator and forensic scientist, indicted the entire legal community when he lamented:

Appellate decisions often are simply appalling in the degree of scientific naivete displayed. Subsequent decisions then rest upon them as precedent for the validity or general acceptance of a scientific procedure. . . .

An even more important consideration is the inability of the defense bar to handle scientific matters. The sad truth is that those attorneys simply are incapable by education, and all too often by inclination, to become sufficiently familiar with scientific evidence to discharge their responsibilities toward the administration of justice. The scientific illiteracy of nearly all lawyers is a disgrace to their profession. The fault lies equally with the individual lawyers and the legal profession, including law schools and bar associations.

Id. at 221.

Professor Michael Graham commented that "[a]n underlying problem is that lawyers do not understand science, including the fundamentals of the scientific method and the techniques by which scientific evidence is generated." *Id.* at 232. Similarly, Professor Margaret Berger noted "the lack of scientific literacy on the part of most defense attorneys." *Id.* at 233. Prosecutors fare no better, but they typically are supported in their efforts by the state's expert witnesses. *Id.*

28. 384 U.S. 757 (1966).

test. The United States Supreme Court held that the evanescent quality of blood and other body fluids, and the need to preserve the evidence of intoxication, permitted the police to take a blood sample without first obtaining a warrant.²⁹ Because the blood-alcohol level changes as the body metabolizes alcohol, police must obtain a blood sample immediately to measure accurately the blood-alcohol concentration at the time of arrest.

Unfortunately, courts have not always interpreted *Schmerber* sensibly. In *Ortega v. State*,³⁰ a police officer had observed several bloodstained items in the bedroom of a murder suspect. The officer notified a detective who then seized the bloodstained evidence without a warrant. The Wyoming Supreme Court held that the officers had the right to seize the evidence without a warrant because the evidentiary value of blood and body fluids diminishes with time,³¹ a point recognized by the United States Supreme Court in *Schmerber*.³² The majority apparently did not believe that evidence of bloodstains for the purpose of determining the blood type is very stable, and not evanescent—a fact known by all forensic serologists. Blood type will not deteriorate quickly and appreciably, as will the blood-alcohol concentration of an intoxicated driver. As the dissent accurately noted, even dried bloodstains are stable and can be typed months after the stains were left.³³ Yet, because *Schmerber* dealt with evidence involving blood, the court in *Ortega* thoughtlessly applied the *Schmerber* ruling to the evidence before it, apparently reasoning that the purpose for which blood is analyzed is irrelevant.³⁴

Another example of judicial misunderstanding of scientific evi-

29. *Id.* at 770-71. The evanescent quality was not the blood itself, but the measurable level of alcohol in the blood of the suspected drunken driver.

30. 669 P.2d 935 (Wyo. 1983).

31. *Id.* at 942.

32. *Id.*

33. *Id.* at 946 (Rose, J., dissenting); see also Stone, *Capabilities of Modern Forensic Laboratories*, 25 WM. & MARY L. REV. 659, 668 (1984).

34. Another famous blood-typing case is *Berry v. Chaplin*, 74 Cal. App. 2d 652, 169 P.2d 442 (1946). In a paternity suit against Charlie Chaplin, the court held that although the scientific evidence of the blood tests conclusively established that Chaplin could not have been the father, the jury was not bound to accept this scientifically immutable fact and could find that the plaintiff had established paternity. To support the jury's factfinding, the court noted that Chaplin had been required to stand in front of the jury next to the plaintiff and her child, so as to permit a visual comparison—hardly a test of scientific value!

dence occurred in *Smith v. State*.³⁵ In *Smith*, the court considered for the first time whether the results of a psychological stress evaluator (PSE), a device designed to detect deception by an examination of the voice, were admissible. The theory underlying the technique is that a person's voice emits both audible sound frequencies and a series of inaudible frequency sound waves.³⁶ The examiner feeds the recorded voice tape into a PSE, "which is similar to an electrocardiogram machine."³⁷ From an examination of the printed frequency bands of the sound, the examiner purports to determine whether the speaker is telling the truth.³⁸

The court in *Smith* compared the device's accuracy to that of the "lie detector."³⁹ The court concluded that Maryland had rejected "the art of lie detecting" because it generated unreliable results,⁴⁰ and the court, therefore, rejected the PSE results.⁴¹ The court reasoned that "[t]he difference, if any, between the psychological stress evaluation test and a lie detector test is too minor and shadowy to justify a departure from our prior decision. A lie detector test by any other name is still a lie detector test."⁴² A similarity might exist between the nature of the PSE technique and the voiceprint spectrographic examination. No similarity exists, however, between the techniques of the PSE and the polygraph, although both seek the same result. The court demonstrated a lack of understanding of scientific evidence in its refusal to recognize the differences between scientific techniques.

A final example⁴³ of the lack of judicial understanding of scientific evidence involved gunpowder residue testing. In 1933, a Mexican criminalist developed the paraffin test to prove that a person

35. 31 Md. App. 106, 355 A.2d 527 (1976).

36. *Id.* at 119, 355 A.2d at 535.

37. *Id.*

38. *Id.*

39. *Id.* at 119-20, 355 A.2d at 536. The court, in using the term "lie detector," probably was referring to the polygraph because the cited authority discussed polygraphs.

40. *Id.* at 120, 355 A.2d at 535.

41. 31 Md. App. at 120, 355 A.2d at 536.

42. *Id.* at 120, 355 A.2d at 536. Similar reasoning could lead a court to conclude that no difference exists between the functioning of an automobile, an airplane, and a ship because all are designed for the same purpose—to move people.

43. This is not the final example in the sense that no more examples exist. In fact, dozens of other examples of judicial scientific inaccuracies exist. The author is collecting such examples for use in another study.

recently had fired a gun. When a gun is discharged, the gases exploding from the ammunition leave nitrate and nitrite particles on the hand that held the weapon. The paraffin test is used to determine whether the suspect has traces of these substances on his hands.⁴⁴

The first appellate decision to approve of paraffin test evidence was *Commonwealth v. Westwood*.⁴⁵ In *Westwood*, the Pennsylvania Supreme Court upheld the admission of gunpowder residue evidence of nitrates and nitrites despite testimony by a chemist for the defense that the chemical test would produce an identical reaction with many other substances that might adhere to the hand, including substances found in any household.⁴⁶ The court upheld the technique because it believed that the test was fairly reliable, if not infallible.

