SCIENCE, LAW, AND THE EXPERT WITNESS

JOSEPH SANDERS*

> [S]cientific inquiry is by nature tentative and thoroughly fallibilist; it focuses on the general law or principle rather than the particular case; its core values are intellectual honesty and willingness to share evidence . . . . So it is hardly surprising that the legal system has had trouble handling scientific testimony, for the legal culture could hardly be more different: adversarial; focused on the specific case; formally procedurally anchored; valuing promptness and finality . . . .[1]

I

INTRODUCTION

The theme for the Spring 2007 SKAPP (Scientific Knowledge and Public Policy) conference in New Hampshire was "Conventions in Science and Law." For me, the central issue was how legal conventions and scientific conventions differ, and, insofar as they do differ, what impact this has on the behavior of individuals at the interface of law and science.[2] This article addresses one aspect of that question: how these conventions affect the behavior of expert witnesses when they appear in court in both civil and criminal cases. Expert witnessing is a particularly useful place to observe the clash of legal and scientific conventions because it is here that one group of people (scientific experts) who are integrated into one set of conventions are challenged by the expectations of a different set of conventions.

Section II of this article reviews differences in scientific and legal conventions as they apply to expert knowledge. Section III discusses two central reasons for these differences: adversarialism and closure. Section IV focuses on expert testimony. It indicates how differences in legal and scientific conventions caused by adversarialism and the law's need for closure create role conflicts for experts, as well as uncertainty about the level of justification an expert should

This Article is also available at http://www.law.duke.edu/journals/lcp.

* Professor of Law, University of Houston Law Center. I wish to thank Susan Haack for helpful comments on an earlier draft.

1. Susan Haack, *Irreconcilable Differences? The Troubled Marriage of Science and Law*, 72 LAW & CONTEMP. PROBS. 1, 12 (Winter 2009).

2. The term "conventions" is not self-explanatory. In this article, the term refers to those routinized ways of doing and understanding that are built into a set of institutional arrangements. Some of these things are simply procedures. Others have a normative component. My perspective is informed and influenced by the "new institutionalism" in sociology. *See generally* Mark C. Suchman and Lauren B. Edelman, *Legal Rational Myths: The New Institutionalism and the Law and Society Tradition*, 21 LAW & SOC. INQUIRY 903 (1996).

have before expressing an opinion in court.[3] The article concludes with some thoughts about the appropriate accommodation between scientific and legal conventions.

II

SCIENTIFIC AND LEGAL CONVENTIONS CONCERNING EXPERT KNOWLEDGE

A. Scientific Conventions

What are the conventions surrounding scientific expert knowledge?[4] Most people who study the "doing of science" would agree that there is no special "scientific method" that is different from and better than other ways of understanding the world.[5] The successes of the natural sciences over the last few centuries are not the result of a special way of going about the production of knowledge.[6]

But methods are a core part of scientific conventions. Each corner of the scientific enterprise is chock full of methodological prescriptions. A substantial part of having what passes for scientific expertise in a field is an ability to use the tools of the trade and an appreciation of the nuances of the methods of investigation commonly employed in the discipline. Susan Haack divides these aids to understanding into three categories: "helps" to the senses, "helps" to reasoning, and "helps" to evidence-sharing and intellectual honesty.[7]

Instruments that expand our senses are at the very heart of progress in physics, astronomy, chemistry, and biology, as well as in such practical disciplines as medicine and engineering. Aids—"helps"—to reasoning are also critical. These include mathematics in its many different forms as well as experimental and quasi-experimental designs and other investigatory devices

---

3. This discussion builds on an earlier paper on expert-witness ethics. Joseph Sanders, *Expert Witness Ethics*, 76 FORDHAM L. REV. 1539 (2007).

4. This section borrows heavily on articles by Susan Haack and Herbert Kritzer in this issue. *See* Haack, *supra* note 1; Herbert Kritzer, *The Arts of Persuasion in Science and Law: Conflicting Norms in the Courtroom*, 72 LAW & CONTEMP. PROBS. 41 (Winter 2009).

5. Haack notes,

> [A]ll empirical investigation demands the same epistemic virtues: respect for evidence, care and persistence in seeking it out, good judgment in assessing its worth; and that, in a sense, all empirical investigation uses the same method—the method of experience and reasoning: making an informed conjecture, seeing how it stands up to the available evidence and any further evidence you can lay hands on, and then using your judgment whether to drop it, modify it, stick with it, or what. What is distinctive about natural-scientific inquiry isn't that it uses a peculiar mode or modes of inference, but the vast range of helps to inquiry scientists have developed, many of them—specific instruments, specific kinds of precaution against experimental error, specific models and metaphors—local to this or that field or sub-discipline.

SUSAN HAACK, DEFENDING SCIENCE WITHIN REASON: BETWEEN SCIENTISM AND CYNICISM 167 (2003).

6. As Percy Bridgman felicitously phrased it: "[T]he scientific method, as far as it is a method, is doing one's damnedest with one's mind, no holds barred." *Id.* at 93.

7. *Id.* at 98. Haack hastens to add that each of these is intertwined with the other two.

designed to assist in making causal assertions.[8] The third set of aids, aids to evidence-sharing and intellectual honesty, includes such things as peer review, publication, replication of findings, and other formal and informal devices that involve scientists looking over each other's shoulders. Often this peek over the shoulder focuses on the correct use of the first two types of aids—instruments and mathematics and experimental design. All of these aids are fallible and none guarantees that we will arrive at correct outcomes.[9] Collectively, however, these conventions are thought to facilitate inquiry over the long term.

This article focuses on the second and third set of aids: aids to reasoning and aids to evidence-sharing and intellectual honesty. The common mathematical and logical aids to reasoning are designed to facilitate not simply inquiry, but inquiry of a certain type: inquiry into general laws or principles. This does not mean that scientists are uninterested in the particular case; many scientists and individuals in fields such as engineering that rely on science may devote most of their energy to specific situations. But the heroes of science are those who are able to put forth explanations in terms of general laws that explain myriad particular observations.

This interest in the general and the generalizable leads to a second component of scientific conventions concerning knowledge—the lack of a timetable. An inquiry takes as long as it takes and, with respect to many questions, the answer experts are most comfortable with is, "We don't know." "We don't know" does not necessarily mean that we don't have a guess. Often it means we do not have enough evidence of the kind we find persuasive to support a conclusion.[10]

Aids to evidence-sharing and intellectual honesty are central components of the ethical culture of the scientific enterprise. They are part of what Merton described as a "norm of communism"—calls for the sharing of data and results.[11] Peer review and publication are also part of this set of aids. Although these

---

8. *See generally* WILLIAM R. SHADISH, THOMAS D. COOK & DONALD T. CAMPBELL, EXPERIMENTAL AND QUASI-EXPERIMENTAL DESIGNS FOR GENERALIZED CAUSAL INFERENCE (Kathi Prancan ed., 2002). Even the social sciences play an important role in this process when they uncover and document the many systematic reasoning errors that result from judgment by heuristics and then suggest affirmative steps we might take to minimize such errors. *See* Cass R. Sunstein, *Cognition and Cost-Benefit Analysis*, 29 J. LEGAL STUD. 1059, 1065 (2000).

9. From the supposed benefits of bleeding to the more recent realization that many ulcers have a bacteriological, not a psychological source, it is easy to point to occasions in which we have been led astray for lengthy periods of time.

10. When a community of investigators says this, it is referring to evidence that is derived from application of the aids to reasoning (and the instruments) to which a field of inquiry is committed. There may not be a "scientific method" writ large, but there are methods and aids to inquiry to which communities of scholars are committed, and evidence derived from these techniques enjoys greater warrant in the community than other types of evidence. Over time, these methods may change as new ways to collect and observe are created. Methods are, ultimately, simply tools, and a new problem may call for new tools. In this sense, methodology is a pragmatic search for what works. However, at any given point in time, the ability of an investigator to persuade her peers about some hypothesis without the use of these devices and methods is limited.

11. ROBERT K. MERTON, *The Normative Structure of Science*, *in* THE SOCIOLOGY OF SCIENCE: THEORETICAL AND EMPIRICAL INVESTIGATIONS 267, 268–70 (Norman W. Storer ed., 1973).

latter devices may play a small role in detecting intellectual dishonesty, most studies that have explored the peer-review process agree that it is better suited to evidence-sharing than to ferreting out deception.[12] As Kitcher notes, scientific communication and cooperation within the scientific community usually are based on the risky assumption that scientists can trust one another to tell the truth as they understand it.[13] Scientists rarely prepare for deception and betrayal. Except when specifically warranted by circumstances, attacks that imply less than honest communication are out of bounds.[14] This is one reason the peer-review process often appears to fall short when asked to perform the role of assessing the truth of assertions made in a manuscript. Were scientists to turn the peer-review process into a search for deception, they would perhaps prevent a few cases of scientific fraud, but only at the cost of an enormous amount of investigator time and of undermining the scientific culture of trust.

In the long run, the failure of others to replicate one's alleged findings may act as a counterweight to fabricated results; but in the short run, the culture of honesty is the primary bulwark against deception. At the core of this culture are norms calling on individuals to be honest with themselves and others about what the evidence is, and to adopt what Merton called "a posture of disinterestedness."[15] Intellectual honesty and disinterestedness are threatened by the pressures that test the commitment to any such norms: reputation, money, job security, et cetera. These pressures come from all sides—from businesses that fund one's research, from the need to publish significant results in order to obtain future grants, from lawyers prepared to offer substantial remuneration to testify in court, and insidiously, from one's own political and social values that cause one to assess evidence somewhat differently when it appears to affect those values. What is most noteworthy, perhaps, is not that individuals succumb to such pressures, but that so often they do not, a fact that is a testament to the internalization of this scientific convention.

