

BOOK NOTE

TOXIC TORTS: SCIENCE, LAW, AND THE POSSIBILITY OF JUSTICE, by Carl F. Cranor.* Cambridge, England: Cambridge University Press. Forthcoming 2006. Pp. xvi, 370.**

I. INTRODUCTION

Adjudicating toxic tort suits is uniquely challenging. Toxic substances and the harms they cause have certain traits that make evaluating victims' claims of injury particularly difficult.¹ By necessity, courts and juries rely on the opinion testimony of experts, testimony that is itself often drawn from "the frontiers of existing scientific knowledge."² Legal institutions designed to prevent and redress harms caused by these substances are frequently strained as they are called upon to apply doctrines of causation and evidentiary sufficiency to such testimony. Assessing the evidentiary value of expert scientific testimony by attempting to fit its assertions into these legal categories has many inherent risks, not the least of which is the potential for non-specialists to apply naïve norms of reasoning to scientific data and, in this way, to arrive at mistaken conclusions concerning the weight, sufficiency and correctness of the evidence being presented.³ When judges and juries make such a mistake, the legal consequences can be disturbingly severe. A victim who was harmed (perhaps gravely⁴) by a toxic substance may be uncompensated for that injury, while the manufacturer of the substance will be allowed to profit by externalizing social costs of its profit-seeking activities; or else damages may be paid to a plaintiff whose injuries were not attributable to the substance, and manufacturers will be subject to incorrect economic incentives in their production of a substance with beneficial uses.⁵ Epistemological, logistical and

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¹ CARL F. CRANOR, TOXIC TORTS: SCIENCE, LAW, AND THE POSSIBILITY OF JUSTICE 10–11 (forthcoming 2006). These difficulties include the fact that such substances "often operate by means of unknown, complex, subtle molecular mechanisms and, when they materialize into harm, injure humans in ways that researchers might not discover for years." *Id.* at 11.

² *Id.* at 11.

³ *See, e.g., id.* at 115 (noting that "some judges have had a tendency to adopt comparatively simple indicators of reliable scientific reasoning, indicia that must be jettisoned or modified in favor of a more subtle understanding of scientific reasoning").

⁴ *See id.* at 84 (e.g., cancer or reproductive defects).

⁵ *See id.* at 273–74. Cf. Anthony Z. Roisman et al., *Preserving Justice: Defending Toxic Tort Litigation*, 15 *FORDHAM ENVTL. L. REV.* 191, 193 (2004) (noting that, when properly functioning, tort law provides "compensation of persons injured by exposure to toxic substances and products, and . . . economic incentive[s] for producers to reduce the frequency and severity of such exposures").

practical issues can thus have the effect of precluding just and fair resolutions of legal controversies involving toxic substances.

Toxic Torts: Science, Law, and the Possibility of Justice is Professor Cranor's attempt to sort through these complicated issues in a way that will appeal to, and enlighten, readers from both scientific and legal disciplines. The book examines the role of expert scientific testimony in toxic tort suits, taking as its starting point the Supreme Court's decision addressing the question of expert testimony admissibility in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*⁶ Presenting analyses of both legal procedure and the norms and methodologies of the scientific reasoning process, *Toxic Torts* suggests that courts, guided by *Daubert*, have misunderstood the credibility of scientific evidence and the testimony of experts in subsequent toxic tort suits.⁷ This misunderstanding, Cranor argues, has resulted in the exclusion of relevant, probative scientific evidence in toxic tort cases, and has thus increased the likelihood of court decisions at odds with scientific judgments.⁸ In order to diminish such misunderstanding, Cranor offers several possible policy responses, including requiring increased pre-market testing of potentially toxic substances and instituting a new negligence rule that would require manufacturers to provide adequate information regarding the risks their substances pose to the public.⁹ If political reality prevents the implementation of such measures, courts will instead require a workable, accurate method of assessing the reliability of expert testimony and scientific fact patterns. Cranor suggests that courts should learn to identify when scientific testimony falls within a "zone of reasonable scientific disagreement," using this "zone" as a standard to guide their reliability judgments.¹⁰

II. BACKGROUND: *DAUBERT* AND THE ROLE OF FEDERAL JUDGES

Courts have long been concerned about the credibility of expert testimony because of its ability to sway the decisions of factfinders.¹¹ Experts are given wider latitude in their testimony and, unlike other witnesses, can testify on the basis of opinion and offer interpretations of facts that

⁶ 509 U.S. 579 (1993).