This precedent survived until the 1950's, when evidence appeared in legal and technical literature demonstrating that the test results not only were nonspecific for gunpowder residues, but that the likelihood that an accurate conclusion could be drawn from the test was less than fifty percent.⁴⁷ The Supreme Court of Colorado reversed a conviction based on the paraffin test because the test enjoyed no particular reputation for accuracy.⁴⁸ However, not until Interpol published a report on scientific methods of identification that included a condemnation of the paraffin test as unreliable and without evidentiary value⁴⁹ did the death knell sound for the par-

44. The particular technique used is described in A. MOENSSSENS & F. INBAU, *supra* note 11, § 4.12. After making a paraffin cast of the suspect's hands, the inside of the cast is then treated with a chemical solution. If blue specks form on the paraffin, the suspect might have fired a gun recently.

45. 324 Pa. 289, 188 A. 304 (1946).

46. *Id.* at 296-300, 188 A. at 307-09.

47. See, e.g., Turkel & Lipman, *Unreliability of Dermal Nitrate Test for Gunpowder*, 46 J. CRIM. L. CRIMINOLOGY & POLICE SCI. 281 (1955). But see Conrad, *Evidential Implications of the Dermal Nitrate Test*, 44 MARQ. L. REV. 500 (1961).

48. *Brooke v. People*, 139 Colo. 388, 339 P.2d 993 (1959). *Accord* *Born v. State*, 397 P.2d 924 (Okla. Crim. 1964), *cert. denied*, 379 U.S. 1000 (1965); *Clarke v. State*, 218 Tenn. 259, 402 S.W.2d 863 (1966).

49. Note, INT'L CRIM. POLICE REV., Jan. 1968, at 28. The report was actually quite scathing:

The [First Interpol Seminar on Scientific Aspects of Police Work] did not consider the traditional paraffin test to be of any value, neither as evidence to put before the courts, nor even as a sure indication for the police officer. The participants were of the opinion that this test should no longer be used.

affin test.

Meanwhile, forensic laboratory technicians experimented with a new technique that uses the same methodology for the collection of gunpowder residues, the paraffin glove.⁵⁰ This technique, however, uses different chemicals to test for the presence of barium, antimony, and lead—elements that are not found around the house in the same quantities as they appear on the hands of a person who has fired a gun. Forensic scientists initially were confident that the new test was relatively specific for gunpowder residues and suffered none of the infirmities of the old paraffin test.

In 1971, the court that had first approved dermal nitrate evidence had an opportunity to consider the new test. In *Commonwealth v. Farrior*,⁵¹ the Pennsylvania Supreme Court upheld the admission of evidence given by two “criminologists” who had used the new paraffin glove test for gunpowder residues. Ironically, in supporting its decision, the court cited *Commonwealth v. Westwood*,⁵² which had approved the use of dermal nitrate evidence, evidence that experts criticized so resoundingly for its unreliability.⁵³ The court in *Farrior* apparently was unaware not only of the decisions that had rejected dermal nitrate evidence as unreliable, but also that the barium-lead-antimony was an entirely different technique. The court in *Farrior* may have reached the correct conclusion,⁵⁴ but it certainly was based on the wrong reason.

The cited examples indicate that the courts not only have failed to determine properly the discipline that must confer general acceptance, but that they also have used general acceptance without understanding what was being generally accepted. Courts experience difficulty determining whether the underlying principle, the instrument that measures certain data, or a technique devised to evaluate the data requires general acceptance.

Id. at 28.

50. This technique is sometimes called the Harrison-Gilroy method.

51. 446 Pa. 31, 283 A.2d 684 (1971).

52. 324 Pa. 285, 188 A. 304 (1946).

53. See, e.g., Turkel & Lipman, *supra* note 47.

54. The decision is correct if the barium-lead-antimony test does not suffer from the same deficiencies as the dermal nitrate test, an assumption that is neither accepted nor rejected in this Article.

C. *Evolution of a Scientific Technique*

The process of bringing novel forensic evidence to life, like any scientific inquiry, has a certain logical progression. In tracing this progression, the following stages may be isolated:

Stage 1: A theory is postulated.

Stage 2: Experiments are designed to verify the validity of the theory.

Stage 3: If the theory's validity is not disproven after a searching inquiry and empirical testing, it is "proven" valid and a court then appropriately may take judicial notice of the theory.⁵⁵ This result is unlikely to occur at this stage, however, because no vehicle exists for translating the theory into relevant evidence in a law suit.

Stage 4: A technique is devised, or an instrument is designed and built, that will permit the theory to be applied practically in a forensic setting.

Stage 5: After devising a methodology, further tests must demonstrate a positive correlation between the results and the underlying theory. This stage is necessary to prove that the effects observed are not the result of some unidentified cause.

Stage 6: After the test has been shown to yield reliable results that are relevant to disputed issues in a law suit, a court then may admit these results properly into evidence, and a qualified expert may interpret the results before the jury.

A survey of cases applying the *Frye* test, especially those cases admitting evidence based on techniques that the scientific community has criticized, indicates that courts have accepted expert testimony involving techniques that did not undergo this six-stage process. For example, consider the identification of individuals by means of sound spectrography. The underlying theory of voice identification is that all human voices are unique, despite any at-

55. See McCormick, *supra* note 6, § 204. McCormick suggested:

General scientific acceptance is a proper condition for taking judicial notice of scientific facts, but not a criterion for the admissibility of scientific evidence. Any relevant conclusions which are supported by a qualified expert witness should be received unless there are other reasons for exclusion.

