## THE ARTS OF PERSUASION IN SCIENCE AND LAW: CONFLICTING NORMS IN THE COURTROOM

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To claim that Charles Darwin was a "rhetorician" may seem to confuse the provinces of rhetoric and science. Their juxtaposition, however, is not only warranted; it is also inescapable. Even scientific discourse must be persuasive to rescue insight from indifference, misunderstanding, contempt, or rejection.<sup>1</sup>

Ι

#### INTRODUCTION

The *Daubert* trilogy<sup>2</sup> and the calls for reform that preceded it<sup>3</sup> have echoed through the legal and scientific communities since the early 1990s. Much has been made of the limited views of the scientific enterprise reflected in the Supreme Court's decisions.<sup>4</sup> Critics argue that the Court accepted a standardized view of science that serves the interests of the business community and key elements of organized science, but fails to reflect the diversity of science in actual practice.<sup>5</sup>

Epistemology is important in the debate about science and technology in the courtroom. The epistemological issues and the arguments about them in the

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- 1. John Angus Campbell, *Charles Darwin: Rhetorician of Science*, in The Rhetoric of the Human Sciences: Language and Argument in Scholarship and Public Affairs 69, 69 (John S. Nelson, Allan Megill & Donald N. McCloskey eds., 1987).
- 2. Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579 (1993); Gen. Elec. Co. v. Joiner, 522 U.S. 136 (1997); Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999).
- 3. See, e.g., Peter W. Huber, Galileo's Revenge: Junk Science in the Courtroom (1991) (decrying reliance on "junk science" in court).
- 4. See generally Susan Haack, Trial and Error: The Supreme Court's Philosophy of Science, 95 Am. J. Pub. Health (Supplement 1) S66 (2005) [hereinafter Haack 2005]; Susan Haack, Epistemology Legalized: Or, Truth, Justice, and the American Way, 49 Am. J. Juris. 43 (2004) [hereinafter Haack 2004]; Sheila Jasanoff, What Judges Should Know About the Sociology of Science, 77 Judicature 77 (1993).
- 5. See, e.g., Gary Edmond, Just Truth? A Partial Archaeology of the Admissibility Revolution Associated with Daubert 38, 40 (July 10, 2006) (unpublished manuscript, available at http://ssrn.com/paper=916062) (arguing that federal judges have become more deferential to business and organized science, and that judicial reforms must account for the fact "that there is no single model of science").

context of scientific and technical evidence are now well developed.<sup>6</sup> Of equal importance, though, is an understanding of norms of persuasion and how those norms may differ across disciplines and groups. Norms of persuasion in the courtroom and in legal briefs differ from norms at a scientific conference and in scientific journals. This article examines the disconnect between science and the courtroom in terms of the differing norms of persuasion found within the scientific community and within the legal community.

The importance of persuasion is suggested by the idea of the "rhetoric of inquiry." The central premise of the rhetoric of inquiry is that "[s]cholarship uses argument and argument uses rhetoric. The 'rhetoric' is not mere ornament or manipulation or trickery. It is rhetoric in the ancient sense of persuasive discourse. In matters from mathematical proof to literary criticism, scholars write rhetorically." Scholarship here can be broadly defined to include science. The epigraph at the beginning of this paper referenced Darwin. Its author goes on to elaborate,

To claim that Darwin was a rhetorician, therefore, is not to dismiss his science, but to draw attention to his accommodation of his message to the *professional and lay audiences* whose support was necessary for its acceptance. Commonly overlooked in studies of Darwin is that he persuaded his peers and the wider community by using plain English words and plain English thoughts.<sup>9</sup>

Darwin employed colloquial language and sought to appeal to the reader's common sense. Darwin is by no means unusual. One need only think of the straightforward image of the double helix used by James Watson and Francis Crick to describe the DNA molecule over fifty years ago. Darwin ago. Darwin employed colloquial language and sought to appeal to the reader's common sense. Darwin is by no means unusual. One need only think of the straightforward image of the double helix used by James Watson and Francis Crick to describe the DNA molecule over fifty years ago.

Persuasion can operate within a community or across communities. Economics literature provides a good example. Donald, now Deidre, McCloskey has written extensively about the rhetoric of economics. Within the community of modern-day economists, the languages of mathematics and statistics are the primary vehicles of persuasion. However, one of the most famous examples of a rhetorical device used to persuade a broad audience is from economics: Adam Smith's notion of the "invisible hand" of the market described in his *The Wealth of Nations*. Despite sophisticated mathematical models and thousands of statistical studies of market forces, the imagery of the

<sup>6.</sup> See sources cited supra note 4.

<sup>7.</sup> See John S. Nelson, Allan Megill & Donald N. McCloskey, in The RHETORIC OF THE HUMAN SCIENCES: LANGUAGE AND ARGUMENT IN SCHOLARSHIP AND PUBLIC AFFAIRS, supra note 1, at 3–18 (discussing scholars' use of rhetoric).

<sup>8.</sup> Id. at 3.

<sup>9.</sup> Campbell, *supra* note 1, at 69 (emphasis added).

<sup>10.</sup> *Id.* at 70–71.

<sup>11.</sup> See generally James D. Watson, the Double Helix: A Personal Account of the Discovery of the Structure of DNA (1968).

<sup>12.</sup> See generally Donald N. McCloskey, If You're So Smart: The Narrative of Economic Expertise (1990); Donald N. McCloskey, Knowledge and Persuasion in Economics (1994); Donald N. McCloskey, The Rhetoric of Economics (1985).

<sup>13.</sup> ADAM SMITH, AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS 293 (Harriman House 2007) (1776).

invisible hand remains the best way to capture quickly one of the central theoretical points of market economics.

Scientific and technical evidence in the U.S. courtroom bring together three communities: the community of legal professionals comprised of lawyers and judges, the community of scientific and technical experts, and the community of lay citizens embodied in the jury empanelled to decide a particular case. Although we like to think of the courtroom as a setting where we seek truth and justice, in reality the courtroom is fundamentally a world where the art of persuasion is paramount. Evidence, both technical and nontechnical, is presented to persuade. Even though there are common elements to effective persuasion across multiple audiences (such as clarity, parsimony, et cetera), the norms governing persuasion can and do differ among groups in society in general and the groups that come together in the courtroom in particular. While the lay jury may find "common sense" crucial in assessing the arguments they hear, scientists are trained to be skeptical of common sense unless there is systematic evidence to support it.15 More generally, the lay person not imbued with the scientist's skepticism looks to his or her own experience to judge evidence:

How supportive evidence is of a claim depends on how well it anchors the claim in experience, and how well it integrates it into an explanatory account; i.e., on how good the circumstances of any relevant observations were, and how well the claim in question fits into an explanatory story with the other relevant facts presumed known.<sup>16</sup>

Rhetoric and persuasion are likewise in play in how the question is variously framed, addressed, or resolved: "The law and science represent two strikingly different ways of thinking, which reflect their different methods. The law frames questions in adversarial terms, and lawyers see problems as best resolved by controlled argument." This is not to suggest that the issue of persuasion is unrelated to epistemology. The norms of persuasion within science and related technical fields are closely related to understandings of epistemology. However, the movement from the scientific–technical arena into the legal–courtroom arena makes explicit the role of persuasion and the rhetorical frames that go with persuasion.

<sup>14.</sup> I do not here mean to suggest that juries are unable to assess expert evidence. See Neil Vidmar, Expert Evidence, the Adversary System, and the Jury, 95 Am. J. Pub. Health (Supplement 1) S137 (2005) ("Empirical research indicates that jurors... do not automatically defer to the opinions of experts, and that their verdicts appear to be generally consistent with external criteria of performance"). Rather, I am arguing that lay juries bring a perspective different from that of the scientist.