How then should we summarize the conventions of expert (scientific) knowledge? Four components are particularly relevant to this discussion. Scientific conventions involve: (1) searching for the general and theoretical, (2) employing the methods and techniques accepted by one's field, (3) an attitude of agnosticism that encourages waiting for persuasive evidence before making up one's mind, and (4) a commitment to sharing data, intellectual honesty, and disinterestedness. How do these stack up against legal conventions concerning expert knowledge?

---

12. Effie J. Chan, *The "Brave New World" of Daubert: True Peer Review, Editorial Peer Review, and Scientific Validity*, 70 N.Y.U. L. REV. 100, 100 (1995); Susan Haack, *Peer Review and Publication: Lessons for Lawyers*, 36 STETSON L. REV. 789, 789 (2007).

13. PHILIP KITCHER, THE ADVANCEMENT OF SCIENCE: SCIENCE WITHOUT LEGEND, OBJECTIVITY WITHOUT ILLUSIONS 394 (1993).

14. Stephen Fuchs & Steven Ward, *What is Deconstruction and Where and When Does it Take Place? Making Facts in Science, Building Cases in Law*, 59 AM. SOC. REV. 481, 489 (1994).

15. MERTON, *supra* note 11, at 275.

B. Legal Conventions

In his article in this symposium, Professor Kritzer notes that legal conventions differ from scientific conventions in at least three ways relevant to the preceding discussion: differences in data sources, differences in mindset toward drawing conclusions, and differences in the approach to evidence.[16] A word about each of these is in order.

If scientific conventions focus on systematic and general knowledge, legal inquiry, at least in the context of most trials, focuses on experience and specific events. To be sure, law is often concerned with general questions, such as, "Does drug *X* cause injury to *Y*?" However, law is nearly always also concerned with what happened to a specific person at a particular point in time.

The second difference is what Professor Kritzer calls mindset. He quotes a comment from an engineer who had never appeared in court before, concerning one of his first preparation sessions with a trial attorney named Bill:

> Bill asked me a question about whether the belt was on or not, the lap belt. And I said, "Well, could have been. But then, it may not have been." Woo, rockets went off. "What do you mean? You're my expert in this case, and you say it 'could be' or 'couldn't be?' Look, I'm going to tell you. The other side doesn't waffle. They pick one view. And they will push that view. And they will make their case in front of a jury. And there will be no misunderstanding. There will be no gray area. They will take a position one way or the other and make it stick. Now, they don't have any other course of action. That's their life. They make their living going in front of juries and making statements, whether they have facts to back them up or not. Now you, you can go back to designing cars. You have another career. They don't. You better start thinking like they do.[17]

In this passage, the expert's initial position reflects the scientific convention that values caution and a "wait and see" attitude. It runs headlong into the legal convention that pushes the witness to make a decision and to do so with a reasonable degree of certainty.[18]

The legal preference for certainty is related to a third difference. Expert knowledge in law is a partisan resource. Each party gets to choose which experts to present and to shape its presentation in the way that puts the party's

---

16. Professor Kritzer poses the issue as one of persuasion. Kritzer, *supra* note 4, at 41.

17. FRED PRICHARD, EXPERTS IN CIVIL CASES: AN INSIDE VIEW 30–31(2005), *quoted in* Kritzer, *supra* note 4, at 53–54.

18. I say "reasonable degree" because too much certainty—that is, absolute, inflexible belief in every fact that supports a party's position and rejection of every fact that does not—is very likely to backfire for the witness who expresses such views. The person will be perceived as simply a hired gun who has no commitment to the truth. Experts report pressures for greater certainty in other studies as well. *See, e.g.*, Anthony Champagne, Daniel Shuman & Elizabeth Whitaker, *An Empirical Examination of the Use of Expert Witnesses in American Courts*, 31 JURIMETRICS J. 375, 385 (1991) [hereinafter Champagne, Shuman & Whitaker, *Expert Witnesses*] (reporting that fifty-six percent of the experts they interviewed say their lawyers ask them to be less tentative). They found a similar percentage (fifty-seven percent) in a second, follow-up study. Daniel W. Shuman, Elizabeth Whitaker & Anthony Champagne, *An Empirical Examination of the Use of Expert Witnesses in the Courts—Part II: A Three City Study*, 34 JURIMETRICS J. 193, 201 (1994) [hereinafter Shuman, Whitaker & Champagne, *Expert Witnesses Part II*]. Perhaps more alarmingly, twelve percent of the experts in the first study and twenty-two percent in the second study agreed with the statement that lawyers try to get their experts to testify to issues for which there is no scientific basis.

case in the best possible light. There is no obligation to take a critical, disinterested look at all the evidence and, as Kritzer notes, it is part of the partisan nature of the process that an advocate is expected to do everything possible to cast doubt on opposing testimony, even when the advocate knows that the testimony is accurate.[19] It goes without saying that this approach is contrary to scientific conventions of data sharing, intellectual honesty, and disinterestedness.

Professors Kritzer and Haack are quick to observe that this distinction describes an ideal. On the one hand, scientists are not always disinterested. They often become advocates for their preferred hypothesis or theory. Moreover, all of us, scientists included, are prone to what psychologists call confirmation bias.[20] On the other hand, the legal system places limits on partisanship. Witnesses are sworn to tell the "whole truth." But if it is important to avoid the trap of a false dichotomy, it is equally important to eschew an attitude that science and law are the same. There are real differences. The norm among scientists is to take a critical approach to evidence. That norm is not always followed. But it is different from the legal arena where the norm is to adopt a partisan approach to evidence.

III

REASONS FOR THE DIFFERENT APPROACHES TO EXPERT KNOWLEDGE

Two factors explain much of the difference in legal and scientific approaches to expert knowledge. They are the U.S. adversarial system and a legal system's need for prompt closure. Understanding how each of these factors influences legal conventions is necessary if we are to find an appropriate accommodation when science enters the courtroom.

A. Adversarialism

One source of differences between legal and scientific conventions is the U.S. legal system's commitment to adversarial processes—most importantly, the partisan use of expert knowledge. Adversarial processes are a part of a larger commitment to what Robert Kagan terms "adversarial legalism."[21] Oscar Chase focuses on four components that define U.S. adversarial processes: (1) the civil jury, (2) the use of party-controlled pretrial investigation, (3) the relatively passive role of the judge at the trial or hearing, and (4) the method of obtaining and using expert opinions (that is, parties hire and prepare experts).[22] Note that three of these components—party-controlled, pretrial investigation, passive

19. Kritzer, *supra* note 4, at 50 n.46.

20. *See generally* Raymond S. Nickerson, *Confirmation Bias: A Ubiquitous Phenomenon in Many Guises*, 2 REV. GEN. PSYCH. 175, 175 (1998) (defining confirmation bias as "the seeking or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis at hand").

21. ROBERT A. KAGAN, ADVERSARIAL LEGALISM: THE AMERICAN WAY OF LAW 3 (2001).

22. Oscar G. Chase, *American "Exceptionalism" and Comparative Procedure*, 50 AM. J. COMP. L. 277, 287 (2002).

judiciary, and party selection and employment of experts—are directly tied to the idea that expert knowledge is a partisan resource. Moreover, the features interact with each other to heighten the overall level of adversarialism. Party control of pretrial investigations and a relatively passive judiciary both enhance the effect of the party selection of witnesses.

Professor Chase speaks of these four components as the essential procedural elements that define what he calls "American exceptionalism."[23] The point is that among western legal systems, this constellation of features is nearly unique to the United States. European legal systems and legal systems from other developed countries, such as Japan, that have borrowed from European systems do not share these elements. Those systems are much more inquisitorial. Among other things, this means the judiciary plays a much larger role in pretrial investigations and in trial proceedings. For example, Professor Chase notes that German judges have a statutory "duty" to clarify issues; this often involves asking questions designed to mark out areas of agreement and disagreement and thus inevitably weaken party control of the evidence.[24] Most importantly, experts are retained by the court, not the parties.[25] In most of the world, the judge, not the parties, controls the selection and examination of experts.[26]

Although a commitment to adversarial procedures is an important source of differences between legal and scientific conventions concerning evidence, one should not lose sight of the fact that this commitment is an incidental feature of a legal system.[27] To claim that our strong commitment to adversarial procedures is an incidental feature may sound heretical to a large portion of the U.S. legal community that has little knowledge or interest in other legal systems and whose members have been steeped in adversarial ideology since law school. From a wider international perspective, however, our commitment to the party selection of experts is unusual and, judging by the operation of other legal systems, unnecessary.

---

23. Professor Chase's point is not that no other countries have any of these elements, but that this set of all four factors distinguishes U.S. trial practice from that of most other countries. The difference is especially pronounced on the civil side, in which relatively few other countries employ juries. It is less pronounced on the criminal side. For a recent example of a work comparing the use of experts in civil litigation in the United States and other counties, see ANDREW J. MCCLURG, ADEM KOYUNCU & LUIS EDUARDO SPROVIERI, PRACTICAL GLOBAL TORT LITIGATION: UNITED STATES, GERMANY AND ARGENTINA. 83–97 (2007).

24. *Id.* at 297.

25. Michael J. Saks, *Expert Witnesses in Europe and America*, *in* ADVERSARIAL VERSUS INQUISITORIAL JUSTICE: PSYCHOLOGICAL PERSPECTIVES ON CRIMINAL JUSTICE SYSTEMS 235, 235–44 (Peter J. van Koppen & Steven D. Penrod eds., 2003).

26. Chase, *supra* note 22, at 300; *see also* MIRJAN R. DAMAŠKA, EVIDENCE LAW ADRIFT 78 (1997).

27. To say that something is incidental does not mean that it is easily changed. Many members of the U.S. legal profession support the present arrangement with almost religious zeal. *See* MONROE H. FREEDMAN, UNDERSTANDING LAWYER'S ETHICS (1990); Monroe H. Freedman, *Our Constitutionalized Adversary System*, 1 CHAP. L. REV. 57 (1998).