Id.

tempt at deception, and despite the apparent similarity of the voices of two different individuals to the lay person. This difference can be proved and demonstrated by the use of a sound spectrograph. The theory of voice uniqueness, however, which the scientific community should have subjected to a searching stage-two inquiry, never has been proven by empirical evidence. As long as the theory remains a postulate, and not a proven fact, the technique of comparing voice spectrograms cannot establish the identity of a speaker with any relative degree of certainty. Upon what basis then could a court find that voiceprint identification had been generally accepted? If the court accepted the technique because it recognizes the sound spectrograph, the acceptance would be meaningless. The spectrograph is a respected research tool with many practical uses, but as used by voiceprint proponents, it produces results based on an unproven assumption. Thus, a court's failure to examine the development of a scientific technique compounds judicial misunderstanding of scientific evidence.

D. Excessive Reliance on a Single Expert

A court's necessary reliance on expert witnesses further complicates the general acceptance test. In most criminal cases, for a variety of reasons, only one side—the prosecution—produces expert testimony. The trial judge, in assessing the acceptability of the technique, will rely only on the testimony of the prosecution's expert witness. The testimony of this expert is predictable. If he did not believe the technique was reliable, he would not be using it. This expert is not likely to identify inadequacies or uncertainties that may surround the technique.⁵⁶ As a technician, he may be unaware of research done by others or he may have accepted a procedure described by others in scientific literature. Perhaps the expert witness has accepted the published conclusions of reliability and validity without independent verification. Even the most skilled

56. See *People v. Kelley*, 17 Cal. 3d 24, 549 P.2d 1240, 130 Cal. Rptr. 144 (1976) (discussed in *supra* text accompanying notes 22-25). A rare example of the contrary is *People v. Slone*, 76 Cal. App. 3d 611, 143 Cal. Rptr. 61 (1978). In *Slone*, a "nationally recognized authority [in forensic odontology] declined to offer the results of electron microscopy [in evaluating bitemark impressions] on the ground it had not yet been validated as a scientific identification technique." *Id.* at 622 n.6, 143 Cal. Rptr. at 67 n.6. Of course, the expert already had identified the bitemark by a different method.

cross-examiner will not be able to wrest from the expert an admission that he may have been too quick to seize upon a technique. In such a situation, the scientifically illiterate defense lawyer is at a distinct disadvantage.

Whether the defense or the prosecution calls an expert, the expert's impartiality always can be questioned. Once aligned with one side in the adversarial process, even an impartial expert loses his objectivity. Although this may be an expected result of testifying in a trial setting and being paid by one side, the lack of impartiality subverts a fair assessment of general acceptance. Furthermore, experts frequently testify beyond the bounds of their expertise and offer opinions about adjacent disciplines in which they are untrained.⁵⁷ Much of the blame for this phenomenon rests on lawyers who ask experts questions that are beyond the scope of their expertise. The lawyers may be unaware that their questions transcend the expert's education and training. The expert, who may have some general knowledge of fields outside of his area of expertise may assume that the lawyer expects answers and may answer the questions with inadequate knowledge of the necessary facts.

In *People v. Lauro*,⁵⁸ for example, a qualified ballistics expert testified that the recoil of firing a shotgun could have caused a red mark observed below the right shoulder of a murder suspect.⁵⁹ This testimony was not an issue on appeal, apparently because the defense attorney never objected to the expert's opinion. Although the expert's testimony was partially incompetent, the appellate court overlooked this defect. The fault was not with the expert who merely answered the questions; the fault was with the attorney who had asked and the attorney who had failed to object to the inappropriate questions.⁶⁰

57. See *infra* notes 58-60 and accompanying text.

58. 91 Misc. 2d 706, 398 N.Y.S.2d 503 (1977).

59. *Id.* at 708, 398 N.Y.S.2d at 504.

60. This phenomenon occurs in a variety of situations. For example, lawyers frequently ask toxicologists, who identify chemical substances such as poisons and drugs, about the general effects of drugs upon the human body as well as the effects of certain dosages. Such questions are appropriately addressed only to medical doctors or pharmacologists, but if asked, the toxicologist is likely to venture an answer because he may have read about these effects. Similarly, lawyers often ask forensic pathologists, who encounter many bullets in their examinations of gunshot wounds, to describe the workings of guns or to offer opinions

Many, if not all, of these problems are inherent in the adversarial system and result from factors other than the *Frye* test. The *Frye* test, however, does not ameliorate these problems; it exacerbates them. To rectify these problems, a new standard for determining the admissibility of novel scientific evidence is needed.

III. THE NEED FOR A NEW ADMISSIBILITY TEST

A. *The Inadequacies of Frye*

The need for caution in dealing with forensic science is both great and urgent. Our technology continues to advance at an ever increasing pace. Twenty years ago, trial lawyers had not heard of the human leukocyte antigen test⁶¹ or of analyzing blood for enzymes and proteins. Many sophisticated instrumental techniques now routinely used in forensic laboratories were largely unknown to law enforcement.⁶² Entirely new disciplines, such as forensic odontology and forensic physical anthropology, have developed only recently as separately organized scientific subspecialties.

The disciplines that did exist in forensic laboratories a generation ago have grown exponentially in their capabilities. Questioned document examiners formerly compared handwritten and typewritten samples. Today, the questioned document examiner has expanded his practice to include the use of sophisticated instru-

on the caliber of deformed bullets. Yet, pathologists do not study firearms or ammunition identification. For an interesting example of misuse of an expert witness, see *Smith v. Commonwealth*, 223 Va. 721, 292 S.E.2d 362 (1982) (error to allow a chemist to testify that LSD "made people go as far as to tear their eyes right out of their sockets, chew off an arm, jump out of windows, do some really . . . bizarre things").

61. Human leukocyte antigen tests can establish paternity much more reliably than traditional tests. See Jaffee, *Comment on the Judicial Use of HLA Paternity Test Results and Other Statistical Evidence: A Response to Terasaki*, 17 J. FAM. L. 457 (1979); Protogere, *Use of Human Leukocyte Antigen Test Results to Establish Paternity*, 14 IND. L. REV. 831 (1981); Sterlek & Jacobson, *Paternity Testing with the Human Leukocyte Antigen System: A Medicolegal Breakthrough*, 20 SANTA CLARA L. REV. 511 (1980); Terasaki, *Resolution by HLA Testing of 1000 Paternity Cases Not Excluded by ABO Testing*, 16 J. FAM. L. 543 (1978).