⁷ See, e.g., CRANOR, *supra* note 1, at 138-40 (arguing that the Supreme Court made a "simple mistake" in *General Elec. Co. v. Joiner*, 522 U.S. 136 (1997), when it affirmed the District Court's functional decision to analyze whether each piece of evidence supported a conclusion individually, rather than undertake a "weight of the evidence" review).

⁸ See, e.g., CRANOR, *supra* note 1, at 139-40. He further argues that, because of prejudicial tendencies in both science and legal procedure, much of the burden of scientific misunderstanding falls on plaintiffs in cases in which proof of liability depends upon scientific and expert testimony. *Id.* at 278.

⁹ See *infra* Part III.B.

¹⁰ See CRANOR, *supra* note 1 at 290.

¹¹ See generally M. Neil Browne et al., *The Epistemological Role of Expert Witnesses and Toxic Torts*, 36 AM. BUS. L.J. 1, 5-11 (1998).

are not personally known to them.¹² Because of this latitude, courts have applied admissibility standards to the testimony of experts. Prior to the decision in *Daubert*, testimony from well-credentialed experts was generally admitted when it did not rely on “‘novel’ techniques or studies.”¹³

Daubert changed everything. In *Daubert*, the Supreme Court created a new standard of admissibility based on Rule 702 of the Federal Rules of Evidence.¹⁴ This new standard fashioned a “gatekeeping” function for federal trial judges, who would have to review the proffered testimony and adjudge both the reliability of its foundation and its relevance to the task at hand before admitting it into evidence.¹⁵ The trial court’s review would be directed to answering questions of whether the proffered testimony is “scientific knowledge” and whether it “will assist the trier of fact to understand or determine a fact in issue.”¹⁶ In order to determine whether testimony represents “scientific knowledge,” the Court asserted that trial judges should conduct “a preliminary assessment of whether the reasoning or methodology underlying the testimony is scientifically valid and of whether that reasoning or methodology properly can be applied to the facts in issue.”¹⁷ The Court proceeded to give a non-exhaustive list of factors whose consideration this assessment might entail.¹⁸ Finally, it pronounced itself “confident that federal judges possess the capacity to undertake this review.”¹⁹

III. CAPACITY BUILDING: TRANSLATING SCIENCE INTO LAW AND PRESERVING JUSTICE

Toxic Torts argues that courts have had mixed success in their attempts to fulfill the gatekeeping role created for them by *Daubert*. Courts, Cranor argues, face several problems in their attempts to determine the reliability of expert testimony. First, the guidance offered by the Supreme Court in *Daubert* regarding “scientific knowledge” was less than clear, in that the Court seemingly endorsed “two inconsistent philosophies of science,” making it unclear exactly what the Court intended.²⁰ Second, be-

¹² FED. R. EVID. 702, 602, 701.

¹³ CRANOR, *supra* note 1, at 40. Prior to *Daubert*, most courts relied on the so-called “Frye test” for determining the admissibility of expert testimony. *Id.* See *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).

¹⁴ See CRANOR, *supra* note 1, at 49; *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579, 589 (1993) (stating that “the Frye test was displaced” by the Federal Rules of Evidence).

¹⁵ *Daubert*, 509 U.S. at 589–90, 597.

¹⁶ *Id.* at 592.

¹⁷ *Id.* at 592–93. Whether the methodology can be applied to the facts in issue has been glossed as the idea of “fit.” See CRANOR, *supra* note 1, at 82–83.

¹⁸ See *Daubert*, 509 U.S. at 593.