B. Closure

The second source of differences in legal and scientific conventions is the law's need for closure. Both science and law deal with controversy, and both, therefore, must be concerned with how controversies come to an end. The end of a controversy may be influenced by both epistemic and nonepistemic factors. Epistemic factors are those that people involved in the controversy regard as knowledge-based and therefore internal to the very understanding of the problem. Nonepistemic factors are those factors external to the undertaking of the issue as an endeavor of rational, empirical investigation.[28]

Controversies may conclude in a number of ways. Two types of closure are particularly relevant to this discussion: closure by way of *resolution* and by way of *termination*.[29] A controversy is resolved when agreement is reached on the merits of the case. The factors involved are necessarily epistemic. Termination occurs when nonepistemic factors, such as an authoritative ruling by some official agency, brings an end to a controversy. These two types of closure are not mutually exclusive. Closure is often accomplished by a combination of these processes. However, both empirically and normatively, different arenas assign different weights to methods of closure. The conventions of science value resolution as a proper way to resolve questions. And in one sense, science lives up to this idea. Closure without substantial resolution is very rare in science. As Professor Haack notes,

> We describe disagreements among proponents of rival scientific theories or historical claims as 'debates'; and participants in such controversies sometimes engage in something that looks a lot like advocacy. Moreover, eloquence and appeals to authority sometimes produce artificial consensus, at least temporarily. But disagreements among inquirers, unlike debates between rival advocates, cannot be decided by a vote on the basis of rival presentations; they will settle on a conclusion only if and when the evidence brings the community of inquirers to a genuine, unforced, consensus.[30]

---

28. H. Tristram Engelhardt & Arthur L. Caplan, *Patterns of Controversy and Closure: The Interplay of Knowledge, Values and Political Forces*, *in* SCIENTIFIC CONTROVERSIES 1, 5 (H. Tristram Engelhardt, Jr. & Arthur L. Caplan eds., 1987).

29. Ernan McMullin, *Scientific Controversy and its Termination*, *in* SCIENTIFIC CONTROVERSIES, *supra* note 28, at 49, 77–82; *see* Mike Redmayne, *Expert Evidence and Scientific Disagreement*, 30 U.C. DAVIS L. REV. 1027, 1031–35 (1997). A third way controversies may end is abandonment; no way may be found to resolve an issue and people lose interest.

30. Susan Haack, *Epistemology Legalized: Or Truth, Justice, and the American Way*, 49 AM. J. JURIS. 43, 47 (2004). A notable recent example of an attempt to end a scientific debate by an appeal to authority was the thirty-year dominance of the views of Soviet agronomist T.D. Lysenko. With the help of the repressive powers of the state, first under Stalin and later under Khrushchev, Lysenko was able to suppress all controversy between his views and those of classical genetics. McMullin, *supra* note 29, at 80. Of course, with the passing of the repressive apparatus of the state, the artificial "consensus" quickly evaporated.

Even in the absence of a repressive political regime, resolution is rarely complete and other, nonepistemic factors often play a role. People clinging to an increasingly minority position may find it difficult to obtain grants to do research or to gain access to the leading journals to publish their findings. For a discussion of ways in which termination strategies were used to bring about an end to research and controversy concerning the drug Bendectin, see JOSEPH SANDERS, BENDECTIN ON TRIAL 86-88 (1998).

The problem with resolution as a strategy to end controversies is that it is open-ended. Science's commitment to resolution produces the attitude of agnosticism that values doubt and encourages waiting for persuasive evidence before making up one's mind. Given that a central objective of courts is to bring controversies to an end in reasonably prompt fashion, it is not surprising that the legal system is rarely willing to wait for an issue to be resolved before concluding litigation. Instead, courts usually rely on termination, that is, an authoritative ruling by the court, to bring an end to a controversy.

This does not mean that courts are indifferent to achieving the factually (and legally) correct outcome. They would prefer to get it right, and thus resolution is a goal, but one to be achieved within the boundaries of the court's obligation to resolve disputes in a timely fashion. Reopening a case that has been decided is a rare phenomenon.[31]

The tortured history of *Oxendine v. Merrell Dow Pharmaceuticals, Inc.*[32] provides an instructive example that reveals the tension between timely termination and proper resolution. In February 1982, the parents of Mary Oxendine filed a suit in her name in the District of Columbia Superior Court, claiming that her limb-reduction birth defect was caused by the drug Bendectin, which her mother had taken to control morning sickness while pregnant with Mary.[33] The trial lasted a month and resulted in a $750,000 verdict for the plaintiff, with a punitive-damages trial scheduled to follow.[34] Following the trial, the judge entered a judgment notwithstanding the verdict (j.n.o.v.) in favor of the defendant.[35]

In 1986, the District of Columbia Court of Appeals concluded that the trial-court j.n.o.v. ruling was an abuse of discretion and ordered the trial court to reinstate the verdict.[36] When the case was remanded to the trial court, the defendant filed a motion for a new trial on the grounds that one of the plaintiff's experts had testified falsely at trial.[37] After an evidentiary hearing, the trial judge agreed and granted the motion in February 1988.[38] Plaintiff appealed, and in 1989 the Court of Appeals again reversed, ruling that the trial judge had erred in granting a new trial.[39] Once again, it ordered the trial court to reinstate

31. Reopening cases is particularly problematic in a system that relies on jury trials. Largely because of the central place of juries in our civil justice system, U.S. trials are concentrated events in which all the evidence is presented at one time. Systems without juries are more likely to have episodic trials and less need for a final determination at a certain point in the process. Moreover, the substantial expense involved in mobilizing for a new trial argues against upsetting jury verdicts in the absence of plain and significant error. For a discussion of the concentrated trial in the United States, see DAMAŠKA, *supra* note 26, at 58–73.

32. Oxendine v. Merrell Dow Pharms., Inc., 506 A.2d 1100 (D.C. App. 1986).

33. *Id.* at 1103.

34. *Id.*

35. *Id.*

36. *Id.* at 1114.

37. *Id.*

38. The original trial judge recused himself subsequent to the reversal, and this order came from a new judge.

39. Oxendine v. Merrell Dow Pharms., Inc., 563 A.2d 330, 332 (D.C. App. 1989).

the original verdict.[40] The defendant petitioned for a writ of certiorari, which was denied in 1990.[41]

However, when the case was returned to the trial court and the plaintiff asked the trial judge to enter a judgment on the verdict, the defendant again appealed. In 1991 the Court of Appeals agreed with the defendant that the judge could not enter an enforceable and appealable "final judgment" on the $750,000 compensatory damage award until the completion of the punitive damage phase of the trial which, due to the many appeals, had never taken place.[42] Faced with this ruling, the plaintiff abandoned her punitive damage claim and, in the summer of 1993, moved for summary affirmance of the compensatory damage claim.[43]

At this point, the defendant asked the trial judge to reconsider the original jury verdict in light of post-trial scientific developments.[44] The trial judge refused to do so and entered a judgment on the 1982 verdict. The defendant again appealed and in 1994, twelve years after the jury verdict, the appellate court held that the trial court had erred in flatly refusing to consider post-trial evidence regarding the drug's safety—although relief could be granted only if the defendant manufacturer could demonstrate that newly discovered evidence would probably produce a different verdict if a new trial were granted.[45] Two years later, in the fall of 1996, the trial court entered an order granting the defendant a judgment as a matter of law.[46] The order was accompanied by an opinion that reviewed nearly all of the scientific data published from 1983 to 1996 and concluded that the plaintiff could not produce admissible evidence that Bendectin is a teratogen.[47] Apparently, the plaintiff never appealed this ruling, effectively bringing an end to the litigation.

A number of things could be said about this lengthy proceeding, but for purposes of this article three points are central. First, at the end of the proceedings, when it would have been relatively easy for the Court of Appeals to simply permit the case to be terminated in the way the jury had decided many years before, it chose to compel the trial court to reconsider the scientific evidence. It was interested in what the scientific community thought, especially if that community had come close to resolving the underlying factual issue of whether Bendectin is a teratogen. Clearly, it had.[48] Second, even here, the

40. *Id.* at 338.

41. Oxendine v. Merrell Dow Pharms., Inc., 563 A.2d 330, 332 (D.C. App. 1989), *cert. denied*, 110 S. Ct. 1121 (1990).

42. Merrell Dow Pharms., Inc. v. Oxendine, 593 A.2d 1023, 1027 (D.C. App. 1991).

43. Merrell Dow Pharms., Inc. v. Oxendine, 649 A.2d 825, 827 (D.C. App. 1994).

44. *Id.*

45. *Id.*

46. Oxendine v. Merrell Dow Pharms., Inc., No. 82-1245, 1996 WL 680992, at *33 (D.C. Super. Oct. 24, 1996).

47. *Id.* at *34. A teratogen is any substance that interferes with fetal development, thereby causing birth defects.

48. JOSEPH SANDERS, BENDECTIN ON TRIAL 83–86 (1998). Even when a case is properly resolved from the point of view of outsiders, the losing litigant may not agree. It is not surprising, therefore, that

willingness of the Court of Appeals to permit the trial court to take a second look would have been very unlikely if there had been a final termination of the litigation. Absent proof of some serious wrongdoing by the prevailing party, undoing a final judgment in a civil matter is extremely rare.[49] The defendant's most remarkable achievement in the *Oxendine* litigation was not its ultimate victory, but its relentless effort to prevent a final judgment in the litigation. Finally, even though the courts did not formally undo a final judgment, *Oxendine*'s *Jarndyce v. Jarndyce*-like longevity may strike many as unseemly. Courts should not let cases linger in this way. The prompt termination of disputes is itself an important goal.