62. The new instrumental techniques may use mass spectrometers, infrared spectrophotometers, atomic absorption spectrophotometric analysis, ion microscopy techniques, the scanning electron microscope, neutron activation analysis, thin layer chromatography, gas chromatography with electron capture detection, circular dichroism spectropolarimetry, immunocytochemical methods, voice spectrography, x-ray diffraction, the argon ion laser, and immunofluorescence.

mentation and the study of inks, papers, watermarks, erasures, sequencing and dating of documents, microcomputer assisted word processing equipment, and color xerographic copies.

Fingerprint identification, the oldest and best known of the forensic laboratory functions, has become far more sophisticated. The search for latent fingerprints has evolved from routine dusting for fingerprints with powder, or iodine fuming and silver nitrate processing, to include such chemical methods as ninhydrin development, and techniques such as laser processing and cyanoacrylic ester fuming. Moreover, computer assisted fingerprint retrieval may replace the old fingerprint card files that investigators once searched manually.

The admission of evidence derived from the application of any of these methods requires expert testimony. The forensic laboratory field has grown from a few dozen well-equipped labs in the 1950's to several hundred well-staffed and superbly equipped multi-functional state and regional laboratories. From the few hundred individuals who routinely testified as experts in forensic analysis, the field now includes thousands of forensic technicians and examiners.

The expansion of techniques and the growth in the number of laboratories have caused considerable problems. Many laboratories experience difficulty in finding staff to perform the new functions. Laboratories often hire people who are not fully qualified or appropriately trained in forensic methodologies. Increasingly, experts reach erroneous conclusions and make misidentifications even in disciplines as old and widespread as fingerprint identification.⁶³

63. A number of cases have involved fingerprint experts who either intentionally fabricated incriminating fingerprint evidence or who made erroneous identifications. See, e.g., Brunelle, *Science and Practice Committee Report (1976)*, IDENTIFICATION NEWS, Aug. 1976, at 7 (section on fingerprint fabrication); Dunleavy, *Fabricated Identification Detected*, IDENTIFICATION NEWS, Dec. 1982, at 12. Experts in other fields occasionally are discovered to have perjured themselves. See, e.g., *People v. Cornille*, 95 Ill. 2d 497, 448 N.E.2d 857 (1983) (state arson investigator who had testified repeatedly for the prosecution was an imposter).

Fingerprint specialists began a certification process for latent print examiners in 1977. Although initially some 750 of the practicing fingerprint examiners were "grandfathered" in, a great many examinations are conducted to test the proficiency of technicians seeking certification. In a report on the certification program presented by George J. Bonebrake, Executive Secretary of the Certification Board, published in a Newsletter of the Chesapeake Bay Division of the IAI in February, 1982, he stated that as of January 1, 1982, 172 law enforce-

Laboratories maintained by public authorities have not fared well when subjected to independent testing. The Forensic Science Foundation recently completed a three-year study of forensic laboratories and concluded that an appalling number of laboratories reported erroneous results.⁶⁴ About 250 crime laboratories took part in at least one of the many tests that were offered. "[I]n blood typing, 94 of the 132 laboratories, or 71.2%, got unacceptable results. [Eighty-eight] laboratories tried to match .22 caliber bullets from two different weapons. Nine laboratories were in error, and four had inconclusive results."⁶⁵ Other test results showed that 34% of the laboratories could not match paint samples; 22% could not spot the difference between three metal samples; 50% could not identify dog hairs; and 18% failed to analyze document specimens correctly.⁶⁶

The *Frye* test does not recognize, understand, or evaluate the inherent problems present in the rapid growth of the nation's forensic laboratories. The expert testifying in a particular case is certain to be impressive in the presentation of findings. After all, the expert and his colleagues use the test daily and have staked their professional reputations on its accuracy. Testimony that a scientist

ment officers had taken the certification exam "with 82 or 47% passing." Bonebrake emphasized that "the certification test is not an easy one and should be approached with careful study and preparation." He also revealed that all but one of the 90 who failed the test failed the comparison of latent fingerprints. "That is, they failed to correctly compare 12 of the 15 latent prints or made one or more erroneous identifications." Because fingerprint experts do not have to be certified to qualify as experts in court, many of the "experts" who failed the exam possibly are testifying in court on fingerprint identification.

64. Mooney, President's Address at the Annual Meeting of the International Association for Identification (1979). Mooney is a forensic scientist and officer of a distinguished association of crime laboratory specialists. See also LEAA Newsletter, Sept. 1978. A follow-up study published in 1983 on the testing of toxicology laboratories also showed errors in the analyses performed by the participating laboratories, Peat, Finnigan & Finkle, *Proficiency Testing in Forensic Toxicology: A Feasibility Study*, 28 J. FORENSIC SCI. 139 (1983). Also, in 1981, the American Society of Crime Laboratory Directors—Laboratory Accreditation Board was incorporated. The Board promulgates standards for the performance of most forensic laboratory functions, evaluates personnel in terms of education, training and experience, reviews laboratory management practices, inspects facilities, and observes the operational methods and instruments used in a laboratory. In 1982, the Board awarded the first certificates of accreditation to the eight laboratories that comprise the Illinois Forensic Science System.

65. Mooney, *supra* note 64.

66. *Id.*

regularly performs a particular test may convince a trial judge that the test is generally accepted, but this testimony will not reveal the underlying problems in the reliability of forensic laboratories.