<sup>15.</sup> See generally William Haltom & Michael McCann, Distorting the Law: Reform Politics, Mass Media, and the Litigation Crisis (2004).

<sup>16.</sup> Haack 2004, *supra* note 4, at 46.

<sup>17.</sup> MARCIA ANGELL, SCIENCE ON TRIAL: THE CLASH OF MEDICAL EVIDENCE AND THE LAW IN THE BREAST IMPLANT CASE  $28 \, (1996)$ .

#### Π

#### AN EXAMPLE OF PERSUASION IN COURT

One pre-Daubert example of the factors in a trial judge's assessment of experts in a products-liability bench trial is Wells v. Ortho Pharmaceutical Corp., 18 in which a child and her parents sued the manufacturer of a spermicidal contraceptive jelly for birth defects they alleged had resulted from its use. The mother had used the contraceptive jelly before and after the child's unintended conception, and the baby was born with a number of birth defects. In addition to alleging that the jelly had caused these defects, the plaintiffs alleged that the defendant manufacturer had been negligent in failing to warn the mother that using its product increased the likelihood of birth defects, 9 should a child be conceived despite its use. Samuel Gross, who includes this case in an extensive discussion of the problems associated with expert evidence, notes that "[t]he presiding judge, the Honorable Marvin Shoob of the Northern District of Georgia, clearly took his task seriously and did a conscientious job" in assessing the conflicting evidence of numerous experts.<sup>20</sup> In the opinion, the judge himself described the extent of his efforts and those qualities of the experts that contributed to his assessment of their credibility:

[T]he Court considered each expert's background, training, experience, and familiarity with the circumstances of this particular case; and the Court evaluated the rationality and internal consistency of each expert's testimony in light of all the evidence presented. The Court paid close attention to each expert's demeanor and tone. Perhaps most important, the Court did its best to ascertain the motives, biases, and interests that might have influenced each expert's opinion.<sup>21</sup>

Interestingly, the judge noted that his judgment as to the experts' credibility was impressed as well by the appearance of objectivity or of bias: "With few exceptions, the Court found the testimony of plaintiffs' experts generally to be competent, credible, and directed to the specific circumstances of this case. The testimony of defendant's experts, in contrast, often indicated bias or inconsistency." "Primarily because the Court found plaintiffs' expert testimony to be far more credible than defendant's," Judge Shoob continued, he concluded "that plaintiffs had carried their burden of proving that the spermicide proximately caused some, but not all, of Katie Wells' birth defects and that defendant had been negligent in failing to warn plaintiff [Katie's mother] of this danger." Gross notes the details of the bias of defendants' experts and of the objectivity of plaintiffs' experts as perceived by the judge:

For example, the plaintiffs' "primary expert witness" was Dr. Bruce Buehler. "The Court found Dr. Buehler to be the most credible of all the witnesses presented in this case." His credentials were impressive; he had personally examined the child

<sup>18. 615</sup> F. Supp. 262 (N.D. Ga. 1985), aff'd in part, 788 F.2d 741 (11th Cir. 1986).

<sup>19.</sup> Id. at 266.

<sup>20.</sup> Samuel R. Gross, Expert Evidence, 1991 WIS. L. REV. 1113, 1121 (1991).

<sup>21.</sup> Wells, 615 F.Supp. at 267, quoted in Gross, supra note 20, at 1121.

<sup>22.</sup> Id., quoted in Gross, supra note 20, at 1121.

<sup>23.</sup> Id.

plaintiff, and he gave a "detailed explanation" of how he ruled out other possible causes of her birth defects, demonstrating "a careful, methodical reasoning process..." Most of all, "his demeanor as a witness was excellent: he answered all questions fairly and openly in a balanced manner, translating technical terms and findings into common, understandable language, and he gave no hint of bias or prejudice."

On the other side, Judge Shoob disregarded the defense experts because of bad demeanor and apparent bias. For example, although Dr. Paul Stolley had impressive credentials, the court "assign[ed] little weight" to his opinions because his "responses on cross-examination and his overall demeanor and manner indicated a degree of bias," and because of "the difference between his apparent certainty on direct examination and his less-than-certain tone on cross." Similarly, Dr. Robert L. Brent's credentials were "most impressive," but "he was not a convincing or credible witness." The "absolute terms in which he expressed his conclusions" suggested an "unwarranted" degree of confidence; "[h]is criticisms of plaintiffs' attorneys and of expert witnesses who testify for plaintiffs in malformation lawsuits strongly suggest a distinct prejudice." "24"

As Gross points out, this is a well-reasoned judicial decision, "[i]n most respects... a first rate specimen of judicial craft."<sup>25</sup> It reflects the norms of persuasion within the courtroom: witness credibility, including factors such as demeanor, assessment of bias, completeness of explanation, and certainty of opinion.<sup>26</sup> However, in terms of the science of the day, it went against the body of generally accepted scientific evidence, which provided limited support for the judge's conclusion in the case.<sup>27</sup>

One interpretation of the judge's decision is that he did not understand or properly weigh the conflicting evidence. If this is true, then the decision is not surprising, given that the judge was applying standards of persuasion that are the norm in the courtroom. In fact, attorneys specifically look for experts who will be persuasive within such norms. Gross quotes one attorney's description of the physical image that will favorably impress jurors:

Usually, I like my expert to be around 50 years old, [to] have some gray in his hair, wear a tweedy jacket and smoke a pipe.... You must recognize that jurors have prejudices and you must try to anticipate these prejudices.... Some people may be

<sup>24.</sup> Gross, *supra* note 20, at 1121–22 (quoting *Wells*, 615 F. Supp. at 266, 267, 269, 272–73, 286, 291).

<sup>25.</sup> Id. at 1122.

<sup>26.</sup> Scallen and Wiethoff use the concept of *ethos*, drawn from Aristotelian analyses of rhetoric, to capture the problem of credibility of expert witnesses. *See* Eileen A. Scallen & William E. Wiethoff, *The Ethos of Expert Witnesses: Confusing the Admissibility, Sufficiency and Credibility of Expert Testimony*, 49 HASTINGS L.J. 1143, 1146–49 (1998) (arguing that the power of expert testimony depends upon the expert's *ethos*, translated to mean character or credibility).

<sup>27.</sup> Although much commentary on the *Wells* case argues that there was an absence of scientific support for the judge's decision—see, for example, HANS ZEISEL & DAVID KAYE, PROVE IT WITH FIGURES: EMPIRICAL METHODS IN LAW AND LITIGATION 271 (1997); Gross, *supra* note 20; James L. Mills & Duane Alexander, *Teratogens and "Litogens*," 315 NEW ENG. J. MED. 1234 (1986); *Federal Judges vs. Science*, N.Y. TIMES, Dec. 27, 1986, at A22—Gastwirth argues that some epidemiological evidence was in fact consistent with the judge's opinion, and that more might have been if properly analyzed, Joseph L. Gastwirth, *The Need for Careful Evaluation of Epidemiological Evidence in Product Liability Cases: A Reexamination of* Wells v. Ortho *and* Key Pharmaceuticals, 2 LAW PROBABILITY & RISK 151, 173–85 (2003).

geniuses, but because they lack training in speech and theater, they have great difficulty conveying their message to a jury.

Gross notes that this comment reflects the standard advice given to lawyers about selecting experts.<sup>29</sup> Of course, as Gross also notes, the issues of presentation broadly reflect the trial setting and apply to fact witnesses as well as to experts.<sup>30</sup> The key difference between fact and expert witnesses is that the lawyer can select experts based on how they will perform in the courtroom, while with fact witnesses the lawyer is typically limited to trying to exclude witnesses who will not perform well.