¹⁹ *Id.*

²⁰ CRANOR, *supra* note 1, at 68–69 (noting the Court’s endorsement of both Karl Popper’s “falsifiability” view and Carl Hempel’s “confirmation theory”).

cause scientific reasoning involves non-deductive inferences,²¹ employing this type of reasoning requires substantive knowledge drawn from specific scientific disciplines; thus, “[n]onexperts risk being at sea in attempting to evaluate the *substantive quality of scientific research and inferences from it* when they lack the appropriate scientific background to do so.”²² Finally, several courts have taken naïve approaches to critiquing the formal aspects of non-deductive arguments in general.²³ According to Cranor, this is perhaps the most serious fault, given that non-deductive argument is the dominant form of reasoning in scientific endeavors and that conclusions drawn from this type of reasoning constitute much of what is properly termed “scientific knowledge.”²⁴

Because of the three basic problems, Cranor contends, some courts have implemented “unduly constrained, idealized, or overly simplistic heuristics for reviewing scientific testimony on causation,”²⁵ which has led them to reject expert testimony on the basis of “mistaken scientific views.”²⁶ When valid expert testimony is rejected in this way, factfinders are denied the opportunity to pass judgment on a claim while in full possession of all of the relevant facts and their decisions may lack “acceptability.”²⁷ Litigants are thus denied justice. Cranor argues that plaintiffs suffer most from this limitation in access because they bear the burden of proof and because admissibility hearings occur before trial.²⁸ Thus, these hearings can determine the outcome of a trial before a plaintiff’s claims ever come before a jury.²⁹

Problems stemming from the implementation of *Daubert*’s gatekeeping duties are further compounded in the case of toxic torts by the nature of toxic substances and the harms that they cause, as well as by the lack of substantive scientific understanding of the vast majority of such substances.³⁰ Cranor asserts that these problems similarly result mostly in bias

²¹ For detail on non-deductive reasoning, see *infra* notes 41–44 and accompanying text.

²² CRANOR, *supra* note 1, at 70.

²³ *See id.* at 62–90, 205–82.

²⁴ *See id.* at 128–34.

²⁵ *Id.* at 283. *See generally id.* at 220–70.

²⁶ *Id.* at 16. This functional result of the *Daubert* decision is in tension with the Supreme Court’s characterization of the Federal Rules of Evidence in that very same decision. The Court stated that the rules have a “liberal thrust” and that they relax “the traditional barriers to ‘opinion’ testimony.” *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579, 588 (1993) (quoting *Beech Aircraft Corp. v. Rainey*, 488 U.S. 153, 169 (1988)).

²⁷ *See* CRANOR, *supra* note 1, at 343–49.

²⁸ *Id.* at 335. Because it is plaintiffs who bear the burden of proof, even were the testimony of both sides’ experts subjected to scrutiny under this heightened standard, the plaintiff would bear more of the risk; without the testimony of these experts, there would be no evidence of causation and thus no possibility of satisfying plaintiff’s burden. *See id.* at 36–37.

²⁹ *Id.* at 42–44.

³⁰ *Id.* at 8–13, 160–80. *But see* David L. Eaton, *Scientific Judgment and Toxic Torts—A Primer in Toxicology For Judges and Lawyers*, 12 J.L. & POL’Y 5, 27 (2003) (asserting that “awareness and early identification of potential cancer-causing chemicals,” have been “[g]reatly improved”).

against plaintiffs. These include the fact that toxic substances: (a) have long latency periods between exposure and symptoms of harm that make documentation difficult; (b) lack “signature effects” that would betray their role in disease causation; and (c) often cause diseases that are either rare and little studied or so common that their etiology is difficult to establish.³¹ Furthermore, because scientific studies are expensive, many of those injured will be unable to finance any investigation into the toxicological properties of the substances to which they have been exposed.³² Manufacturers would be the only parties to the suit with sufficient funding to undertake the necessary studies. Because the plaintiffs bear the burden of proof, however, heightened standards of admissibility give these defendants perverse incentives to do as little research as possible on the toxicological properties of the substances they produce, since they can rely “‘on the non-credibility of the proponent’s proofs . . . [instead of producing] affirmative evidence.’”³³ Given the time and expense required for such studies, the problems with funding them, the relatively lax regulations governing pre-market testing of new products, and the fact that lack of etiologic evidence can stymie the corrective and distributive goals of tort law, Cranor argues that it should come as no surprise that there is a paucity of good scientific evidence available to plaintiffs in toxic tort suits.³⁴