Only in rare cases will an appellate court reverse a decision based upon unreliable expert testimony. Even if appellant's counsel identifies published reports showing inherent weaknesses in a technique used by the appellee's expert, reviewing courts have an array of stock phrases to justify leaving the trial court's decision undisturbed. The *Frye* test's insistence on general acceptance is based on the erroneous assumption "that the scientific community speaks with a single voice on the acceptance of novel scientific procedures."⁶⁷ Proceeding on this assumption, courts often find general acceptance that is nonexistent in the early stages of the development of a new process. Moreover, because the *Frye* rule places undue reliance on the opinion of witnesses appearing only for either the prosecution or the defense, the test does not appear to fulfill its function as a meaningful screening device to admit reliable evidence and to exclude unreliable evidence.

In April 1983, a group of lawyers and scientists met to examine the *Frye* rule and its alternatives at a workshop sponsored by the National Conference of Lawyers and Scientists.⁶⁸ The participants divided into three working groups to consider the following charge:

You have been appointed by a judicial authority to serve as an advisory panel on scientific matters. At this meeting, you are asked two questions: (1) If the *Frye* test is retained, how should a judge determine whether it has been met? (2) If the *Frye* test is not retained, what consequences, if any, might follow?⁶⁹

The three groups, working independently, concluded unanimously that the *Frye* test should be discarded.⁷⁰ The conclusions of the groups, as reported in a plenary session, coincided remarkably in three key aspects: *Frye* was found to be unworkable because no agreement could be reached on the real meaning of the test; aban-

67. *Symposium Report, supra* note 2, at 221.

68. See generally *Symposium Report, supra* note 2. The National Conference is a joint organization comprised of members of the American Bar Association and the American Association for the Advancement of Science. *Id.* at 187.

69. *Id.* at 229.

70. *Id.* at 229-33.

doing *Frye* did not mean that a loosely structured relevancy test ought to be substituted;⁷¹ and the courts should engage in meaningful screening to determine reliability of test results before admitting them.⁷² The conference did not reach agreement on a substitute for the *Frye* test or on the manner in which courts could perform the screening function.

One group advocated the initiation of a new procedure for dealing with novel expert testimony, rather than the formulation of a new rule for admissibility:

If novel scientific evidence is to be proffered in the absence of satisfactory legal precedent . . . the judge has an obligation to screen it prior to trial. Just what standard to use is not clear, but it should include an evaluation of whether the jury would give the evidence undue weight in relation to its scientific validity. [T]he judge independently should solicit information bearing on the usefulness and validity of the evidence, even if the information might not be included in the adversarial proceeding. This could help mitigate the consequences of having one well prepared and one poorly prepared advocate. At a pre-trial hearing to pass on the admissibility of evidence, the judge should employ loose criteria for determining who qualifies as an expert witness. At this early stage, it might not be at all clear how to define the scientific community with an interest in the integrity of the evidence. The judge should not be too quick to reject the testimony of experts from fields that might not appear to be appropriate sources of scientific expertise. If the judge does admit the evidence, . . . a special instruction to the jury should be prepared that goes beyond the ordinary jury instructions concerning expert testimony. It should include clear explanations of the uncertainties about the evidence and of the opposing views concerning its validity.⁷³

Another group suggested that the judge consider four factors,

71. Such a test might be based on an interpretation of rule 401 of the Federal Rules of Evidence, which defines relevancy as "evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence." FED. R. EVID. 401. Under this interpretation, scientific evidence that has not been shown to be reliable would nevertheless be relevant because the evidence would satisfy the more or less probable test.

72. *Symposium Report*, *supra* note 2, at 229-33.

73. *Id.* at 231.

among others, in deciding the admissibility issue:

(1) The reputation of the expert within the scientific community, (2) The strengths of opposing views and the standing of the persons who express them, (3) Whether the expert is prepared to discuss uncertainties in the techniques used to prepare the evidence and in the conclusions, and (4) Whether both sides to the controversy have reasonably comparable access to scientific authorities.⁷⁴

The same group also advocated a wider judicial use of court-appointed experts to aid in determining the reliability issue, as well as the development of expert panels by professional organizations.⁷⁵ These organizations would have to avoid affiliation with any special interest group in order to ensure a demonstrably unbiased assessment of the validity of novel types of evidence.

B. The Postulates of a New Admissibility Procedure

This Article does not suggest the use of a static test such as the *Frye* general acceptance rule, but rather suggests the adoption of a flexible procedure to determine the admissibility of novel scientific evidence. The procedure would comprise a series of options available to the trial judge. The procedure would require the judge to familiarize himself with certain scientific information and consider various factors before making his ruling. The proposed options are not radically novel in their components, and adoption of the suggested procedure would not require a drastic change in our adversarial system.⁷⁶

The new procedure must avoid the pitfalls of the *Frye* test and other admissibility tests that might exclude reliable evidence not generally accepted because of its novelty, or admit unreliable evidence that some practitioners in the field have adopted. The pro-

74. *Id.*

75. *Id.* at 232.

76. The author does not suggest the creation of special science courts or independent tribunals to deal with complex scientific issues. Although, on the basis of experience with the western European civil law systems, the author believes such an approach may have merit, support for such a drastic change is not apparent. See Giannelli, *supra* note 11, at 1231-32 & n.269; Note, *Scientific Evidence and the Question of Judicial Capacity*, 25 WM. & MARY L. REV. 675, 687-91 (1984).

cedure also must be sufficiently flexible to permit the court to determine admissibility on an ad hoc basis. This flexibility would allow the judge to tailor the procedure to the characteristics of widely divergent disciplines without sacrificing control.

Many techniques do not fall neatly within one field, but rather cut across several fields by combining theories of various disciplines. In such situations, the new procedure should consider the interdisciplinary standing of the theory, and provide for a structured discussion by the relevant branches of science, calculated to provide the judge with an informed basis for deciding the issue of admissibility. This consultation of knowledgeable scientists and people outside the immediate group of experts concerned with the new technique avoids the problem under the *Frye* test of selecting the appropriate field in which the new test belongs.⁷⁷

The new procedure must emphasize reliability of the technique rather than its general acceptance. The means of determining the reliability of the evidence should not hinder the litigation process. If the new procedure is to be more successful than *Frye* or its alternatives, it must ensure that courts will not admit testimony based on techniques that do not produce accurate results, or methodologies that do not provide reliable conclusions.