At least one aspect of the potential persuasiveness of experts in the courtroom setting is unique: specifically, the expert's persuasiveness depends in part on her apparent qualifications. As Gross notes,

The graduate student who knows more about the effects of a particular virus than anybody might not qualify as an expert witness on the topic, and therefore would probably never be called as a witness. The chairman of the graduate student's department, on the other hand, will qualify easily, no matter what she knows.<sup>31</sup>

Gross goes on to observe that "[i]n legal proceedings (unfortunately, but perhaps inevitably) decisions on expert evidence depend more on authority and less on analysis." 32

#### Ш

#### PERSUASION IN COURT AND IN SCIENCE

The idealized trial seeks to identify the "truth" so that the adjudicator can make a correct and just decision.<sup>33</sup> In the U.S. criminal-justice system this goal is reflected in the criteria that, in order to find a defendant guilty, the fact finder

<sup>28.</sup> Gross, *supra* note 24, at 1133.

<sup>29.</sup> *Id.* at 1133 n. 65. The other key element is, of course, choosing an expert who will support the lawyer's theory of the case. This does not mean finding an expert who will say whatever the lawyer wants (a "hired gun"); rather it involves finding an expert who is "already disposed to [the lawyer's] theory of the case," which may mean "screening multiple candidates to find an expert who is predisposed to [the lawyer's] theory." FRED PRICHARD, EXPERTS IN CIVIL CASES: AN INSIDE VIEW 129–30 (2005); *see also* FREDERICK PAYLER, LAW COURTS, LAWYERS AND LITIGANTS 188 (1926) ("The search [for an expert] goes on until one is discovered whose views coincide with the line of argument it is proposed to pursue.").

<sup>30.</sup> Gross, *supra* note 24, at 1134.

<sup>31.</sup> Id. at 1161.

<sup>32.</sup> Id. at 1178.

<sup>33.</sup> See SHEILA JASANOFF, SCIENCE AT THE BAR: LAW, SCIENCE, AND TECHNOLOGY IN AMERICA 7 (1995) ("The contrasts between law and science are often described in binary terms: science seeks truth, while the law does justice."). I do not take this as Jasonoff's own view, nor would most judges draw this distinction; rather, for law the goal is to get at truth in order to do justice. However, at a later point, Jasanoff observes, "The considerable differences between scientific and legal thinking are most apparent in their approaches to fact-finding. Science, as conventionally understood, is primarily concerned with getting the facts 'right'—at least to the extent permitted by the existing research paradigm or tradition. The law also seeks to establish facts correctly, but only as an adjunct to its transcendent objective of settling disputes fairly and efficiently." *Id.* at 9. The process of fact-finding in the U.S. legal setting is not that it is an adjunct to dispute resolution, but that it is pursued in an explicitly partisan way. *See infra* V.

must be persuaded of that guilt "beyond a reasonable doubt." <sup>34</sup> In the civil trial, the standard of persuasion is less demanding: the fact finder must find for the side that it believes is supported by the "preponderance of the evidence." 35 Whichever criteria applies, the fact finder must be persuaded to find for one side or the other: "[T]he end product of a trial is not truth or error but rather a winner and a loser."36 The fact finder makes a decision about where the "truth" lies, at least in the legal sense. In the criminal case, the truth has to do not with the defendant's guilt, but with whether the prosecution has proven its case: the finding of "not guilty" does not mean that the fact finder believes that the defendant is innocent, only that the prosecutor has not persuaded the fact finder "beyond a reasonable doubt" that the defendant is guilty. Even in the civil case, with its lower standard of persuasion, the finder of fact must make a decision based less on what is "true" than on which side's case was more persuasive. If the party with the burden of proof fails to establish its case by the preponderance of the evidence, the decision will be for the other side. Thus, although in science it is perfectly acceptable for the conclusion to be, "We don't know yet; let's wait for more data or more studies," in court, the adjudicator must make a decision and even has a default decision if the evidence fails to support one side or the other.<sup>37</sup>

In law,<sup>38</sup> the focus is on arriving at truth and justice, at least in the ideal. While science, broadly construed, also seeks truth, it is fundamentally about questioning and doubt. Those who train scientists seek to create an inclination to question one's assumptions and findings, and to express results in terms of probabilities that can be viewed as a formalization of doubt.<sup>39</sup> One way to see

<sup>34.</sup> See ROBERT A. CARP ET AL., JUDICIAL PROCESS IN AMERICA 270 (4th ed. 2004).

<sup>35.</sup> Id.

<sup>36.</sup> Scallen & Wiethoff, *supra* note 26, at 1148. However, who is the winner and who is the loser is not necessarily the same as which side prevails in a trial. *See* HERBERT M. KRITZER, THE JUSTICE BROKER: LAWYERS AND ORDINARY LITIGATION 155–56 (1990) (discussing the difficulty of reaching conclusions about who actually wins in litigation).

<sup>37.</sup> See Susan Haack, Of Truth, in Science and in Law, 73 BROOK. L. REV. 985, 985–86 (2008) (arguing that although truth is relevant to legal proceedings, trials are not primarily about seeking the truth, but rather assessing guilt or liability); see also Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579, 596–97 (1993) ("Scientific conclusions are subject to perpetual revision. Law, on the other hand, must resolve disputes finally and quickly.").

<sup>38.</sup> These observations are about persuasion concerning facts. A second area of persuasion in the legal setting is persuasion about the law itself—what it is, what it means, and how it should be applied. Persuasion about law and persuasion about facts are separable, at least in theory, and involve different types of issues. Significantly, persuasion about law is directed to the judge, not to lay jurors. In this article, I discuss a set of four dimensions that distinguish the scientific and legal modes of inquiry vis-àvis what in the legal setting would be described as finding of fact. *See infra* Table I and section IV.

<sup>39.</sup> Arguably something like this is also true in the training of lawyers, although that does not extend to how lawyers are trained to persuade as advocates. Even in science, I am describing something of an ideal. There are many examples of scientists who assume their hypotheses are correct, and who do little or nothing to look for contradictory evidence. Faigman observes in connection with one book by social scientists on battered-woman syndrome, "In fact... this book was little more than a patchwork of pseudoscientific methods employed to confirm a hypothesis that the researchers never seriously doubted." DAVID L. FAIGMAN, LEGAL ALCHEMY: THE USE AND MISUSE OF SCIENCE IN THE LAW 72 (1999).

this is in the statistical constructs of Type I error (failure to see something that is not actually there, that is, a false positive) and Type II error (failure to see something that is in fact there, that is, a false negative). Although these two types of error are stated in a particular way in the context of statistical analysis, they are important concepts in scientific and technical investigation even when that investigation is not statistical in nature. One need simply consider the process of medical diagnosis and the constant concern about false positives and false negatives. <sup>41</sup>

To better understand the differences in persuasion in legal and scientific settings, it is useful to consider these differences along four dimensions: (1) the choice of "data" or evidence, (2) how evidence is used, (3) the mindset of the inquirer, and (4) the goals of the inquiry. Table 1 summarizes the differences along these dimensions for legal and scientific—technical inquiries. The discussion that follows will address each dimension in turn.