With *Toxic Torts*, Cranor tries to ameliorate the problems that confront courts when they are called to adjudicate toxic torts, in two ways. First, he attempts to provide the tools necessary for legal professionals to understand, and make informed critiques of, scientific reasoning and scientific data. This, he hopes, will result in admissibility decisions being “better founded scientifically than at present.”³⁵ Further, such decisions will “comport better with how scientists themselves assess the evidence.”³⁶ Second, Cranor explores three possible policy-based solutions that could address some of the structural problems noted above: increased pre-market testing, a return to the *Frye* test, and tort liability reform.³⁷

A. Analyzing Scientific Reasoning and Patterns of Evidence

In order to make the testimony of experts more perspicuous for legal professionals, Cranor analyzes the forms of reasoning that scientists employ in their professional capacity and provides concrete examples of

³¹ See *id.* at 158, 170–80.

³² *Id.* at 216–17.

³³ *Id.* at 280–81 (quoting Vern R. Walker, *Preponderance, Probability and Warranted Fact Finding*, 62 BROOKLYN L. REV. 1075, 1115 (1996)).

³⁴ See CRANOR, *supra* note 1, at 160–70, 353–59.

³⁵ See *id.* at 283.

³⁶ *Id.*

³⁷ *Id.* at 357–66.

these forms at work in scientific fields.³⁸ The examples reveal that some methodologies employed on a daily basis by scientists, especially “weight-of-the-evidence” analysis, are given short shrift when courts decide upon the admissibility of expert testimony.³⁹ Cranor provides an in-depth explanation of the difference between deductive reasoning, the type with which courts are perhaps more familiar, and non-deductive reasoning, the type most often used in scientific studies and diagnostic procedures.⁴⁰ While in deductive reasoning, results of a valid argument are “guaranteed” if the premises are true, in non-deductive reasoning there exist only stronger and weaker links between premises and conclusions.⁴¹ That is, the set of possible explanations of a given set of premises and conclusions is “underdetermined.”⁴² Although many causal explanations can be given for a set of premises and a set of results, this does not mean that each explanation is *equally plausible*; rather, relying on the tools of non-deductive reasoning as well as substantive insights gleaned from experience in a certain field, “an expert must consider different plausible explanations of the evidence in order to assess which explanation best accounts for the evidence.”⁴³ In order to assess the relative plausibility of various explanations, scientists regularly employ a “weight-of-the-evidence” methodology, which is a form of non-deductive reasoning that takes into consideration *all* the available, relevant scientific evidence.⁴⁴

Cranor argues that, absent an understanding of the role that non-deductive inference plays in the formation of scientists’ opinions, courts are likely to continue to make errors in their assessments of the reliability of an expert’s testimony.⁴⁵ For example, courts have in the past attempted

³⁸ See, e.g., *id.* at 115–28 (detailing case studies and the manner in which scientists have evaluated case reports in various circumstances). Cranor also adverts to the tension between the norms that govern reasoning in science and law; these norms are conditioned by the distinct goals of each discipline. See *id.* at 207–17. This Book Note will not consider the implications of these differences.

³⁹ See, e.g., *id.* at 75–79, 136–40, 142–44. Cranor argues that “good scientific practice,” *id.* at 136, requires weighing and assessing, simultaneously and cumulatively, all available types of evidence, including human, animal, and mechanistic. He also provides examples in which courts “did not assess [the evidence] as an integrated whole,” *id.* at 76, either by dismissing particular types of evidence (such as case studies) or by testing an expert’s hypothesis sequentially against each individual piece of evidence. *Id.* at 75–77. For example, Cranor cites *In re Agent Orange Prod. Liab. Litig.*, 611 F. Supp. 1223 (E.D.N.Y. 1985) as one, unfortunately persuasive instance in which a court excluded a particular type of evidence, animal studies, that rather should have been included in the process of weighing the overall reliability of the expert’s testimony. See *id.* at 248–50.

⁴⁰ See *id.* at 75–79, 125–44.

⁴¹ *Id.* at 128–30.