The paramount function of an admissibility procedure is to ensure that admissible novel expert testimony is reliable and that unreliable evidence is excluded. This function is entirely consistent with the general rules of relevancy, which limit the admission of evidence to information that will aid the trier of fact in properly determining the issues. Conclusions that lack predictability or replicability do not aid in the proper determination of triable issues. The suggested procedure should eliminate the possibility of a jury relying on the incorrect, but persuasive, opinions of an articulate expert witness.

The existing admissibility tests have oversimplified the complex and pervasive nature of scientific endeavors in our society. The belief that the application of a single, mechanistic test such as the *Frye* rule can determine the difficult issue of reliability in every

77. Under *Frye*, the fortuitous classification of a technique as belonging to a particular field can shape the court's determination of the technique's general acceptance and, therefore, its admissibility. See generally *supra* notes 12-26 and accompanying text.

case is another example of the scientific illiteracy that hampers courts. If the primary purpose of an admissibility test is to determine the reliability of expert opinion evidence, then an understanding of reliability is essential. Reliable evidence has those attributes of certainty that a well informed and properly instructed jury would assign to the evidence. Reliability may differ in degree depending on the type of evidence. With some disciplines the jury expects that the evidence will prove a point positively, without possibility of error. If the court admits evidence from those disciplines, the evidence should fulfill the jury's expectations, or the jury will be misled. The typical example of jury expectation of positive proof is fingerprint identification. Nearly a century of popular literature has led the public to believe that fingerprints establish identity without any possibility of error. Judges universally accept that theory and, therefore, admit fingerprint identification evidence because the evidence is reliable. The only issues are the expert's training and his competent performance of recognized identification procedures.

If the prosecution offers circumstantial evidence to link a defendant with a crime, the jury may perceive that the evidence proves only that the link is a possibility. A judge can admit the evidence although it is not positive and although the process whereby it was obtained is not infallible. Although the evidence is not conclusive, it may be reliable if based on an assumption that proves true in most cases. If the jury perceives that the evidence is true in all cases, however, then a significant evidentiary problem exists.

A judge may admit the evidence if he can ensure that the jury will interpret correctly the information presented. This task, however, may be fraught with considerable difficulty. For example, consider the jury's interpretation of expert testimony comparing a hair sample found at the crime scene, and an exemplar coming from the defendant. If the testimony indicates that these two hairs match in all microscopic detail, the jury may interpret such evidence as indicating that the crime scene hair came from the defendant, when that is not what the expert implies. In fact, the determination of whether two hairs have a common origin is scientifically impossible to prove by microscopic analysis. The expert can imply only that the two hairs could have a common origin.

Typically, he would not know whether a common origin was statistically probable.

Reliability, then, is a word that can have many meanings, depending on the purpose for which we use the term. Reliability is not a scientific test or an objective criterion; the term implies a value judgment. A court may deem evidence reliable if the information is safe for the purpose for which it is being offered, yet the court may deem the same evidence unreliable if offered for a different purpose. In the context of expert testimony, reliability should correlate the degree of certainty that the underlying techniques permit with the jury's perception of this degree of certainty. This correlation is difficult to make in today's courtrooms because juries have been conditioned by the novels they read and the television programs they watch to believe that science can do anything and that scientific evidence is always accurate. When experts testify in a criminal case, the jury frequently perceives that the testimony's value or reliability is far greater than the underlying principles or techniques would justify. Conversely, when the prosecutor does not use expert testimony, the jury may believe that he has not proven his case and, therefore, may acquit. After all, the prosecution always introduces scientific evidence on television.⁷⁸

IV. A PROPOSED PROCEDURE FOR ADMITTING NOVEL SCIENTIFIC EVIDENCE

The best approach to the admissibility of scientific evidence is a new procedure, rather than a new test. The procedure should recognize the lack of meaningful communication and real understanding between lawyers and scientists, and seek to bridge this gap. In this manner, a trial judge can make a truly informed decision on the potential risk of error in admitting the evidence and can determine correctly whether the evidence's prejudicial effect outweighs its probative value.

Determining the intrinsic worth of the evidence in light of its

78. This assertion is by no means flippant. Many prosecutors have complained about this phenomenon at CLE meetings in which the author has participated. Professor Imwinkelried makes similar observations from his experience with prosecutors in Imwinkelried, *The Standard for Admitting Scientific Evidence: A Critique from the Perspective of Juror Psychology*, 28 VILL. L. REV. 554, 559-60 (1983).

reliability for a specific purpose should guide the admissibility procedure. The judge can better evaluate the admissibility of evidence by emphasizing the reliability determination in three separate stages of the litigation process: the discovery stage; the pretrial hearing stage; and the decisionmaking stage.

A. The Discovery Stage

Although the discovery process in criminal cases is less extensive than in civil litigation, existing rules do permit some discovery concerning scientific evidence and expert testimony.⁷⁹ The two basic deficiencies in the present system of discovery are, first, the lack of opportunity to discover and understand the nature of the expert's involvement in the examination of evidence, and second, the lack of a formal opportunity to depose the expert to determine his role in the litigation.⁸⁰

In criminal cases, a party has the right to receive a copy of the opposing side's expert reports.⁸¹ This opportunity usually proves peculiarly unenlightening, however, because forensic laboratory reports typically disclose nothing more than the examiner's ultimate conclusion.⁸² The typical forensic laboratory report states, in essence, three things: we have received evidence items a, b, and c; we have compared them; and we have concluded x, y, and z. The conclusion usually is couched in such terms as: "the items are consistent with one another"; "they may have a common origin"; "they

79. Rule 16(a)(1)(D) of the Federal Rules of Criminal Procedure allows the defendant, upon request, "to inspect and copy or photograph any results or reports of physical or mental examinations, and of scientific tests or experiments, or copies thereof, which are within the possession, custody, or control of the government"; Rule 16(b)(1)(B) gives the government a reciprocal right of discovery. FED. R. CRIM. P. 16. Similar provisions are contained in most state statutes or rules of court permitting discovery in criminal cases. See, e.g., VA. SUP. CT. R. 3A:14(b)(1).