Table 1: Persuasion in I	_aw & Science
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	Persuasion in Legal Inquiry	Persuasion in Scientific Inquiry
"Data" sources	Reliance on experience and specific events	Systematic, replicable inquiry
Use of Evidence	Partisan use of evidence	"Critical" use of evidence
Mindset	Values certainty	Values doubt and skepticism
Goal of inquiry	Moving toward truth (there is a single truth that will be revealed through the adversary process)	Moving away from falsity (truth is complex and elusive, and we proceed by eliminating what is not true)

### IV Data Sources

Much of the evidence in the U.S. courtroom setting comes in the form of oral testimony concerning what people saw and what people did. Eyewitnesses, victims, plaintiffs, and defendants report the events they saw or participated in; they may also describe what was in their minds during the events in question. Police officers report what they saw at a crime scene and what transpired when a defendant was taken into custody. Experts report opinions and what they did to reach those opinions. While documents and other physical evidence are

<sup>40.</sup> DAVID S. MOORE & GEORGE P. MCCABE, INTRODUCTION TO THE PRACTICE OF STATISTICS 435–38 (5th ed. 2005).

<sup>41.</sup> Of course the legal process is also concerned about false positives and false negatives, and this is reflected in "standards of proof" (for instance, beyond a reasonable doubt).

usually also introduced during the proceedings, the emphasis tends to be on testimony. The focus throughout the presentation of evidence is largely on specific events and specific people. Although issues of general patterns or causation may also enter, ultimately specificity must be considered: what happened to a specific person (or piece of property) and why it happened to that specific person (or property). The focus is on the particular situation and on explaining what happened in that situation.

In contrast, scientific evidence focuses on the general rather than on the specific.<sup>42</sup> The vehicle for generalization is systematic, replicable data collection. The goal is to obtain data that are valid and reliable. If someone else repeats the data collection, she should be able to obtain consistent data (within the limits that might arise due to random sampling). With certain exceptions, scientists refrain from drawing general conclusions from specific cases, although specific cases can be important for challenging orthodoxies, developing ideas, and suggesting paths of inquiry.<sup>43</sup>

Of course, scientists and technical experts are regularly asked to use their knowledge of the general to reach conclusions about specific cases. The most obvious example is in medical diagnosis. Even in medical diagnosis, though, there is an understanding of uncertainty. The diagnosis may be wrong. This is why false positives and false negatives are so important in that context, particularly when a positive diagnosis leads to significant medical intervention that is painful or risky, or when the failure to diagnose as a result of a test that produces a false negative may be life-threatening.<sup>44</sup>

Some types of expert witnesses may be asked to report both facts and opinions related to the specific case. The most obvious situation is the physician. On the one hand, the physician who has conducted a back surgery and seen the ruptured disk that she then proceeded to repair can testify to the fact that the plaintiff had a ruptured disk. On the other hand, the physician may then be asked for her opinion as to whether the ruptured disk was caused by the automobile accident or for her prognosis about future back problems the plaintiff might be expected to experience (or both). Certainly the physician used her knowledge of the general (combined with medical tests or imaging) to reach a conclusion that surgery was called for, but, by the time she testifies, that is almost irrelevant because the doctor has seen the disk. On the other hand, both the cause and the prognosis cannot be known with certainty by the physician except in the most unusual situations: if the plaintiff happened to be

<sup>42.</sup> Engineering attempts to adapt the general to the specific, but the usual focus in scientific inquiry is on generalization.

<sup>43.</sup> The exceptions arise when there is something that may be a critical case. *See generally* ROBERT K. YIN, CASE STUDY RESEARCH: DESIGN AND METHODS (1984).

<sup>44.</sup> A recent example of this issue is the use of computer-aided detection of breast cancer. An assessment of the effectiveness of this method of evaluating mammograms found that it did not lead to the discovery of an increased number of malignancies, but did produce an increase in the number of false positives leading to biopsies. *See* Gina Kolata, *Study Questions Computerized Breast Cancer Detection*, N.Y. TIMES, Apr. 5, 2007, at A14.

in an automobile accident shortly after leaving the doctor's office where she had been examined and found not to have a disk problem, the physician would be on very firm ground attributing the back problem to the accident.

Even though experts do in fact rely upon case-specific data (information) in forming their testimonial opinions, the underlying basis of those opinions is broad knowledge that draws on data well beyond the instant case. Moreover, it is this broad knowledge of applicable data beyond the instant case that makes the expert an expert. The qualifications of someone to be an expert turn specifically on whether or not they have knowledge of the broad base of data associated with expertise in a particular area.

#### V

#### USE OF EVIDENCE: PARTISANSHIP

An advocate's business is to make the strongest possible case that this—his side's—answer is the true one; so he will be most effective if he selects and emphasizes whatever evidence favors the proposition in question, and ignores or plays down the rest.<sup>45</sup>

The U.S. legal system is based on the adversarial approach to legal procedure. Each party is responsible for presenting only evidence in *support* of its case. Short of outright lying, a party may shape and select evidence to its benefit. With the exception of a prosecutor in a criminal case or as required under specific procedural rules (for example, discovery processes), parties are under no obligation to reveal to the opposing side evidence harmful to the party's own case. The obligation to identify weaknesses and alternatives lies with the opponent, either by directly challenging the evidence through mechanisms such as cross-examination or by advancing different evidence.<sup>46</sup>

In contrast, in scientific discourse the expectation is that the scientist will reveal both the strengths and weaknesses of her evidence, and deal systematically with opposing interpretations or explanations.<sup>47</sup> I would describe

<sup>45.</sup> Haack 2004, *supra* note 4, at 45.

<sup>46.</sup> Importantly, in the court context, the advocate is expected to do everything possible to cast doubt on opposing testimony *even if the advocate knows the testimony is accurate*. Twining notes that "[m]any techniques of the effective [legal] advocate ... involve the undermining of rational argument rather than its promotion: they include techniques for keeping relevant information out, for trapping or confusing witnesses, for 'laundering' the facts, for diverting attention or interrupting the flow of argument, and for exploiting means of non-rational persuasion." WILLIAM TWINING, RETHINKING EVIDENCE: EXPLORATORY ESSAYS 24 (2006).

<sup>47.</sup> Susan Haack contrasts the adversarial presentation of evidence to what she calls "inquiry"; the sentence before the epigram opening this section reads, "An inquirer's business is to discover the true answer to his question; so his obligation is to seek out what evidence he can and assess it as fairly as possible." Haack 2004, *supra* note 4, at 45. In another article Haack observes, "Unlike advocacy, which starts with a proposition to be advanced, inquiry starts with a question. . . . Our inquiries are better conducted the more insightful and informed our conjectures, the more thorough our search for evidence, and the more judicious our assessment of the worth of the evidence." Susan Haack, *Scientific Secrecy and "Spin": The Sad, Sleazy Saga of the Trials of Remune*, 69 LAW & CONTEMP. PROBS. 47, 49 (Summer 2006).

this approach as a "critical" use of evidence:<sup>48</sup> the expectation is that the proponent of a theoretical argument or set of empirical results looks at her evidence with a skeptical eye, questioning her understanding of what the evidence might mean and searching for alternative explanations.<sup>49</sup> Ideally, the analyst identifies alternatives explicitly and provides evidence to undercut those alternatives.<sup>50</sup> Moreover, one of the purposes of peer evaluation<sup>51</sup> is to identify alternative explanations that the analyst may have overlooked.<sup>52</sup>

Nonetheless, this ideal can elude even the scientist whose research is guided by objectivity, not advocacy. To give a simple example from my own work, I conducted a small study of the factors influencing state-supreme-court decisions concerning whether to adopt the *Daubert* standard for state cases. The core hypothesis was that politically conservative states would be more likely to adopt the *Daubert* standard than would be politically liberal ones. We assembled data for all states, including a variety of control variables, and conducted several variations on event-history analysis. The analysis revealed none of the relationships we were looking for. The most interesting result was that the more types of tort reform a state had adopted, the less likely the state's supreme court was to adopt the *Daubert* standard. This seemed to run counter to the original hypothesis.