In sum, closure is a more fundamental issue than adversarialism. Unless we are prepared to craft a tort system that is indifferent to questions of causation, the law's need for relatively prompt closure stands in direct conflict with the scientific convention that closure should only occur when a consensus forms, however long that might be. Moreover, closure requires the fact finder to address specific questions concerning the parties before it, questions that scientists may be relatively less prepared to answer.

IV

ADVERSARIALISM, CLOSURE AND EXPERT WITNESSES

Given these reasons for the differences between legal and scientific conventions, how do they affect our understanding of expert witnessing? The question can be divided into two parts: the *role* the expert should assume and the *justification* an expert should require before making an assertion.

A. Role

From the point of view of many experts, the most troublesome aspect of expert witnessing is balancing the scientific conventions of data-sharing, intellectual honesty, and disinterestedness with legal conventions that treat expert knowledge as a partisan resource. This, ultimately, translates into a question of the expert's proper role. One vision is of the expert as an educator.[50]

---

legal systems devote so much energy to questions of procedure. For it is through procedural correctness that courts hope to assuage the losers. If evidence is what permits the *resolution* of disputes to most everyone's satisfaction, procedure is what permits the *termination* of disputes to most everyone's satisfaction. Over the last twenty years, a large body of research on procedural justice confirms that lawsuit losers are much more likely to accept an adverse outcome if they believe they received procedural justice. *See generally* TOM R. TYLER, WHY PEOPLE OBEY THE LAW (1990).

49. The situation is somewhat different on the criminal side. In recent years many convicted felons have been exonerated through DNA testing. *See* Susan Haack, *Inquiry and Advocacy, Fallibilism and Finality: Culture and Inference in Science and the Law*, 2 LAW, PROBABILITY & RISK 205 (2003); Seth F. Kreimer & David Rudovsky, *Double Helix, Double Bind: Factual Innocence and Postconviction DNA Testing*, 151 U. PA. L. REV. 547 (2002); D. Michael Risinger, *Unsafe Verdicts: The Need for Reformed Standards for the Trial and Review of Factual Innocence Claims*, 41 HOUS. L. REV. 1281 (2004).

50. *See* MELVIN A. SHIFFMAN, *Code of Professional and Ethical Conduct*, *in* ETHICS IN FORENSIC SCIENCE AND MEDICINE: GUIDELINES FOR THE FORENSIC EXPERT AND THE ATTORNEY, 280, 283

The expert is someone who conveys the knowledge of her field in a way that permits the fact finder to understand the strengths and weaknesses of the parties' arguments. A different vision is the expert as part of the team that hired her, a party's advocate.[51] The tension between the two is something felt by many experts. The following comment is typical:

> I always experience a certain amount of tension in the process of testifying. The conflict is between whether I am testifying for the people who hired me or whether I am a servant of the court, and am simply supposed to answer questions and however the questions come up, the answers fall where they will.[52]

Note that this tension is not between the ideal expressed in scientific conventions and the ideal embodied in the law. The legal ideal is identical to the scientific convention. It conceives of the expert witness as a source of independent and disinterested information.[53] The expert is a witness, not an advocate, and as a witness the expert takes the typical oath promising to tell "the truth, the whole truth, and nothing but the truth." This is a promise not only not to lie, but not to engage in half-truths and withheld truths.[54] It is the legal system's commitment to adversarialism in the form of party control of expert witnesses that creates substantial pressures on experts to adopt a more party-oriented point of view.

What evidence we have suggests that adversarial procedures do indeed take their toll. Indeed, in one survey of experts, seventy-seven percent agreed with the statement that lawyers manipulate their experts to weaken unfavorable testimony and to strengthen favorable testimony, and fifty-seven percent agree that lawyers urge their experts to be less tentative.[55] Judges, too, complain about expert-witness bias. In the same study, the authors report that

> [s]eventy-nine percent of the judges did not think expert witnesses could be depended upon to be impartial. . . . Sixty-three percent thought that expert witnesses were

(Melvin Shiffman ed., 1999) ("A forensic expert assumes the added role of a teacher. Members are required to maintain competence in both their expertise and in an ability to clearly and accurately disseminate that expertise to others.").

51. *See* Joanna A. Albers et al., *Toward a Model Expert Witness Act: An Examination of the Use of Expert Witnesses and a Proposal for Reform*, 80 IOWA L. REV. 1269 (1995). The preamble to the model statute drafted by a group of University of Iowa law students begins with the following sentence: "This [Act] is designed to change the role of an expert witness from advocate to educator." *Id.* at 1276 (brackets in original).

52. MARK CHESLER ET AL., SOCIAL SCIENCE IN COURT: MOBILIZING EXPERTS IN THE SCHOOL DESEGREGATION CASES 112 (1988).

53. Steven Lubet, *Expert Witnesses: Ethics and Professionalism*, 12 GEO. J. LEGAL ETHICS 465, 467 (1999); Douglas R. Richmond, *Expert Witness Conflicts and Compensation*, 67 TENN. L. REV. 909, 911 (1999–2000). This position is made explicit in the civil-procedure rules of the United Kingdom. Rule 35.3 states: "(1) It is the duty of an expert to help the court on the matters within his expertise. (2) This duty overrides any obligation to the person from whom he has received instructions or by whom he is paid." CIV. P.R. 35.3, *available at* http://www.justice.gov.uk/civil/procrules_fin/contents/parts/part35.htm#rule35_1.

54. 1 DAVID L. FAIGMAN ET AL., MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY § 3.10 (2007–2008 ed.); *see also* Lubet, *supra* note 53, at 467 ("The single most important obligation of an expert witness is to approach every question with independence and objectivity.").

55. Shuman, Whitaker & Champagne, *Expert Witnesses Part II*, *supra* note 18, at 201.

> usually noticeably biased in favor of the side paying them, and sixty-eight percent thought that the most distressing characteristic of expert witnesses was that they could not be depended upon to be impartial. Fifty-seven percent reported that they thought of expert witnesses as 'hired guns' who gave biased testimony. Sixty-eight percent of the judges feared that some of the fees experts charged were large enough to provide a financial interest in the outcome of the case.[56]

Other studies report similar results. When federal judges are asked about problems they encounter with expert testimony, the most-frequently mentioned problem is that experts abandon objectivity and become advocates for the side that hired them.[57]

Jurors also may perceive bias. A National Law Journal poll in 1992 found that over thirty percent of jurors in civil cases reported the experts were biased.[58] Not surprisingly, some feel that this is a low number. One experienced litigator who thought the percentage would be higher observed, "It means we have a lot of good actors as experts."[59] Or it may mean that jurors, who do not see multiple cases, as do judges, may be less sensitive to bias.

Bias, or at least the perception of bias, is an inevitable part of a system in which experts are chosen by the parties. A limited body of psychological literature suggests that adopting a role affects attention to details, memory retrieval, and decision thresholds.[60] Some research on witnesses confirms this effect. In one study, Shepard and Vidmar conducted an experiment in which undergraduates viewed a slide show and heard an audio tape depicting a fight.[61] The "witnesses" then were interviewed by either an adversary or a nonadversary lawyer and a week later testified about what they saw.[62] Witnesses interviewed by the adversary lawyer biased their testimony in favor of the lawyer's client, and this bias affected impressions of the factual evidence and responsibility judgments of "naive" adjudicators—those unaware of who had interviewed the witness.[63]

Several studies of accountants affirm this result. Bazerman and colleagues have explored what they call a "self-serving bias."[64] They gave undergraduate and business students a complex set of information about a potential sale of a fictional company and asked them to estimate its value. The subjects were assigned different roles—buyer, seller, buyer's auditor, and seller's auditor.

---

56. *Id.* at 202–03.

57. Carol Krafka et al., *Judge and Attorney Experiences, Practices, and Concerns Regarding Expert Testimony in Federal Civil Trials*, 8 PSYCHOL. PUB. POL'Y & L. 309, 328 (2002).

58. Jeffery Harrison, *Reconceptualizing the Expert Witness: Social Costs, Current Controls, and Proposed Responses*, 18 YALE J. ON REG. 253, 255 (2001).

59. *Id.*

60. D. Michael Risinger et al., *The* Daubert/Kumho *Implications of Observer Effects in Forensic Science: Hidden Problems of Expectation and Suggestion*, 90 CAL. L. REV. 1, 18–19 (2002).

61. Blair H. Sheppard & Neil Vidmar, *Adversary Pretrial Procedures and Testimonial Evidence: Effects of Lawyer's Role and Machiavellianism*, 39 J. PERS. & SOC. PSYCHOL. 320 (1980).

62. *Id.* at 320.

63. *Id.*

64. Max H. Bazerman, George Lowenstein & Don A. Moore, *Why Good Accountants Do Bad Audits*, 80 HARV. BUS. REV. 97 (2002).

Most relevant for purposes of showing that expert bias is a byproduct of an adversarial system is the comparison of those subjects asked to play the two auditor roles. Their valuations were biased in their client's favor in both a public statement about the company's worth and in private communication to their client. At the end of the experiment, the subjects were asked to estimate the company's "true value" and were told that they would be rewarded according to how close their private judgments were to those of impartial experts. Even with this incentive, subjects asked to play the role of the buyer's auditor produced estimates that were on average thirty percent higher than the estimates of the subjects asked to play the role of the seller's auditor.[65]

The subjects in a second study by these authors were professional auditors.[66] Each of the 139 subjects was given five ambiguous auditing vignettes and asked to judge the accounting for each. Half the subjects were asked to suppose that they had been hired by the company they were auditing and half were asked to suppose they were hired by a different company doing business with the company in question. They were then asked to state whether or not the firm's financial reports complied with generally accepted accounting principles (GAAP). For all five vignettes, the auditors were on average thirty percent more likely to find that the accounting behind the company's financial report complied with GAAP if they were playing the role of auditor for the firm.[67]

One must be careful in drawing conclusions from studies that are so different from the actual expert-witnessing experience. However, the results do suggest that very weak role manipulations can produce biasing effects even among witnesses who themselves have no psychological or economic interest in a given outcome. In general, these studies suggest that experts are more likely to come to the stand with "hot biases."[68] Such biases are not necessarily intentional, but they are directionally motivated. The experts are more likely to want a certain outcome to prevail.[69]

Party control over the selection of experts produces bias not only by pushing experts to a more one-sided view than the individual expert might express if

65. *Id.* at 100.