⁴² *Id.* at 141–42 (quoting Douglas Weed, *Underdetermination and Incommensurability in Contemporary Epidemiology*, 7 KENNEDY INST. ETHICS 107, 108 (1997), for the proposition that “such inference drawing can result in ‘many opportunities within the practice of causal inference for scientists to hold different opinions about which scientific values are important to the assessment of evidence’”).

⁴³ *Id.* at 79.

⁴⁴ *Id.* at 131–34.

⁴⁵ See *supra* note 39.

to assess the reliability of an expert's testimony by testing each individual piece of evidence, rather than by evaluating the testimony in a manner appropriate to the scientific endeavor, namely by inquiring "whether [the] expert in assembling and integrating *all* the scientifically relevant evidence, taken together, is engaged in reasoning that is scientifically reliable."⁴⁶ Indeed, some courts have even rejected weight-of-the-evidence arguments, asserting that they are *insufficiently scientific* to demonstrate a causal link for the purposes of tort law.⁴⁷

Cranor gives concrete examples of scientists applying this form of reasoning to results of various types of studies that are used to determine the toxicological properties of chemical substances.⁴⁸ In so doing, he supports a coherent argument that the simplistic heuristics that some courts have invented, such as requiring epidemiological evidence to substantiate causation,⁴⁹ misinterpret the substantive value of many types of studies from which scientists form their opinion.⁵⁰ He argues that testimony based on results from these other types of studies can make good evidence, provided courts become sensitive to the indicia of plausible inferences that are particular to each type.⁵¹ Cognizing these insights, legal practitioners (including judges, attorneys, special masters, and others) are better equipped to evaluate and explain the reliability and evidentiary value of expert testimony and the studies upon which it is founded.

Finally, Cranor proposes an alternative heuristic that he argues can serve as a "sociological surrogate" for reliability: the question of whether the expert's proffered testimony is within "the zone of reasonable sci-

⁴⁶ *Id.* at 139–40. It is worthwhile to note that it is not always clear to *what* one should apply the *Daubert* inquiry. *Id.* at 65–66. In some instances it seems that the standard is intended to apply to the materials on which an expert basis her opinion (e.g., to animal studies); in others it seems that the standard should be used to assess the reliability of the expert's testimony itself, that is, to assess the way in which the expert drew her inferences and formed her opinions. *Id.*

⁴⁷ *See id.* at 264–65 (citing *Allen v. Pennsylvania Engineering*, 102 F.3d 194, 198 (1996)). Part of the reason that it is difficult for courts to assess weight-of-the-evidence arguments is that substantive knowledge of the scientific discipline is often required in order to make informed judgments about the sufficiency of an expert's non-deductive reasoning. *See* CRANOR, *supra* note 1, at 69–70 (citing Susan Haack, *An Epistemologist in the Bramble-Bush: At the Supreme Court with Mr. Joiner*, 26 J. HEALTH POL., POL'Y & L. 217, 231–32 (1999)).

⁴⁸ *See, e.g., id.* at 136–40 (offering several examples of scientific reasoning at work, including the stepwise process employed by the International Agency for Research on Cancer to determine the carcinogenicity of substances and the Institute of Medicine and National Research Council's guidelines for assessing dietary supplements' adverse effects). *See also id.* at 115–28, 140–44, 248–60, 264–70.

⁴⁹ *See id.* at 224–27 (noting that some courts demand epidemiological evidence even after *Daubert*).

⁵⁰ *See id.* at 221–23 (stating that courts often demand particular kinds of scientific evidence).

⁵¹ For example, he argues that case studies, often denigrated by courts, can in certain circumstances provide exceptionally reliable evidence of causation. *See id.* at 116–17. He then provides several examples of case studies that he would consider good scientific evidence of causation. *See id.* at 117–25.

entific disagreement.”⁵² This heuristic would only require that judges be able to compare the reasoning used by an expert in her testimony with analogous reasoning employed by scientists analyzing similar issues.⁵³ Keeping in mind that the standard for measuring reliability is not that demanding (indeed, “*the evidentiary requirement of reliability is lower than the merits standard of correctness*”⁵⁴), Cranor suggests that an expert’s testimony would be sufficiently reliable if it relied on similar reasoning and similar patterns of evidence as those used by, for instance, “consensus scientific committees to conclude that substances can cause human harm.”⁵⁵ In effect, it would save judges from having to make “substantive scientific judgments about [a] particular argument,”⁵⁶ because all judges would need to do is compare forms of reasoning and patterns of evidence.