80. Rule 15(a) of the Federal Rules of Criminal Procedure allows a defendant, on motion, to depose a prosecution expert witness if the defendant can convince the judge that "due to exceptional circumstances of the case it is in the interest of justice that the testimony of a prospective witness . . . be taken and preserved for use at trial." FED. R. CRIM. P. 15(a).

81. FED. R. CRIM. P. 16(a).

82. The notable exception to this obstruction of discovery is the autopsy protocol prepared by forensic pathologists in medical examiners' offices. These reports are usually very explicit and fulfill the true function of a "report." Forensic pathologists are, of course, not considered a true part of the forensic laboratory organization, although they may work closely with the laboratory.

are microscopically indistinguishable"; or variations on such language. Forensic laboratory reports do not mention the methods used to analyze evidence, the instrumental analyses used, the objective data noted or measured, or, in a number of cases, the name of the examiner.⁸³ This information is very important in establishing the reliability of the conclusions reached, and should therefore be in the report.⁸⁴

Although subject to discovery, the report does not contain any meaningful information. Concealment seems to be the express purpose of keeping forensic laboratory reports terse. The forensic laboratory technicians are not necessarily responsible for the nearly meaningless form of their reports. In discussing the topic of forensic laboratory reports at forensic science meetings, many experts have indicated that they have no objection to including in the report the information that trial participants logically would expect to find. The prosecutors who request and receive these reports, however, prohibit the experts from including more than the minimum amount of information. A clearer example of intentional frustration of the discovery process cannot be imagined.

This phenomenon is especially appalling because the court later may permit the expert to testify at trial "without prior disclosure of the underlying facts or data."⁸⁵ No pretrial mechanism exists, aside from informal discovery, for determining the process that the expert used, or how he arrived at his conclusions. This nondisclosure frustrates the underlying purpose of the discovery rules.

Clearly, the analyses conducted by forensic laboratory examiners should contain some basic information that will make the documents worthy of the title "report." A critical requirement is that a laboratory report contain the methodology used by the expert in arriving at his conclusion. This information is especially important because some evidence specimens can be examined by widely differing methods. Depending on the tests conducted and the instru-

83. Some law enforcement agencies have supervisors sign all reports. The agency may identify the analyst of the evidence by some code known only to the organization.

84. If a scientist called to testify as an expert in a civil case examined such a report, he would reject the report as inadequate and technically unjustifiable. Indeed, the reports filed by examiners of evidence in civil cases are encyclopedic in comparison with crime laboratory reports.

85. FED. R. EVID. 705.

ments used, the degree of certainty obtained may vary from a conclusion expressed as a mere possibility to one of a strong probability.⁸⁶ Without knowing the methodology that the expert used, the opposing attorney will be unable to determine whether an evidentiary challenge is possible, desirable, or wasteful. Additionally, the attorney's own expert will not be able to evaluate the report because of this lack of elementary information.

Frequently, forensic laboratories have inadequate standards for performing particular scientific analyses. Laboratory examiners also have substantial discretion in selecting the methods of analysis they will use. Examiners can use that discretion to ignore methods of analysis reputedly more accurate, but in which they have not become proficient. These examiners may choose inappropriate methods instead of more accurate methods that are more costly or complicated.

A proper report also should identify the names of the actual examiners, testers, or technicians who participated in the analysis. Additionally, appended to the report should be a summary of the credentials of the examiner and of the person who will appear in court as the expert witness if the case goes to trial. Requiring pre-trial disclosure of the qualifications of the examiners and analysts is necessary because many laboratories have encountered difficulties in hiring qualified staff, and may be employing technicians whose credentials do not qualify them as scientists or experts. More importantly, some forensic laboratories are staffed by individuals who do not have to exhibit or prove their skills by undergoing board certification. States with laws imposing certification requirements for certain occupations and professions may exempt personnel of state and local forensic laboratories from the licensing requirement. Ironically, in some jurisdictions these unlicensed state examiners examine their "civilian" counterparts for competency when the civilians apply for state certification.

In sum, a laboratory report should include the following facts: the type of analysis done; who performed the analysis; the objective findings or measurements; the conclusions derived from the

86. Consider the statistical probabilities of possible innocent coincidence between a blood analysis done in the ABO system only, as opposed to one conducted in a series of enzyme, as well as antigen, systems.

findings; and the basic qualifications of the examiner. Implementation of this recommendation would force "reports" to actually be reports. A change in the law is not required; compliance with existing law could implement this recommendation.

A second recommendation for improvement of the discovery process is for judges to exercise their discretion more freely and allow the defense to depose prosecution experts. Forensic laboratory experts do not oppose this suggestion, nor does the recommendation worry them. As professionals, experts do not believe that their job is to conceal information. Many experts frequently express the view that depositions give them the opportunity to explain in a meaningful way the available scientific evidence, and to convince the defense attorney that their conclusions are scientifically valid. Such free communication between state experts and defense attorneys may result in fewer evidentiary challenges at trial and shorter cross-examinations. The trial lawyer who has not had an opportunity during the discovery process to explore what happened in the laboratory will be inclined to probe the meaning of the evidence during cross-examination of the expert. For this reason, better discovery should result in shorter expert testimony at trial.

B. The Pretrial Hearing Stage

Systematic use of the motion in limine could resolve issues of admissibility before trial. The purpose of this Article is not to develop a procedure to regulate the expanded use of the motion in limine, nor to suggest who should bear the burden of proof. Increased use of the motion in limine, however, is the logical result of more meaningful discovery, at least in connection with innovative scientific evidence. Proper laboratory protocols and reports will aid the attorneys in determining what further inquiries are necessary to decide whether they should raise an admissibility issue. Litigators should raise the issue of disputed scientific evidence by making a motion in limine. The proponent of the evidence may seek to avoid a battle of experts during the trial on the issue of reliability because such battles raise doubts in the jurors' minds. The opponent of the evidence may use a motion in limine to exclude the evidence completely.