66. *Id.* at 100–01.

67. *Id.*; *see also* Bazerman et al., *supra* note 64, at 97; Lawrence A. Ponemon, *The Objectivity of Accountants' Litigation Support Judgments*, 70 ACCT. REV. 467, 484 (1995) (noting that when accountants act in a litigation-support role, despite a professional responsibility to act objectively, they favor their clients' economic interests and will provide a higher estimate of an inventory destroyed by fire if hired by the plaintiff and a lower estimate if hired by the defendant).

68. Some biases are intentional, such as those that are the result of fraud or advocacy. Other biases may be thought of as "hot." They are often unintentional and even unconscious, but they are directionally motivated because the individual expects or wants an outcome to prevail. Still other biases are "cold." They occur even in the absence of a desire for a certain outcome and in spite of a desire to achieve accuracy. Robert J. MacCoun, *Biases in the Interpretation and Use of Research Results*, *in* 49 ANN. REV. PSYCHOL. 259, 268 (Janet T. Spence et al. eds., 1998).

69. *See* D. Michael Risinger et al., *supra* note 60, at 90. These results would come as no surprise to early twentieth-century commentators on expert witnesses. George C. Harris, *Testimony for Sale: The Law and Ethics of Snitches and Experts*, 28 PEPP. L. REV. 1, 59 (2000) (quoting a number of passages to this effect, including one from Wigmore in the 1923 edition of his evidence treatise).

placed in a different role; it produces bias in the selection process itself. Witnesses are chosen because they prefer a point of view, and the very choice of experts clouds the degree of consensus that may surround a topic. Other aspects of the adversarial trial produce similar effects. As Jasanoff notes,

> Adversarial process is indeed a wonderful instrument for deconstructing "facts," for exposing contingencies and hidden assumptions that underlie scientific claims, and thereby preventing an uncritical acceptance of alleged truths. The adversary process is much less effective, however, in reconstructing the communally held beliefs that reasonably pass for truth in science. Cross-examination, in particular, unduly privileges skepticism over consensus. It skews the picture of science that is presented to the legal factfinder and creates an impression of conflict even where little or no disagreement exists in practice.[70]

Given the many shortcomings of the present arrangement, complaints about the use of expert witnesses have a long history, beginning shortly after party control of experts became the norm,[71] and continuing to the present time.[72] These concerns have lead to many proposals designed to lessen the adversarial nature of expert testimony. They include expert panels, neutral experts, court-appointed experts, and science courts. None of the proposals has met with much success, although many of them would be an improvement over the status quo. A less-adversarial selection of experts would assist juries by giving them a more balanced view of the scientific issues at stake.

These proposals are resisted precisely because they interfere with attorney control and, more fundamentally, they challenge adversarial procedures that are, as Kessler notes, far more than a legal technique and instead encompass an entire political image of justice.[73] In light of this ideology, substantial movements away from party-witness experts seems unlikely.[74]

---

70. Sheila Jasanoff, *What Judges Should Know About the Sociology of Science*, 32 JURIMETRICS J. 345, 353–54 (1992).

71. As early as 1901, Learned Hand wrote his well-known article criticizing party-selected experts. Learned Hand, *Historical and Practical Considerations Regarding Expert Testimony*, 15 HARV. L. REV. 40 (1901). For a general overview of expert witnesses prior to the 1900s, see TAL GOLAN, LAWS OF MEN AND LAWS OF NATURE: THE HISTORY OF SCIENTIFIC EXPERT TESTIMONY IN ENGLAND AND AMERICA (2004).

72. Edward K. Cheng, *Same Old, Same Old: Scientific Evidence Past and Present* reviews the many attempts to establish court-appointed, expert-witness systems in the United States. 104 MICH. L. REV. 1387, 1394–96 (2006). For example, The Model Expert Witness Act, published in 1937, would have improved the fit between fact-oriented experts and the normative tensions of the law. *Id.* at 1394. Under that Act, pretrial conferences between experts would have been held to resolve their factual disagreements. *Id.* Such provisions of the Model Act have never been adopted into law.

Somewhat later, Edward Cleary suggested, "It is not only essential to reduce the partisan element in the selection of experts, but it is equally important that the contentious character of the presentation of the results of the expert's investigation be modified." EDWARD W. CLEARY, MCCORMICK ON EVIDENCE 44 (3d ed. 1984).

73. Amalia D. Kessler, *Our Inquisitorial Tradition: Equity Procedure, Due Process, and the Search for an Alternative to the Adversarial*, 90 CORNELL L. REV. 1181, 1273 (2005); *see also* KAGAN, *supra* note 21, at 3; Sven Timmerbeil, *The Role of Expert Witnesses in German and U.S. Civil Litigation*, 9 ANN. SURV. INT'L & COMP. L. 163, 163 (2003).

74. Professor Easton believes we are stuck with a system of party witnesses testifying in an adversary setting. The central idea informing the Easton proposal is that the jury will find it easier to make an informed evaluation of the experts' testimony if each side is required to report all communications between hiring attorneys and expert witnesses as well as all of the items considered by

However, U.S. courts have taken smaller steps toward reducing the untoward effects of the adversarial selection of witnesses. The so-called *Daubert* revolution has pushed courts in the United States toward a slightly more inquisitorial posture. Prior to the adoption of the Federal Rules of Evidence in the 1970s, most states followed the *Frye* rule.[75] Although the *Frye* test could have been employed by judges to exert greater control over expert testimony, it was often honored in the breach and rarely invoked in civil cases.[76] The era of a totally passive judiciary slowly ended after the adoption of the Federal Rules of Evidence, and, since *Daubert*, the federal judiciary and the courts in many states have adopted a more active, inquisitorial posture in assessing the quality of a party's experts.[77] This trend is especially noticeable in mass tort cases that end up in multidistrict litigation (MDL) proceedings.[78] Often, key causal questions are decided in MDL admissibility rulings long before any case is returned to its home district for trial.[79]

A more proactive judiciary may assist jurors in understanding evidence in cases by eliminating from their consideration the least probative evidence.[80] It does not, however, help experts to resolve the role conflicts that inhere in the party selection of witnesses.[81] If we are unwilling to move away from party selection as the primary method of witness selection, we can at least better arm experts to resist efforts by their attorneys to have them adopt a more partisan stance. Many professional associations have codes of ethical conduct that call

---

the experts. If bias cannot be controlled, at least it can be revealed. Moreover, a full disclosure system might encourage attorneys to do less to influence expert testimony. Stephen D. Easton, *Ammunition for the Shoot-out with the Hired Gun's Hired Gun: A Proposal for Full Expert Witness Disclosure*, 32 ARIZ. ST. L. J. 465, 474, 608 (2000).

75. Frye v. United States, 293 F. 1013 (D.C. Cir. 1923). According to the *Frye* test, scientific evidence should be admitted only when the scientific principle upon which the expert's testimony is based is "sufficiently established to have gained general acceptance in the particular field in which it belongs." *Id.* at 1014.

76. *See* Paul Giannelli, *The Admissibility of Novel Scientific Evidence:* Frye v. United States, *a Half-Century Later*, 80 COLUM. L. REV. 1197 (1980).

77. *See* Howard M. Erichson, *Mass Tort Litigation and Inquisitorial Justice*, 87 GEO. L. J. 1983 (1999); Joseph Sanders, *Scientifically Complex Cases, Trial by Jury, and the Erosion of Adversarial Processes*, 48 DEPAUL L. REV. 355 (1998).

78. Barbara J. Rothstein, Francis E. McGovern & Sarah Jael Dion, *A Model Mass Tort: The PPA Experience*, 54 DRAKE L. REV. 621, 626–27 (2006).

79. Occasionally, MDL judges go even further. In the silicone-breast-implant litigation, Judge Pointer appointed an expert panel under Federal Rule of Evidence 706. The panel's finding that implants did not cause autoimmune disease played a central role in ending the litigation. *See* DAVID L. FAIGMAN ET AL., 3 MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY § 28.2 (2007–2008 ed.).

80. Joseph Sanders, *The Merits of the Paternalistic Justification for Restrictions on the Admissibility of Expert Evidence*, 33 SETON HALL L. REV. 881 (2003).

81. *See* David E. Bernstein, *Expert Witnesses, Adversarial Bias, and The (Partial) Failure of the* Daubert *Revolution*, 93 IOWA L. REV. 451, 489 (2008) ("The problem with the *Daubert* revolution, then, is not that it was too radical, but that it was not radical enough. Rule 702 attempts to solve the problem of adversarial bias through a reliability test, but it leaves intact the general adversarial structure that creates the underlying reliability problem.").