When the results were presented at the Conference on Empirical Legal Studies in the fall of 2006,<sup>54</sup> the commentator on the paper suggested that the pattern we found surprising made sense to him because it indicated that in states where courts had taken the initiative to adopt conservative measures, the legislatures would not feel the need to adopt significant tort reform. Essentially, the commentator's argument was that we had the causal direction backward.

In revising the paper to submit to a journal, we sought to respond to this alternative explanation. We could not test the argument directly because we did

<sup>48.</sup> I am avoiding the use of the term "objective" because it has been so thoroughly discredited. *See, e.g.*, Gary Edmond, *After Objectivity: Expert Evidence and Procedural Reform*, 25 SYDNEY L. REV. 131, 134–35 & n.12 (2003) (discussing the highly idealized notions of objectivity as applied to science).

<sup>49.</sup> Haack speaks of "impartiality," meaning "that you have no unbudgeable preconceptions, that you [are] willing to check out all the evidence and will change your initial judgment if the evidence turns out against it." Haack, *supra* note 11, at 170.

<sup>50.</sup> Note that I am speaking of the "expectation" for a scientist. This is an ideal type; it is easy to identify scientists and engineers who are so committed to a particular perspective that they are not willing to entertain contradictory evidence. A fictionalized version of this problem is depicted in the recent film *Dark Matter*, in which faculty member turns against a graduate student who pursues a project that goes against the faculty member's favorite theory. *See* Dennis Overbye, *A Tale of Power and Intrigue in the Lab, Based on Real Life*, N.Y. TIMES, Mar. 27, 2007, at F3.

<sup>51.</sup> I use the term "peer evaluation" rather than "peer review" because I include here not just the classic peer-review process but also the presentation of papers at conferences and meetings, and the sharing of drafts for comment and feedback.

<sup>52.</sup> I recently completed a term as the editor of a peer-reviewed journal. One of the issues that I always looked for in considering articles that had received positive reviews was whether the author(s) had overlooked some alternative explanation that needed to be confronted.

<sup>53.</sup> The study was funded by the Project on Scientific Knowledge and Public Policy.

<sup>54.</sup> The paper was coauthored with my research assistant, Darryn Beckstrom, who presented the paper at the conference because I was unable to attend.

not have data adequate to do so. Consequently, we devised an indirect test. Specifically, because state-supreme-court hostility to tort reform is typically associated with a court's liberalness, we could test the commentator's argument by examining whether states with liberal courts were more likely to pass tort reform. We could find no statistical evidence that this was the case (in fact, almost all of the results ran in the opposite direction!).<sup>55</sup>

Of course, I am talking about an ideal here. The reality is that scientists and other scholars do not always look for evidence or interpretations that might undercut their position, <sup>56</sup> though no doubt they should. Still, the manner in which scientists advocate for their preferred analyses or conclusions differs from the form of advocacy in the courtroom in crucial ways. <sup>57</sup> In the words of one prominent scholar,

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 an 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. <sup>58</sup>

The norms of relevance here are the norms governing the conduct of persuasion in the two settings. Except as devil's advocates, scientists and scholars would not normally advance as arguments positions that they had a strong reason to believe were untrue. However, no such norms apply in the courtroom; advocates can and do routinely advance arguments about which they have grave doubts, the most obvious of which is the innocence of criminal defendants they are representing.<sup>59</sup>

Evidence is always filtered through belief systems. This is a broad issue in political discourse, as evidenced by the differing opinions on the Iraq war. Each

<sup>55.</sup> A revised version of the paper was later published. See Herbert M. Kritzer & Darryn C. Beckstrom, Daubert in the States: Diffusion of a New Approach to Expert Evidence in Court, 4 J. EMPIRICAL LEGAL STUD. 983 (2007).

<sup>56.</sup> See Haack, supra note 11, at 108 (noting that "proponents of one approach or theory are motivated to seek out evidence disfavoring its rival, which its proponents are motivated to neglect or play down").

<sup>57.</sup> Perhaps it is instructive that most scholarly oriented legal publications in the United States are not peer-reviewed. Moreover, most are not even peer edited. The norm in most of these publications might be described as scholarly advocacy: advocating for a legal position or a change in legal norms.

<sup>58.</sup> Haack 2004, *supra* note 4, at 47.

<sup>59.</sup> Arguably lawyers face some constraints imposed by specific rules such as FED. R. CIV. P. 11(b)(3)—"the factual contentions have evidentiary support or, if specifically so identified, will likely have evidentiary support after a reasonable opportunity for further investigation or discovery"; it is worth noting that the rule says nothing about whether the evidentiary support is believable! When I was observing in a defense-oriented law firm, I came face-to-face with this issue in working on a brief in connection with a *Daubert* motion. See Herbert M. Kritzer, *The Commodification of Insurance Defense Practice*, 59 VAND. L. REV. 2053, 2056–59 (2006) [hereinafter Kritzer 2006]; Herbert M. Kritzer, Daubert in the Law Office: The Routinization of Procedural Reform, 5 J. EMPIRICAL LEGAL STUD. 109, 114–16 (2008) [hereinafter Kritzer 2008]. The senior partner wanted to advance the argument that the design change advocated by the plaintiff would not have prevented the accident and the resultant injury. At best this was doubtful, but that did not seem to trouble the lawyer (it troubled me a lot!).

side considers the other irrational for its unwillingness to see what to each appears self-evident. The "truth" or the "material reality" is perceived through this belief filter. The process of persuasion must take this belief-filter into account. In science this belief-filter is what Kuhn called the paradigm, <sup>60</sup> and a scientist trying to persuade her peers in a way that stands outside the dominant paradigm is likely to encounter problems even with strong evidence. Advocates in court tailor their arguments by choosing their theories of the case and the associated witnesses to appeal to what they think are the belief systems of the fact finder. Evidence that accords with a decisionmaker's belief system is more likely to be accepted by the decisionmaker; evidence that sharply conflicts with that belief system will be radically discounted if not completely ignored.<sup>61</sup>

#### VI

#### MINDSET: CERTAINTY VS. DOUBT

When a lawyer looks for an expert witness, the lawyer is typically looking for three things:

- 1. An expert who will convey certainty about the opinion she expresses.
- 2. An expert whose relevant opinion accords with the lawyer's theory of the case.
- 3. And, an expert who will present well to the judge or jury, or both.

The first criteria can be seen in a standard colloquy in questioning an expert witness, which involves inviting the witness to say something indicating that she has "a reasonable degree of scientific or medical certainty" about the conclusion or opinion which she has just expressed (for instance, "Can you say with a reasonable degree of scientific certainty that Bert Kritzer is a competent scholar?").

The second criteria can bring the differences between legal certainty and scientific certainty unpleasantly to the surface. In his study of lawyers and engineering experts, Fred Prichard notes that "the jury focused attorney demands an immediate, unequivocal answer—'yes' or 'no.' But for the data focused engineer, there is room for nuance and discussion. Attorneys perceive such uncertainty as disastrous for their case." He reports the following comments by an engineer:

[The lawyer] asked me... whether the [lap] belt was on or not,... [a]nd 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

<sup>60.</sup> THOMAS S. KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS 10 (1963).

<sup>61.</sup> In the context of a *Daubert* challenge, the judge effectively serves as the finder of fact, in that the judge must weigh the qualifications of the expert and determine whether they meet the *Daubert* standard. Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579, 592–93 (1993). The reluctance of judges to discard long-accepted sources of evidence, which systematic or scientific research has increasingly called into question (such as eye-witness testimony and fingerprint identification), reflects something of the belief-filter described above.