B. Policy Prescriptions

Merely remedying courts’ too-rigorous performance of their evidentiary gatekeeping role under *Daubert*, Cranor argues, may not be enough to restore the possibility of justice for litigants in toxic tort cases or to protect public health. Among other things, it fails to address the perverse incentives that the current legal regime gives to manufacturers with regard to product testing.⁵⁷ Cranor offers three possible policy-based solutions.⁵⁸ The first involves mandating increased pre-market testing of new, potentially toxic substances; the second is a return to the *Frye* test; and the third is reforming tort law by creating a new cause of action, sounding in negligence, under which manufacturers could be held liable for “failure to provide substantial information relating to risk.”⁵⁹

⁵² *Id.* at 290.

⁵³ *Id.*

⁵⁴ *Id.* at 286 (quoting *In re TMI Litigation*, 193 F.3d 613, 665 (3d Cir. 1999)).

⁵⁵ *Id.* at 292.

⁵⁶ *Id.* at 290.

⁵⁷ *Id.* at 338. *But see* Christopher H. Buckley, Jr., *Toxic Tort Cases: Risk Assessment and Junk Science*, 9 KAN. J.L. & PUB. POL’Y 487, 494 (2000) (arguing that juries will be unsympathetic toward those companies who do not perform responsible testing). Buckley’s argument is somewhat compromised, of course, if Cranor is correct in arguing that these suits are being frustrated at the admissibility stage, *before* they ever come before a jury.

⁵⁸ *See* CRANOR, *supra* note 1, at 357–66.

⁵⁹ *Id.* at 364 (quoting Margaret A. Berger, *Eliminating General Causation: Notes Towards a New Theory of Justice and Toxic Torts*, 97 COLUM. L. REV. 2117, 2143 (1997)). *But see* Jonathan Mosher, *A Pound of Cause for a Penny of Proof: The Failed Economy of an Eroded Causation Standard in Toxic Tort Cases*, 11 N.Y.U. ENVTL. L.J. 531, 616 (2003) (arguing “that an eroded standard of causation is an inefficient method of achieving the goals of toxic torts”). Mosher’s argument seems not to consider fully, however, the fine distinction between scientific and legal norms of reasoning; for example, the article seems to accept the same sort of statistical notions about the results of epidemiological studies that, Cranor argues, have misled courts in the past. *See id.* at 620–21. *Cf.* CRANOR, *supra* note 1, at 232–38 (discussing relative risk rules).

Cranor admits that there currently exists "little political will" for implementing regulatory measures that would require increased pre-market testing of new products.⁶⁰ He further suggests that, while a return to *Frye* might remove some of the admissibility barriers courts have raised following *Daubert*, it nonetheless would do "nothing to encourage greater scientific testing of substances."⁶¹ One solution that would encourage such testing, he argues, is the innovative negligence rule proposed by Professor Margaret Berger: holding manufacturers liable for "failure to provide substantial information relating to risk," without requiring proof that such failure "caused plaintiff's injury."⁶² Several defenses would be allowed to defendants, including showing (1) that they had met the requisite standard of care; (2) that the harms suffered by the plaintiff could not plausibly result from exposure to the defendant's product; and (3) that other factors contributed to the plaintiff's injury.⁶³ As others have pointed out, this amounts to shifting the burden of proof regarding general causation to defendants,⁶⁴ which would create incentives for defendants to conduct the studies necessary to determine a substance's toxicological properties.⁶⁵ Arguably, it is fair for them to bear this burden because they are in the best position to conduct the studies, to balance the costs of studies against the potential cost of tort suits, and to distribute those costs.⁶⁶

IV. CONCLUSION

Toxic Torts presents a thoughtful analysis of the issues surrounding the admission and use of scientific evidence in the courtroom. It is generally well-written and persuasively argued, though its meticulous organization sometimes leads to repetition and an overabundance of internal cross-reference. In addition, because of the way in which science, law, epistemology, and logic are intermingled throughout the book, there are often abrupt transitions from, and long pauses between, different threads of the argument. For instance, the section on scientific reasoning begins with a critique of judges' ability to assess forms of non-deductive arguments in science; almost immediately, however, Cranor makes a transition into a related, but not identical, concern about how courts have tended to treat case studies.⁶⁷ Though, as promised, the author does eventually return to his critique of the courts' understanding of scientific reasoning, it

⁶⁰ CRANOR, *supra* note 1, at 338.