> (3)If an expert witness considers that his or her opinion is not a concluded opinion because of insufficient research or insufficient data or for any other reason, this must be stated when the opinion is expressed.[85]

The code of conduct must be provided to each expert and the expert's testimony or written report cannot be entered into the case unless the expert acknowledges the receipt of the code of conduct and agrees to be bound by it.[86]

The underlying purposes of the code are to inform experts that their duty is to the court and to reinforce the ideal of a disinterested, educator role for experts. Even if the code of conduct is only hortatory, without any sanctions for its violation, it underlines that both the court and the professional organization expect an expert to adopt a neutral, educator role when testifying and that just because one of the parties engaged the expert should not present an ethical role conflict. At the very least, such a code provides some ammunition to the conscientious expert when dealing with her attorney. In the absence of such codes, one could argue that the legal system itself is not meeting its ethical obligations to assist experts themselves as much as possible to live up to the role expectations of their profession and the legal system alike.

B. Justification

1. The "Same Intellectual Rigor" Standard

If role conflicts are the most serious ethical conundrum confronting expert witnesses in U.S. courts, the level of justification an expert should have for an opinion is the most serious intellectual question. Moreover, it is an intellectual question with significant ethical overtones. When is it proper for an expert to say she "knows" something? The dominant epistemological approach to this question involves the interplay of three factors: belief, truth, and justification.[87] Belief is a person's subjective position concerning the truth of a proposition. Truth is the reality of the proposition independent of belief. Justification involves the quality of the reasons for a belief. For a person to have 'knowledge,' the person must believe something is true, it must be true, and the person's belief that it is true must be justified.[88] Even correct beliefs without appropriate justification are not knowledge.

What is wrong with beliefs without good justification? First, of course, there is the instrumental objection. Such beliefs are more likely to be wrong, causing us to make mistakes. Moreover, knowledge has a normative dimension. When we say we believe something to be true, we are warranting our commitment to

85. *Id.* § 5.

86. *Id.* § 31.23.

87. D. Michael Risinger & Michael J. Saks, *Rationality, Research and Leviathan: Law Enforcement-Sponsored Research and the Criminal Process*, MICH. ST. L. REV. 1023, 1024 (2003).

88. MICHAEL WILLIAMS, PROBLEMS OF KNOWLEDGE: A CRITICAL INTRODUCTION TO EPISTEMOLOGY 16 (2001). In the absence of a belief, what we have is ignorance. In the absence of truth, what we have is error. In the absence of appropriate justification, what we have is mere opinion. *Id.*

the truth of a proposition (the belief condition) and that we are entitled to this belief (the justification condition). When we attribute knowledge to another, it is because we concede that he believes the proposition and that he has a right to his belief.[89] It is irresponsible to assert knowledge without adequate justification.

As with most forms of irresponsibility, irresponsibility of this sort is relatively harmless when it is not inflicted on others. When beliefs are shared, however, one is more or less vouching for the truth of the belief and inviting others to rely on this knowledge as well. Behavior that is irresponsible in this way is unethical when it occurs within settings in which individuals hold themselves (and their representatives) out as having knowledge upon which others rely. It is unethical for expert witnesses to express unjustified beliefs. But what constitutes appropriate justification? The answer to this question requires that once again we confront the differences between scientific and legal conventions.

An obvious place to look for standards of adequate justification is within the area of study itself. Expert ethical behavior should be judged by the standards of the discipline of the expert.[90] In fact, that a number of professional associations have promulgated codes of conduct for their members is consistent with this view. These codes require that the basis of belief be equal to that required when performing outside the courtroom.[91] For example, one code of professional conduct for forensic experts calls upon witnesses to "consider all relevant data, and analyze it objectively in formulating conclusions" and to perform only as the witness "would routinely perform in the course of normal professional duties."[92]

Not only is this the test advanced by a number of professional organizations, it is also one interpretation of evidentiary-admissibility rules. *Frye*'s general-acceptance test can be understood this way.[93] A slightly different version of this approach appears in *Kumho Tire*'s requirement that, in order for expert testimony to be admissible, the expert must employ "the same intellectual rigor" with respect to his courtroom testimony that he would with respect to his everyday work.[94] Viewed in this light, U.S. admissibility rules are compatible with the standards of many professions.[95]

---

89. *Id.*; *see also* John Pollock, *Epistemic Norms*, *in* EPISTEMOLOGY: AN ANTHOLOGY 192 (Ernest Sosa & Jaewon Kim eds., 2000).

90. The focus here is on what one might think of as the "mean" intellectual rigor of a discipline. Of course, there is reasonable variance around this mean such that some experts would require more or less justification than their colleagues but still be in the normal range of the level of justification required in a field. This article does not discuss the issue of reasonable variance.

91. *See, e.g.*, *supra* note 82.

92. National Forensic Center, *Code of Professional and Ethical Conduct*, *in* SHIFFMAN, *supra* note 50, at 285.

93. Samuel R. Gross & Jennifer L. Mnookin, *Expert Information and Expert Evidence: A Preliminary Taxonomy*, 34 SETON HALL L. REV. 141, 148 (2003) (noting that the *Frye* standard "pass[es] the buck back to the expert field itself, and accept[s] the standards it imposes on itself").

94. Kumho Tire Co., Ltd. v. Carmichael, 526 U.S. 137, 152 (1999) ("The objective of [the *Daubert*] requirement is to ensure the reliability and relevancy of expert testimony. It is to make certain that an

This does not mean there is a single threshold in each profession or area of knowledge. Depending on the question, experts may hold a position with more or less justification. What the standard does acknowledge is that disciplines generally contain a body of norms and conventions defining acceptable instruments, methods, analyses, and interpretations of evidence. These norms and conventions define the intellectual rigor of a field.

2. Objections to the "Same Intellectual Rigor" Standard

The "same intellectual rigor" test is not without its critics. They raise two objections. David Faigman argues that the test is too lenient when it permits individuals in fields with little or no empirical tradition to make factual assertions based on very little or no data simply because most other members of the field also are prepared to make factual assertions based on a similar lack of evidence.[96] Note that this objection is not a rejection of the "same intellectual rigor" test, per se. Commenting on the test in the context of a discussion of *Daubert*, he notes,

> The *Daubert* query is not simply whether the expert is using the same intellectual rigor in court that he or she would use in the field. *Daubert* asks whether the expert testimony itself is based on a sufficiently rigorous research foundation. Surely, if an expert fails to use the same intellectual rigor used in the field, he or she should be excluded. But an expert's use of the same intellectual rigor in the courtroom as in the field does not ensure reliable testimony if the field itself is not rigorous. The same intellectual rigor test is a necessary, but not a sufficient, criterion for admission.[97] This criticism correctly recognizes that the "same intellectual rigor" test should not be the sole measure of acceptable justification for an expert's opinion.

Legal conventions may establish a minimal threshold that must be exceeded before an expert has sufficient justification for a belief.

A more fundamental objection comes from those who argue that meeting the "same intellectual rigor" test is not even a necessary condition. Professor Neil Cohen is among those who hold this view. He is concerned that professional standards of a scientific discipline may be too stringent. Scientific conventions set too high a standard against which to measure the adequacy of

---

expert, whether basing testimony upon professional studies or personal experience, employs in the courtroom the same level of intellectual rigor that characterizes the practice of an expert in the relevant field.").

In *Kumho Tire*, the court criticized the plaintiff's expert on precisely this ground. "Indeed, no one has argued that Carlson himself, were he still working for Michelin, would have concluded in a report to his employer that a similar tire was similarly defective on grounds identical to those upon which he rested his conclusion here." *Id.* at 158.

Apparently, the "same intellectual rigor" test was first advanced by Judge Posner in a set of Seventh Circuit opinions. Braun v. Lorillard, Inc., 84 F.3d 230, 233 (7th Cir. 1996); Rosen v. Ciba-Geigy Corp., 78 F.3d 316, 318 (7th Cir. 1996); *see* J. Brook Lathram, *The "Same Intellectual Rigor" Test Provides an Effective Method For Determining the Reliability of All Expert Testimony, Without Regard to Whether the Testimony Comprises "Scientific Knowledge" or "Technical or Other Specialized Knowledge,"* 28 U. MEM. L. REV. 1053 (1998).

95. *See* Lathram, *supra* note 94, at 1057.

96. David L. Faigman, *The Law's Scientific Revolution: Reflections and Ruminations on the Law's Use of Experts in Year Seven of the Revolution*, 57 WASH. & LEE L. REV. 661, 667 (2000).

97. *Id.*

the justification for an expert's opinion. "Science, particularly empirical science that relies on statistical or other probabilistic methods, routinely uses filters that prevent its experts from reaching exactly the sort of opinions as to the truth of ultimate facts that should be utilized in a civil trial governed by the preponderance of the evidence rule."[98]

If an expert would be behaving inappropriately by claiming a causal relationship between, say, exposure to a substance and cancer in a peer-reviewed, published work in the expert's discipline, why would the same expert be justified in reaching exactly this conclusion on the stand? Professor Cohen offers two central objections to the "same intellectual rigor" test which are in fact arguments about why scientific conventions concerning knowledge are inappropriate in the legal context: the law's need for closure, and the preponderance of the evidence burden of persuasion in civil cases.[99] A word about each is in order.

Cohen argues that the open-ended nature of scientific inquiry produces a convention against coming to any conclusion and that the law's need for closure argues for a different standard. He argues that, in everyday practice, "scientific factfinders have available three possible answers to the question of whether A is associated with B: (i) no, (ii) yes, and (iii) 'the evidence suggests yes, but we are not yet ready to proclaim that the answer is yes because the evidence could be an artifact of chance.'"[100] He might have added a fourth answer, "The evidence suggests no, but we are not ready to close the door on all inquiry because the existing evidence is limited in its power to detect an effect." The point is that, in everyday practice, the norms of many disciplines discourage causal talk, but Cohen believes that in the context of a lawsuit experts should shrink the "suggested but not proven" categories. Since we have to have an answer in order to end the dispute, what we want is the scientist's best guess, even if it is a guess the scientist would refuse to make in the context of an open-ended scientific inquiry where the convention is to avoid coming to a premature judgment.