<sup>62.</sup> PRICHARD, supra note 29, at 30-31.

they will push that view. And they will make their case in front of a jury.... 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 the 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.<sup>63</sup>

Although both law and science are making decisions under conditions of uncertainty, the norm of persuasion in court is to present evidence as though there was no doubt, whereas in science the norm is to be explicit about the doubt.<sup>64</sup>

Then there is the criterion that the fact finder must consider in balancing the testimony of one expert against that of another: the "weight of the evidence" (WOE):

Because there is no algorithm or canonical methodology for determining WOE in circumstances where no single study is definitive and there is no determinative experiment that can foster a consensus on causality, experts will exercise their judgment on the strength of evidentiary support when a subset of the pieces of the puzzle are assembled.... Our first realization is that the "weighing instrument" for "weighing evidence" is human cognition, which has never been calibrated to the task.... The approach that uses WOE applies a method that treats evidence as a continuous variable and turns it into a dichotomous (below or above the threshold) or triadic variable: "yes," "no," or "probably."

In inferential statistical analysis, the protocols of hypothesis testing and accepted standards for decision rules ("levels of significance") are one such method of weighing the evidence,<sup>66</sup> although the language above may be suggesting an even more complex process.

One view of epistemology is that it is a vehicle for achieving factual accuracy. However, this assumes that facts can be accurately known. Certainly that is true for many facts, but often in the courtroom setting there is a lot of uncertainty about ordinary facts, and advocates seek to persuade the fact finder of a particular understanding of the facts. This suggests that knowledge of facts can often be relative. Importantly, in science, many of the most important facts

<sup>63.</sup> Id. at 30-31.

<sup>64.</sup> It is crucial here to note that the focus is on the norm governing the actions of the "persuader," not the norm governing the decider. In the courtroom, the norm governing the decider is very much one of doubt, particularly in criminal cases where the decider is to be persuaded "beyond a reasonable doubt." One reconstruction of decisionmaking in the courtroom focuses on a probabilistic notion of evidence, particularly a Bayesian view. *See generally* DAVID SCHUM, EVIDENTIAL FOUNDATIONS OF PROBABILISTIC REASONING (2001).

<sup>65.</sup> Sheldon Krimsky, *The Weight of Scientific Evidence in Policy and Law*, 95 AM. J. PUB. HEALTH (SUPPLEMENT 1) S129, S134–35 (2005). Krimsky goes on to quote Susan Haack: "[S]cientists... are like a bunch of people working, sometimes in cooperation with each other, sometimes in competition, on this or that part of a vast crossword...." Susan Haack, *An Epistemologist in the Bramble-Bush: At the Supreme Court with Mr. Joiner*, 26 J. HEALTH POL. POL'Y & L. 217, 223 (2001) (quoted in Krimsky, *supra* at S124).

<sup>66.</sup> Moore & McCabe, supra note 40, at 400-16.

<sup>67.</sup> See Edmond, supra note 5, at 29–30 ("Recourse to a consensus model of public science through Daubert, Joiner and Kumho addressed several pressing concerns for federal judges:... (vii) legal reliance on more reliable images of science would produce more accurate fact-finding.").

(that is, those related to causation) are embedded in theory and only become relevant within the context of a particular theory. 68

Although some, including Albert Einstein, have argued that seeking truth in science resembles finding the single correct word to insert into a crossword puzzle based on clues provided and other elements of the puzzle, it is debatable that what science considers can be reduced to single, correct answers, Rather than the crossword metaphor, the metaphor of triangulation may provide a better image. There are alternative answers, and science in practice seeks to find the best answer among the alternatives by combining various pieces of evidence. If one asks the question, "What causes X?," the answer may be that no one thing causes X, and this is made more complex if there are multiple occurrences of X. There are certainly many, many things that do not cause X, but even a single occurrence of X may not have a knowable single cause. To illustrate, one recent winter, I went off the highway during a snowstorm. This was a physical event. What caused it? Was it the snow on the highway? Was it the speed I was driving? Was it the absence of salt on the road? Was it the fact that a snowplow had not gone by recently? Was it my inattention? Was it that my car did not have anti-lock brakes? Was it that the tires on my car were worn and did not have adequate tread to hold the road under the road conditions?

Another way to grasp the drive for certainty in the trial setting versus the acceptance of doubt and uncertainty in the scientific-technical world is to consider the role of narrative in the trial context. Trials are about telling a story. Effective persuasion involves constructing a convincing story that the fact finder can latch on to. Stories—particularly the kinds of stories presented in the courtroom—require simplicity and parsimony. Often, it is the side that can present the best story that will succeed, even if the opposing party can punch very large holes in it. In the *Wells* case, the story told by the plaintiffs and their witnesses was that Katie's birth defects had been caused by her mother's use of the Ortho-Gynol spermicidal jelly.

The defense witnesses had no equivalent story to tell. They excluded Ortho-Gynol as a cause for lack of any scientific evidence that the jelly is *capable* of causing birth defects, but they had no alternative explanation for [Katie's] injuries. This may have placed the defense at a disadvantage, since an expression of ignorance and uncertainty, even if accurate, is often less persuasive than a plausible theory, even a false one.

<sup>68.</sup> See generally Ludwik Fleck, The Genesis and Development of a Scientific Fact (1979).

<sup>69.</sup> See Albert Einstein, Physics and Reality, in IDEAS AND OPINIONS BY ALBERT EINSTEIN 290, 294–95 (Carl Seelig ed., Sonja Bargmann trans., 1954) (stating that, in developing a theory, a scientist is "similar to... a man engaged in solving a well-designed word puzzle [in that h]e may... propose any word as the solution; but, there is only one word which really solves the puzzle in all its parts").

<sup>70.</sup> See W.L. BENNETT & M.S. FELDMAN, RECONSTRUCTING REALITY IN THE COURTROOM: JUSTICE AND JUDGMENT IN AMERICAN CULTURE 3 (1981); Twining, supra note 46, at 280–343; see also JAMES J. WHITE, THE LEGAL IMAGINATION: STUDIES IN THE NATURE OF LEGAL THOUGHT AND EXPRESSION 859 (1973) ("[T]he central act of the legal mind, of judge and lawyer alike, is this conversion of the raw material of life . . . into a story that will claim to tell the truth").

<sup>71.</sup> Gross, *supra* note 24, at 1164.

I heard much the same thing while I was observing in a defense-oriented law firm, particularly regarding fire and explosion cases. Although, legally, the defense need only cast grave doubt on the plaintiff's case by showing that the defendant's product or conduct was very unlikely to have caused the damage or injury, in practice the lawyers know that they are not likely to succeed unless they can produce an alternative story that explains why the fire or explosion occurred. The plaintiff may allege that the cause of the fire was a defect in the coffee-maker, show evidence that the fire started in the vicinity of the coffee-maker, and establish that the coffee-maker did not have an automatic cut-off, which the plaintiff alleges would have prevented the fire. Even if the defendant can produce expert testimony concerning the absence of any evidence of the coffee-maker's ever having caused a fire, and that the temperatures produced by the coffee-maker were insufficient to ignite anything in its vicinity, the defendant is likely to lose unless it can produce some alternative explanation for the fire.