If the parties raise the evidentiary issue for the first time at trial and the defense moves to exclude the expert testimony because the

expert based his opinion on a technique not generally accepted, the court usually will conduct a voir dire on the issue outside of the presence of the jury. The prosecutor who is alert to this eventuality may need to locate an independent expert to establish the scientific validity of a new process or instrument used by the local forensic laboratory. If the trial court denies the defendant's motion, the outside expert will take the stand. He thus will bolster the testimony of the local forensic laboratory technician, who may qualify as an expert witness but lack the prestigious credentials of the independent expert. To avoid having the jury hear the outside expert's testimony, the defense should schedule the hearing before trial.

Conversely, the prosecution may gain the same tactical advantage. Prosecutors who have lost a jury trial involving novel expert evidence may wonder whether the jury found a reasonable doubt because of the acrimonious battle of the experts on the admissibility issue. Juries have a way of knowing far more than the parties tell them. They know that an objection may prevent them from hearing certain evidence. Although no empirical evidence may exist on this point, many trial lawyers are convinced that jurors look more skeptically at evidence admitted immediately after a long sidebar conference or after a session out of their presence.

In addition to encouraging the use of motions in limine, judges also should take a more active role in the process in a number of other ways. After a party files a motion in limine, the judge should abandon his totally passive role as an arbiter and should participate more actively in generating information that will be useful in resolving the issue of reliability versus risk of error. The judge need not become partisan in order to become well informed.

In most jurisdictions, judges may appoint their own experts to evaluate innovative scientific evidence.⁸⁷ In making such appointments, the judge should not restrict expertise to a narrow field. He should involve impartial experts who are best able to explain scientific principles and fundamental reliability issues. A judge also should consult the technical literature to aid his understanding of the technical and scientific issues. In the event that the reliability of an entirely novel form of expert testimony is at issue, the judge

87. See, e.g., FED. R. EVID. 706.

might appoint an advisory panel of scientists to study the problem, even if this approach means postponing the trial.⁸⁸

In short, a far greater degree of judicial participation in gathering information on scientific issues is necessary. This increased participation is essential to obtaining a fair determination of reliability issues, particularly if one of the litigants is less prepared or has less opportunity to secure expert testimony.⁸⁹ Judicial participation also will alleviate the excessive reliance on forensic laboratory witnesses to prove scientific theories that they may not understand fully.

C. The Decisionmaking Stage

After the evidence has been gathered and the information reviewed, the judge should base his admissibility decision on considerations more clearly defined and articulated than the nebulous general acceptance standard or a loose relevancy concept. Chief Judge Weinstein and Professor Margaret Berger have recommended that judges use a series of seven factors to assess the probative value of novel expert testimony.⁹⁰ Justice Mark McCormick recommended that the court consider eleven factors in making its assessment,⁹¹ including the factors suggested by Judge Weinstein and Professor Berger. The eleven factors are:

- (1) the potential error rate in using the technique, (2) the existence and maintenance of standards governing its use, (3) presence of safeguards in the characteristics of the technique, (4) analogy to other scientific techniques whose results are admissible, (5) the extent to which the technique has been accepted by scientists in the field involved, (6) the nature and breadth of the inference adduced, (7) the clarity and simplicity with which the technique can be described and its results explained, (8) the ex-

88. See *Symposium Report*, *supra* note 2, at 232.

89. In *Bond v. Commonwealth*, ____ Va. ____, 311 S.E.2d 769 (1984), the Virginia Supreme Court recognized that the opinion of a witness whom the judge has found to be an expert is accorded significant weight by the jury. Additionally, use of expert witnesses is expensive. The court recognized that, "[d]rawing upon the public fisc, the prosecution can afford to finance a duel of experts; an indigent defendant cannot." *Id.* at ____, 311 S.E.2d at 772.

90. 3 J. WEINSTEIN & M. BERGER, *WEINSTEIN'S EVIDENCE* ¶ 702[03].

91. McCormick, *Scientific Evidence: Defining a New Approach to Admissibility*, 67 *Iowa L. Rev.* 879, 911-12 (1982).

tent to which the basic data are verifiable by the court and jury, (9) the availability of other experts to test and evaluate the technique, (10) the probative significance of the evidence in the circumstances of the case, and (11) the care with which the technique was employed in the case.⁹²

Use of these standards would allow a judge to make a decision based upon significant factual information. The burden on the trial judge would be greater than it has been in the past, but such a solution is preferable to the *Frye* test. Presently, expert witnesses who only use, rather than develop, a technique can testify that the scientific community generally accepts the technique. Courts thus find the technique reliable, a conclusion that does not necessarily follow. In so ruling, judges have become rubber stamps for expert opinions on general acceptance and reliability. If judges follow the procedure for dealing with novel scientific evidence outlined in this Article, they will make the decision on acceptance and reliability by applying meaningful factors to information they purposefully have solicited. This increased judicial participation will help remove the "scientifically illiterate" label bestowed upon the courts by expert witnesses.

V. CONCLUSION

The approach recommended in this Article may not require a departure from the *Frye* rule. Indeed, courts could implement this approach in conjunction with any existing test for admissibility. The courts, however, have not followed this approach in interpreting *Frye*, and are unlikely to adopt it without a total departure from the established *Frye* jurisprudence.

When dealing with some types of scientific evidence and expert opinion, the means used to decide questions of admissibility will not make a difference; any admissibility test would produce the same result. In certain cases, however, the decision on admissibility is very much a function of the test a court adopts. Adoption of the procedure suggested in this Article will permit the courts to make a more informed decision based on a clearer understanding of the scientific strengths and weaknesses of the novel evidence before

92. *Id.* (citations omitted).

the court.

This Article does not posit that these suggestions represent the ultimate solution to the problem of admissibility of novel types of expert testimony or that these proposals cannot be improved upon. These suggestions are offered in the hope that their consideration may improve the judicial factfinding process, contribute to the eradication of the scientific illiteracy of the bar and judiciary, instill a better understanding of the potential and limitations of expert testimony, and alleviate some of the pressing problems that continue to plague courts that must deal with new scientific developments.