This is a reasonable position. Scientific conventions constructed against the background of pure science, in which nothing of immediate importance is at stake, do not map well onto situations where we need closure. But agreeing with this proposition does not answer the harder question about the extent and shape of the deviation. First, agreeing that closure argues for shrinking the "wait and see" category of responses does not commit one to agreeing with the legal view that experts should express their views with greater certainty. The legal convention calling for greater certainty is not simply a response to the need for closure. It is also a response to the adversarial nature of expert testimony. Were the need for closure the only issue, we would ask experts to

98. Neil B. Cohen, *The Gatekeeping Role in Civil Litigation and the Abdication of Legal Values in Favor of Scientific Values*, 33 SETON HALL L. REV. 943, 949 (2003).

99. *Id.* at 949–51.

100. *Id.* at 951.

give us their best estimate, but also ask them, when appropriate, to add the caveat that this is a speculation they would not make in the absence of a need for closure.[101] Such a caveat would be admission of some uncertainty in one's views.

Second, the need for closure does not legitimate every conjecture. Lawsuits are far from the only place where a need for closure occurs; it occurs within the everyday practices of professionals within their profession. The need for a decision now does not justify a general abdication of the level of justification an expert community considers sufficient to make a causal assertion.

Moreover, although trials are organized to achieve closure through authoritative termination of a controversy, it is important to keep in mind that the trial itself is not organized simply to terminate disputes. The trial is intended to seek resolution in the same sense that science does. It is organized to persuade all, or most all, of the fact finders about the merits of the issue at hand. The "need for an answer" does not justify the complete abandonment of the "wait and see" and "don't know" categories.

For example, in the area of drug-related injuries, the evidence of a causal relationship between the drug and some injury usually comes from four possible sources: epidemiology, animal studies, *in vitro* studies, and structure-activity evidence. The last category, structure-activity evidence, provides an argument by analogy. Toxicologists attempt to draw inferences about the biological activity of a drug by examining its chemical structure and comparing it to that of drugs whose biological activity is better understood.[102] If two substances have a similar chemical structure, there is some reason to believe that they may act in the same way when introduced into the body. For example, a key ingredient in the drug Bendectin was an antihistamine, and there is some evidence that some antihistamines are teratogens.

In the Bendectin cases, plaintiffs' experts argued that this structural similarity constitutes evidence that Bendectin causes birth defects.[103] However, by itself, the structure-activity analogy is weak evidence as to whether a chemical will be a teratogen. Molecules with minor structural differences can produce very different biological effects.[104] A number of courts have ruled that expert opinions based solely on structure-activity evidence are unreliable and therefore inadmissible because of differences between the substances.[105] One interpretation of these decisions is that even when there is need for closure, there are limits to how little justification one must have to express a belief about a causal relationship.

---

101. *Id.* at 962.

102. *See* Michael D. Green, *Expert Witnesses and Sufficiency of Evidence in Toxic Substances Litigation: The Legacy of* Agent Orange *and Bendectin Litigation*, 86 NW. U.L. REV. 643, 658 (1992).

103. DeLuca v. Merrell Dow Pharms., 911 F.2d 941, 946 n.8 (3d Cir. 1990); Richardson v. Richardson-Merrell, Inc., 857 F.2d 823, 829 (D.C. Cir. 1988), *cert. denied*, 493 U.S. 882 (1989).

104. FAIGMAN ET AL., *supra* note 79, § 22:34.

105. *See id.* § 22:4 (reviewing relevant cases).

3. Justification and Specific Causation

Limits there may be, but undoubtedly the need for closure produces some shrinkage of the "don't know" domain in the courtroom. Nowhere is this more evident than with respect to questions of specific causation. As noted above, large parts of science focus on general principles, or at least on aggregate findings, while courts are nearly always concerned, among other things, with facts about the individual case. The role of epidemiology in the courts provides an instructive example.[106] By its very nature, epidemiology is about groups. It can provide valuable evidence as to whether a substance increases the risk of injury in a population (general causation). Except in rare cases in which the relationship between exposure and disease is very high, such as asbestos exposure and mesothelioma, epidemiology cannot address the question of whether a particular individual injury was caused by the exposure (specific causation). Nevertheless, the courts need some opinion about specific causation. In most toxic-tort cases, they turn to what is commonly called differential-diagnosis testimony, introduced to rule out other possible causes of a particular plaintiff's injury.[107]

In *Cavallo v. Star Enterprise*, differential diagnosis was defined as "a process whereby medical doctors experienced in diagnostic techniques provide testimony countering other possible causes . . . of the injuries at issue."[108] The term is not used this way in medical discourse. Medical dictionaries define differential diagnosis as "diagnosis based on comparison of symptoms of two or more similar diseases to determine which the patient is suffering from."[109] The use of the same term to define two quite different undertakings masks the fact that often those experts offering "differential diagnosis" testimony in fact have little training in this area. Although courts often say that physicians are well-trained in the process of differential diagnosis and that they devote considerable attention in medical school to learning clinical reasoning, in point of fact the training is in the process of *deducing disease* based on a set of symptoms and laboratory tests.[110] This is a very different task than deducing the *cause* of a disease.[111] As the district court in *Wynacht v. Beckman Instruments, Inc.*[112] noted,

106. *See id.* § 23.

107. *Id.* at § 21; *see also* Joseph Sanders & Julie Machal-Fulks, *The Admissibility of Differential Diagnosis Testimony to Prove Causation in Toxic-Tort Cases: The Interplay of Adjective and Substantive Law*, 64 LAW & CONTEMP. PROBS. 107 (Autumn 2001).

108. Cavallo v. Star Enterprise, 892 F. Supp. 756, 771 (E.D. Va. 1995), *aff'd in part*, *rev'd in part on other grounds*, 100 F.3d 1150 (4th Cir. 1996).

109. TABER'S CYCLOPEDIC MEDICAL DICTIONARY 404 (14th ed. 1981). Some courts do recognize that legal usage is contrary to medical usage and employ the more appropriate term "differential etiology," referring to the study of the causes of disease. *See* Zuchowicz v. United States, 140 F.3d 381, 385 (2d Cir. 1998).

110. See, for example, Jerome P. KASSIRER & RICHARD I. KOPELMAN, LEARNING CLINICAL REASONING (1991), and the many books and articles cited therein on the process of differential diagnosis.

111. In other areas of expertise, however, opinions about specific incidents are the order of the day. In the *Kumho Tire* case for example, the court agreed that tire experts routinely make causal assertions about the reason a particular tire failed. Kumho Tire Co., Ltd. v. Carmichael, 526 U.S. 137, 156 (1999).

> [T]here is a fundamental distinction between Dr. Ziem's ability to render a medical diagnosis based on clinical experience and her ability to render an opinion on causation of Wynacht's injuries. Beckman apparently does not dispute, and the Court does not question, that Dr. Ziem is an experienced physician, qualified to diagnose medical conditions and treat patients. *The ability to diagnose medical conditions is not remotely the same, however, as the ability to deduce, delineate, and describe, in a scientifically reliable manner, the causes of these medical conditions.*[113]

Nevertheless, as long as the plaintiff must prove specific causation as part of his case-in-chief, courts are likely to permit experts to make causal assertions in court that they might choose not to make in other contexts, in which the pressures of closure are not so great.[114]

4. Bias Against Making a Type I Error[115]

Professor Cohen raises a second objection to the "same intellectual rigor" test that turns on the question of burdens of proof. In most civil cases, the plaintiff's burden of persuasion is proof by a preponderance of the evidence. Cohen argues that some experts are reticent to assert causation even when the evidence suggests that it is more likely than not that such a relationship exists. Knowingly or not, they are employing a higher justificatory standard. As evidence of this tendency, Cohen cites the use of a .05 probability threshold when conducting tests of significance to guard against making Type I errors. Cohen is wrong if he means to assert this commonly accepted probability threshold directly translates into bias against making Type I versus Type II errors.[116] However, his general point should not be dismissed out of hand.

Even some branches of medicine routinely make such judgments. Allergists, for example, are about the business of deducing what particular exposure produced a reaction in a specific patient.

112. Wynacht v. Beckman Instruments, Inc., 113 F. Supp. 2d 1205 (E.D. Tenn. 2000).

113. *Id.* at 1209 (emphasis added); *see also* Turner v. Iowa Fire Equip. Co., 229 F.3d 1202, 1208 (8th Cir. 2000); Medalen v. Tiger Drylac U.S.A., Inc., 269 F. Supp. 2d 1118, 1137 (D. Minn. 2003).

114. As noted by Professor Robertson, "The central idea is that when a defendant has engaged in conduct that we consider to be wrongful in major part because such conduct often leads to the kind of harm the plaintiff has suffered, we are rightfully impatient with the defendant's claim that plaintiff cannot prove that the conduct caused the harm on this occasion." David W. Robertson, *The Common Sense of Cause-in-Fact*, 75 TEX. L. REV. 1765, 1774–75 (1997).

115. Type I errors occur when scientists conclude that there is a causal relationship between two variables when in fact there is not. Type II errors occur when scientists conclude that there is not a causal relationship between two variables when in fact one exists. JOSEPH SANDERS, BENEDICTIN ON TRIAL 51 (1998).

116. *See* Joseph Sanders, *Expert Witness Ethics*, 76 FORDHAM L. REV. 1539, 1552–55 (2007). Tests of significance are generally designed to test the "null hypothesis." The null hypothesis might be that a coin is "fair" or that substance A does not cause illness B. The question addressed by tests of significance is: What must the results of a study look like before we are willing to reject the null hypothesis? A p-value represents the probability that a positive association would result from random error if no association is in fact present, that is, if the null hypothesis is true. A p-value of .05 may be interpreted as a 5% probability of observing an association at least as large as that found in the study when in truth the null hypothesis of no association is correct.