One way that so-called "junk science" may be persuasive is that it often appeals to belief systems that focus on blaming someone or something for an unfortunate outcome. The goal in presenting questionable evidence is to persuade the decisionmaker by providing something she can grasp that allows her to externalize responsibility from the "victim" or the victim's plain bad luck to some identifiable "other." It may be that what some observers have called the "pro-plaintiff sentiment" of the jury<sup>73</sup> is not sympathy for the victim but a belief that there has to be some explanation for an injurious outcome beyond simple fate or bad luck.<sup>74</sup>

#### VII

# GOALS OF INQUIRY: MOVING TOWARD TRUTH OR MOVING AWAY FROM FALSITY?

We all want to be "right" and none of us wants to be "wrong." This is true whether one is a scientist, a lawyer, a judge, or a juror. But what does it mean to be "right"? In the courtroom, the focus is on "truth"; the standard oath for a witness is to "tell the truth, the whole truth, and nothing but the truth." Of course, the reason we have trials and similar types of proceedings is that we are uncertain about the truth. Still, the image of the trial is that the goal is to arrive

<sup>72.</sup> See Kritzer 2008, supra note 59, at 120 (discussing the function of Daubert in determining causation in fire and explosion cases).

<sup>73.</sup> Edmond, supra note 5, at 20.

<sup>74.</sup> The alleged pro-plaintiff bias of the jury is undercut by evidence showing that juries are in fact skeptical of plaintiffs' claims, see NEIL VIDMAR, MEDICAL MALPRACTICE AND THE AMERICAN JURY: CONFRONTING THE MYTHS ABOUT JURY INCOMPETENCE, DEEP POCKETS, AND OUTRAGEOUS DAMAGE AWARDS 169–71 (1995) (studies of medical-malpractice suits suggest that juries are often biased against plaintiffs); additional evidence shows that juries are not anti-corporation. Valerie P. Hans & William S. Lofquist, Jurors' Judgments of Business Liability in Tort Cases: Implications for the Litigations Explosion Debate, 26 LAW & SOC'Y REV. 85, 97–98 (1992) (discussing study of tort cases in which "the majority of jurors expressed neutral or positive views of the business litigants").

at, or at least try to arrive at, the simple "truth," and that there is such a truth that we should be seeking to know. Although we cannot be certain that we have arrived at the truth through the trial, the goal of the trial is to move toward "the truth," and based on the best understanding of the truth, to make a decision.

When I write exams for most of my courses, some questions have a clearly correct answer. If I ask students to tell me what an "Article III" court is, I know what it is that I want the students to say, even though they may say it in a variety of ways. However, the more interesting questions that I ask do not have a specific right answer; there is no specific or single "truth" I am looking for the students to give to me. Students often have problems with this type of question, and are wont to ask, "Do you mean you just want my opinion?" In response, I explain that, although there is no one *right* answer to the question I am asking, there are many, many answers that are clearly *wrong*.<sup>75</sup>

This resembles the Kuhnian view of science positing that answers are embedded in paradigms. From paradigms are wrong, some are incomplete, and some are the best currently available. One might say that through the evolution of theories and paradigms, science is moving toward the real "truth" that exists in the material world. However, this fails to capture fully the nature of scientific inquiry. A better description would be that, although science endeavors to move toward *the* truth, it does so by moving away from falsity. After all, "any scientific belief may turn out to be incorrect in some important respect." One way to think about this is that science does seek truth but that the route to truth is by ruling out alternatives, that is, by determining negative truths.

<sup>75.</sup> Even in the exams I give in statistics courses, there are often a combination of right answers, wrong answers, and best answers. Early in my statistics-teaching career, I encountered an angry student. Before coming to graduate school, he had been an elementary-school math teacher, and he was very upset that I often did not say what was the right way to do something. He viewed statistics as akin to simple arithmetic where answers are clearly right or wrong (2 + 2 = 4) is right and (2 + 2) anything else is wrong).

<sup>76.</sup> See Kuhn, supra note 60, at 15–22. A standard critique of Kuhn's position is that it makes scientific knowledge relative. However, another way to see the role of paradigms is that scientific knowledge is "'situated knowledge,' despite efforts to attain universalism." Sheila Jasanoff, Law's Knowledge: Science for Justice in Legal Settings, 95 Am. J. Pub. Health (Supplement 1) S49, S58 n.15 (2005).

<sup>77.</sup> The idea that science yields singular right answers is reinforced by the nature of science training. This is nicely described by Ravetz: "[Science students] have years of intensive training in solving standard preset puzzles. Each of the puzzles has just one correct solution amidst all the incorrect ones. The good, diligent student will find that one correct answer and receive a reward. There is no place for the exercise of judgment; indeed, that would only confuse the student and result in a lower mark." JEROME RAVETZ, THE NO-NONSENSE GUIDE TO SCIENCE 63 (2006). Ravetz goes on to observe, "We know that many people are still shocked by the sight of scientists disagreeing in public. . . . After all, if the scientists are disagreeing then one side must be wrong!" *Id.* at 78.

<sup>78.</sup> *Id.* at 45 (emphasis added); *see also* Haack, *supra* note 11, at 277 (pointing out that it is not "impossible in principle" that the theory of evolution, although strongly supported by scientific evidence, "should turn out to be mistaken after all").

This is not to deny that some scientific knowledge is generally (if not universally) accepted as "firmly established." Still, even when something seems firmly established, new information may call it into question. Take, as an example, the value of breast-feeding. Through the 1950s, 1960s, and into the 1970s, pediatricians in the United States believed that formula feeding combined with the early introduction of solid foods was best for infants because of the importance of weight gain. In the 1970s that began to change radically, and today the view is almost the exact opposite. More generally, scientifically based medical knowledge seems to diverge both over time and across cultures in very significant ways.

In saying that science moves away from falsity, I do not mean to adopt Popperian falsification as the epistemology of science. Epistemologists and sociologists of science have convincingly argued that the Supreme Court has naively adopted an epistemology that is no longer accepted as *the* description of scientific inquiry. However, rejecting the simplistic, falsification image of science does not negate the importance of eliminating alternative explanations from the process of scientific inquiry. Determining what is incorrect is central to scientific advancement even if it is an overstatement to describe falsification as the be-all and end-all of the epistemology of science.

More specifically, persuasion in the context of scientific inquiry involves demonstrating that a proposed explanation, theory, or finding is better than the alternatives. Finding evidence that an alternative is incorrect is an important part of the process of persuasion. In the context of scientific inquiry, the norm is that the proponent of an explanation, theory, or finding should identify and eliminate or otherwise discredit alternatives. In contrast, within the legal arena, the advocate will try to ignore possible explanations *unless* the opposing side

<sup>79.</sup> Haack, *supra* note 11, at 277. Haack uses the term "warrant" to capture the idea of scientific knowledge's being accepted; warrant can operate at both the personal and social levels. *See id.* at 60–77.

<sup>80.</sup> See id. at 301 ("[T]he body of well-warranted theories the sciences have thus far produced is the result of a long process in which most of what was proposed has been, or sooner or later will be, discarded as untenable."); see also Haack, supra note 37, at 996–97 ("Some [scientific ideas, claims, and theories are] so well-warranted by such strong evidence that it is most unlikely they will have to be revised. . . . A few of the now pretty-well-warranted ideas, and perhaps even a very, very few of the best-warranted ideas, will eventually be overturned by overwhelming contrary evidence, but most will not.").

<sup>81.</sup> See Lynn Payer, Medicine and Culture: Notions of Health and Sickness in Britain, the U.S., France and West Germany 23–34 (1988) (medical practice, diagnosis, and prescription vary by culture).

<sup>82.</sup> See generally Karl R. Popper, The Logic of Scientific Discovery (1959) (originally published as Logik der Forschung (1935)).

<sup>83.</sup> See Jasanoff, supra note 4, at 77–78, 81 (discussing the practice of science in contrast to the idealized image of science; "Frye, and to a lesser extent Daubert, are based on a positivist image of science that does not stand up to sociological, and indeed historical or philosophical, scrutiny"); Haack 2005, supra note 4, at S66–S67 (discussing the problems of demarcating science on the basis of falsifiability); see also Haack, supra note 11, at 250–58; Jasanoff, supra note 76, at S53–S54; see generally PAUL FEYERABEND, AGAINST METHOD (1978) (critiquing positivist images of science).