A test employing a .05 significance level does not mean that when we observe a significant result the null hypothesis has a 95% chance of being false. Rather, it means that if the null hypothesis is correct there was less than a 5% chance of generating this data. As Adelman notes,

> Interpreting frequentist significance levels as quantifying the degree of support for a hypothesis is equivalent to concluding that where *A* implies *B* it necessarily follows that *B*

Scientific conventions that focus researchers on a search for the general and theoretical may well cause some scientists to be particularly wary of asserting a causal relationship with less-than-very compelling evidence, and fuel an attitude of agnosticism that encourages waiting for persuasive evidence before making up one's mind. One could easily imagine an expert who said to herself, "I am fairly certain my data confirms my hypothesis. Indeed, I now believe it is more likely than not that my hypothesis is correct. But because I want to be very certain and because I do not want to foreclose other inquiry, I think I will not assert that the hypothesis is true until I am much more certain." For such an expert, a wide range of empirical findings will generate a "wait and see" response long after the expert thinks it is more likely than not that a hypothesis is correct. What is not clear from this example, however, is whether her "wait and see" category is always skewed against making Type I errors. She might be just as hesitant in declaring that her hypothesis has been disproven. If this is the case, then we simply have another example of scientific conventions generating an attitude of agnosticism.

Even if one could demonstrate a bias against making Type I errors on the part of some experts, it is not entirely clear what one should do about that bias. As Professor David Kaye notes, we would hardly wish to advise a scientist to equalize Type I and Type II errors if this were done at the expense of substantially increasing the sum of the two types of errors.[117]

Moreover, it is difficult to imagine asking experts, or other witnesses for that matter, to adjust their testimony depending on the underlying burden of persuasion in the case. We would face an unseemly situation if, on the exact same evidence, experts were prepared to assert a causal relationship when testifying for a defendant in a criminal case, where the state's burden is beyond a reasonable doubt, testifying that they were uncertain in civil cases, and testifying there is no causal relationship if asked to testify for the state in a criminal matter, all because the underlying burden of persuasion is changing. The burden of proof is best understood as an issue for the fact finder, not for the witnesses.[118]

---

implies *A*. Significance tests quantify how likely a test hypothesis is to predict the observed data; they do not quantify how well the observed data support a test hypothesis.

David E. Adelman, *Scientific Activism and Restraint: The Interplay of Statistics, Judgment, and Procedure in Environmental Law*, 79 NOTRE DAME L. REV. 497, 552 (2004).

117. Professor Kaye argues that the proper understanding of the preponderance-of-the-evidence burden of persuasion is as a command to reduce the total error rate, not to equalize error rates. D.H. Kaye, *Apples and Oranges: Confidence Coefficients and the Burden of Persuasion*, 73 CORNELL L. REV. 54, 72 (1987); *see also* David Kaye, *Naked Statistical Evidence*, 89 YALE L.J. 601, 607–08 (1980) (book review) (critiquing the equivalence-of-error interpretation of the burden of persuasion).

118. If there is a threshold for experts, it has often been expressed by asking the expert whether she holds her opinion with a "reasonable degree of scientific (or medical) certainty." It is unclear what this phrase means. It is a legal invention and the relevant expert communities have no such standard. Because of this, the Restatement (Third) of Torts, in § 28 comment *e*, argues that courts should not require experts to state they hold their view to a "reasonable degree of medical [or scientific] certainty" for it to be admissible. RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 28 cmt. e (Tentative Draft No. 5, 2007).

5. Summary

The question of what constitutes sufficient justification poses more serious intellectual and ethical issues than does the question of what role an expert should adopt. Our choices are either to endorse the level of justification routinely employed by experts in a field, or to endorse some lesser standard. In my judgment, the "same intellectual rigor" standard or something like it is the most appropriate benchmark for judging justificatory sufficiency, but this standard must be understood against the backdrop of the law's need for closure. The standard should be no more restrictive than the standard an expert might use in other contexts in which closure is needed. What this implies is a shrinkage of the "let's wait and see" category of responses. Ideally, it also implies that the expert would acknowledge this fact in his testimony.[119] Unfortunately, this latter hope is likely to be dashed on the rocks of the adversarial selection of experts, which pushes not simply for an opinion, but for an opinion that is expressed with a substantial degree of certainty.

V

CONCLUSION: ACCOMMODATING LEGAL AND SCIENTIFIC CONVENTIONS

Nearly everyone agrees that there are several important differences between legal and scientific conventions toward knowledge. As Professors Haack and Kritzer note, scientific inquiry involves (1) searching for the general and theoretical, (2) doing so by employing the methods and techniques accepted by one's field, (3) an attitude of agnosticism that encourages waiting for persuasive evidence before making up one's mind, and (4) a commitment to sharing data, intellectual honesty, and disinterestedness.[120] In contrast, legal inquiry (1) focuses more on experience and specific events, (2) desires certainty in expert judgments, and (3) views expert knowledge as a partisan resource.[121]

A central question is why we observe these differences. There are two central causes: the adversarial nature of U.S. trials and the need for closure. Adversarialism is far more strongly entrenched in the U.S. legal system than in

---

Even if the "reasonable degree" test is poorly phrased, it does capture the central idea that experts should use the standard of their profession when expressing an opinion. From this perspective, it can be understood as a reformulation of the "same intellectual rigor" test.

119. Cohen, *supra* note 98, at 962.

120. *See* Haack, *supra* note 1; Kritzer, *supra* note 4.

121. *See* Haack, *supra* note 1; Kritzer, *supra* note 4. Note that the second element in scientific conventions, a commitment to the methods and techniques of inquiry accepted by one's field, has no direct parallel in legal conventions. The law does, of course, have conventional techniques it uses to uncover knowledge. Substantial parts of the law of evidence could be understood in this way. But ultimately when it comes to methods and techniques of acquiring expert knowledge in the first instance, the law has no alternative to the conventions of science. Presumably the law could be indifferent to the methods and techniques used by an investigator or could even ask the investigator to forego these techniques when appearing in court. Professor Cohen's critique of the use of a .05 probability value to test for significance could be understood as such a request. In point of fact, however, post-*Daubert* courts seems to be increasingly respectful of these methods. Many successful *Daubert* challenges turn on the argument that the expert failed to use the methods deemed to be appropriate by those in his field. Insofar as this is the case, legal and scientific conventions on this issue are the same.

other western legal systems. A key component of U.S. adversarialism is the party selection of experts. Closure is also a central component of our legal system, but a component for which there seems to be no reasonable alternative as long as we believe that a key purpose of a legal system is to permit people to resolve disputes peaceably.

Both of these factors influence all of the differences between scientific and legal conventions, but each has its greatest effect on one of them, by subtly, and sometimes not so subtly altering the role experts play in court. Adversarialism has its greatest impact on the last difference between legal and scientific conventions: science's commitment to sharing data, intellectual honesty, and disinterestedness versus law's view of expert knowledge as a partisan resource. Closure has its greatest impact on the second difference: science's attitude of agnosticism versus law's desire for greater willingness on the part of an expert to express an opinion.

If one accepts the above analysis, it leads to a few conclusions about how law ought to accommodate scientific conventions in the context of expert witnesses. First, as to role, the law should take substantial steps to adopt scientific conventions on the role experts play in court. Abandoning party selection of experts in favor of a European-style, court-appointed-experts system seems to be beyond our reach, but other steps could move law in the direction of science. I particularly favor trying something like what is done in New South Wales, where each expert is given a code of conduct that makes clear the fact that the experts' obligation is to the court and not the party who engaged them. Such steps not only move the law-in-practice toward the scientific norm, they actually move the law toward its own ideal.

Such a move has a number of potential advantages. It may help jurors understand cases better by helping them to understand the many things scientists agree upon, as well as those things that are legitimately in controversy. Second, it may increase the willingness of a number of experts who currently refuse to participate in the role of expert to offer their expertise to the courts. Third, it may improve the opinion each side has of the other. The very process of forcing experts into the role of advocate has the perverse effect of causing the legal profession to look down on experts as hired guns and causes many experts to view law as a place where the search for truth is absent. Procedures that make expert witnessing less adversarial may ameliorate this mutual condescension.

If law should give way to scientific conventions concerning the expert's role, science must make some concessions to law when it comes to justification. Scientific agnosticism concerning the truth of a causal assertion or a theory must be moderated to accommodate the law's need for closure. It is important to note the contours of this accommodation. First, it is not a requirement that scientists become more "certain" of their judgment. The law's interest in certainty is more a result of adversarialism than of a need for closure. What closure does require is that experts be willing to abandon a "wait and see"

response when in possession of probative, but limited, evidence on some point. Moreover, this is not a request unique to legal proceedings. There are many affairs of life in which a need for a decision causes us to ask experts for their best guess.

Finally, a word about law's focus on the specific versus science's focus on the general: Here, scientific communities will perform a great service to law when they develop methods that allow experts to say more with more certainty about a particular case. Any advances in science that give experts a better purchase on the questions of specific causation will find immediate application in the law, as the history of DNA testing has so clearly demonstrated over the last couple of decades. The emerging field of toxiogenomics offers to have a similar impact on the area of toxic torts in the future.[122] Law's need for this information demonstrates a fundamental point that can easily be lost in discussions about the differences between legal and scientific conventions: Law and science share many conventions. Most important, both would prefer as much as possible that controversies end by resolution—an agreement, based on the evidence, that the proper outcome has been reached. This may not be possible with respect to the litigants themselves, but it is possible with respect to the rest of us who would prefer that in both science and in law that we do our best to "get it right."

122. *See* Jamie A. Grodsky, *Genomics and Toxic Torts: Dismantling the Risk-Injury Divide*, 59 STAN. L. REV. 1671 (2007).