<sup>84.</sup> See generally Imre Lakatos, Falsification and the Methodology of Scientific Research Programmes, in Criticism and the Growth of Knowledge 91 (Imre Lakatos & Alan Musgrave eds., 1970).

brings them up. Of course, a good advocate will try to anticipate the opposition's argument and be prepared to respond; however, there is no obligation or norm dictating that the advocate do the decisionmaker the favor of identifying the alternatives.

#### VIII

#### CONCLUSION

In thinking about the role of persuasion in court, we need to keep in mind the special value we as a society and culture put on "science." Scientists are an object of respect in our culture. We have many seekers of "truth" in our society, but for some reason we imbue those who seek truth as scientists with a legitimacy that we do not apply to other truth-seekers (for example, journalists!). This special status accounts for the reluctance of legal advocates to endorse the use of neutral scientific experts. It also creates a challenge for legal advocates faced with a scientific position contrary to their theories of a case. The advocate has to undermine the scientist's apparent authority—often by ascribing motivations to scientists that are inconsistent with the broad cultural view of the role of scientists. This can involve something as simple as asking the scientist to reveal what fee she is receiving for her testimony; alternatively, it can involve attempting to show that the scientist has an interest or bias related to research grants, career advancement, or the like.<sup>85</sup>

A second strategy advocates can and do use to undermine unfavorable scientific or expert testimony is to present conflicting testimony even when that testimony has a very flimsy base. The goal in such testimony is to employ results that have some facial credibility, even if the science (or supposed science) underlying the results is at best dubious and at worst unsupportable. For example, in the early 1980s, Merrell Dow entered into a tentative \$180 million settlement with plaintiffs for a global resolution of claims alleging that the morning-sickness drug Bendectin had caused birth defects. At that time, there were roughly 1,000 claims pending against Merrell Dow along with an unknown number of potential claims. To accomplish the settlement, a class of plaintiffs would have to be certified and the fairness of the settlement to the class would need to be ascertained. The class would include two groups: those who had filed suit, and those who had not yet filed suit but who would be covered by the settlement. A central issue in assessing the fairness of the settlement was whether it was adequate to cover claims from both groups. A substantial number of lawyers representing plaintiffs were opposed to the settlement on the grounds that it was not adequate. The trial judge appointed a lawyer, Samuel Porter, to represent those who had not filed suit. I (along with a colleague and

<sup>85.</sup> This latter tactic was prominently used by plaintiffs' lawyers such as Stanley Chesley in the course of the breast-implant litigation. Importantly, here it was used not to challenge scientists who had specifically been hired as expert witnesses by the defense, but to challenge the research results that the scientists were reporting that were undercutting the plaintiffs' claims of systemic injury. *FRONTLINE: Breast Implants on Trial* (PBS television broadcast Feb. 27, 1996).

an epidemiologist) was hired by Mr. Porter to assist him in ascertaining whether the settlement was fair from the perspective of his clients.

The role of the epidemiologist was to estimate the number of potential clients Mr. Porter had (that is, how many children had the kinds of injuries alleged to be caused by Bendectin, whose mothers had taken Bendectin during the phase of pregnancy when the injuries might have occurred). The role of my colleague and me was to estimate what proportion of those persons would seek compensation under the proposed settlement. Our research suggested that a large proportion of those who became aware of the settlement would file claims. To be viable, the settlement required that relatively few of the potential claimants actually seek compensation. My colleague and I concluded that an estimate anywhere near the high side of what our research had shown would be met with such skepticism that it would not be believed. Consequently, we decided to give a low-ball estimate, but one that was still much too high from the perspective of the proponents of the settlement if they wanted something resembling adequate compensation for the members of what could potentially be a very large class. <sup>86</sup>

To protect the settlement he had reached with Merrell Dow, Stanley Chesley, who was spearheading the settlement for the plaintiffs, needed to undercut our estimates. To do this, he employed an economist who had no background in the area of propensity to sue. To create testimony for the fairness hearing, the economist carried out a regression analysis that generated statistical results consistent with the estimates Chesley needed to show that the settlement was viable. The model employed to generate these results reflected none of the research that had been done on propensity to sue, and it was afflicted with a variety of statistical problems. The technical problem was such that the lawyer who cross-examined Chesley's expert had not picked up on the problem in advance of the hearing and was unable to effectively counter it. At the end of the hearing, the judge more or less threw up his hands and said, "Here I am confronted with the classic problem of two conflicting views by experts, and I have no obvious way to make a decision between them."

<sup>86.</sup> I should note that this is all happening long before the *Daubert* decision; there is no way that our method or estimates would have survived a challenge using contemporary *Daubert* standards.

<sup>87.</sup> The presiding judge had recently attended a judicial education program that had included sessions on statistical analysis and econometrics presented by Orley Ashenfelter. From other actions of the judge, it was clear that he was enamored with regression analysis even though he did not really understand it.

<sup>88.</sup> The best-known of these statistical problems was that of spurious correlation arising when two measures are formed as ratios with an element in common. This issue had been first identified by Karl Pearson in the late nineteenth century. See Karl Pearson, Mathematical Contributions to the Theory of Evolution: On a Form of Spurious Correlation Which May Arise When Indices Are Used in the Measurement of Organs, 60 PROC. ROYAL SOC'Y LONDON 489 (1897). Although the problem has often been misinterpreted, Chesley's expert's analysis was a classic example of the problem described by Pearson: dividing two uncorrelated, random variables by a third uncorrelated, random variable and then correlating the two ratios will produce a nonzero correlation. See generally Herbert M. Kritzer, Substance and Method in the Use of Ratio Variables, or the Spurious Nature of Spurious Correlation?, 52 J. POL. 243 (1990) (describing the issues in the use of ratio variables).

In this situation the challenge for Chesley was how to persuade the judge not to be persuaded by unfavorable testimony. Chesley adopted a standard method of persuasion used in the courtroom. I doubt he really believed that his expert's analysis had any validity, but that did not matter. The witness had used techniques that seemed scientific, and it was not Chesley's responsibility to reveal the weaknesses in the testimony he was advancing. As an advocate, his only responsibility was not to present testimony that involved perjury.

One way to phrase the judge's problem is, "How am I to assess the relative credibility of opposing experts?" It was unclear how the judge could do so, if he was to apply the typical norms used to assess credibility in the courtroom. Neither side's expert was forced to defend his analysis in the way that would be the norm at a scientific meeting, where a presenter would expect a knowledgeable commentator to look critically at the strengths and weaknesses of the analysis, and then present those to the meeting's attendees. Nor did either side's expert need to anticipate a critical peer review and present an analysis that might head off possible criticisms of his work.

My point here is not that peer review or panel commentators are necessarily superior to the cross-examination that is part of the adversary system. Certainly there are times when the approaches used by the scientific and scholarly community fail, or reflect biases toward or against particular approaches and results. My argument is that the norms of persuasion that result from different approaches to assessing credibility are fundamentally different. Although the norms of persuasion, and resulting assessments of credibility, have connections to issues of epistemology, they are not the same as epistemology. In understanding the tension between science and the courts, one must take into account the differences in the norms governing persuasion and how they come to be reflected in judgments about credibility.

<sup>89.</sup> See generally Gary Edmond, Judging the Scientific and Medical Literature: Some Legal Implications of Changes to Biomedical Research and Publication, 28 OXFORD J. LEGAL STUD. 523 (2008) (discussing issues such as biases in what gets published, publication bias, and the impact of research funding).