⁶¹ *Id.* at 363.

⁶² *Id.* at 364 (quoting Berger, *supra*, note 59, at 2143).

⁶³ *Id.* (citing Berger, *supra*, note 59, at 2144-45).

⁶⁴ *Id.* (citing Alani Golanski, *General Causation at the Crossroads in Toxic Tort Cases*, 108 PENN STATE L. REV. 479, 482-85 (2003)).

⁶⁵ *Id.* at 365.

⁶⁶ *Id.* But see Buckley, *supra* note 57 (arguing, implicitly, for the social value of a strict interpretation of current specific and general causation burdens).

⁶⁷ See CRANOR, *supra* note 1, at 115.

is sometimes possible to lose the main thread of his argument during tangents such as these. This may simply be an unavoidable feature of such a broadly synthetic approach to this topic, however; and it is not a serious substantive fault.

It would be helpful were Cranor to clarify, in one comprehensive appendix, the relationship among the related notions of inference, reliability, methodology, plausibility, validity, fit, and conclusion *as they are employed by the courts*. An appendix dealing with these terms, with the various ways and contexts in which the courts have used them, would help to alleviate some confusion and ambiguity in the text. It would also give the reader insight into the fact that this confusion and ambiguity can sometimes be a result of the way in which courts have treated these topics, applying inconsistent, and sometimes faulty, philosophies of science.

The potential impact of the book's policy recommendations remains uncertain. Increased pre-market testing, as an ideal, would both prevent harm by identifying toxic substances before they are distributed as well as allow for more efficient just compensation through tort claims by increasing scientific knowledge about the toxicological effects of a substance. As Cranor acknowledges, however, this type of regulation is unlikely to be adopted given its costs and the current political mood.

The same considerations that would likely thwart the adoption of increased pre-market testing also militate against the acceptance of a new negligence rule covering failure to provide substantial information related to the risk posed by a substance. Though this rule might theoretically be somewhat more politically palatable, in that it leaves the cost-balancing calculus to manufacturers instead of regulators, the fact that it could subject manufacturers to uncertain and potentially significant liability for damages in the many cases in which significant testing has not yet been performed means that there will be considerable political opposition to its implementation. Of course, this is not an argument against the fairness of such a rule. Thus, it is possible that some states might adopt the rule, or develop it in their common law. Other scholars, however, do argue against its implementation;⁶⁸ and its contentiousness means that judges may be hesitant to embrace it without some direction from legislatures.

A more likely result is that state courts will be reluctant to approve *Daubert*-style admissibility hearings, instead either preserving or returning to the *Frye* test. This reluctance makes sense given the contradiction between the policy justifications for the decision and its practical effect. While *Daubert* was ostensibly promulgated in an attempt to liberalize admissibility rules,⁶⁹ its functional result has been a more stringent review of scientific expert testimony than was the case under the earlier *Frye*

⁶⁸ See, e.g., Richard J. Pierce, Jr., *Causation in Government Regulation and Toxic Torts*, 76 WASH. U. L.Q. 1307, 1310-28 (1998).

⁶⁹ See *supra* note 26.

test.⁷⁰ There are already several examples of state courts charting such a course.⁷¹ For now, however, the Federal Judiciary cannot avail itself of this option:⁷² lower courts must abide by and interpret the Supreme Court's decision in *Daubert*, unless and until it is overruled; and, perhaps more importantly, *Daubert*'s basic holding was codified in 2000 in the revised Rule 702 of the Federal Rules of Evidence.⁷³ This quasi-judicial, quasi-legislative approval of the admissibility standards⁷⁴ lends them legitimacy and would require more to overturn than a mere judicial re-thinking of the notion that district court judges, without further training, have the capacity to evaluate scientific patterns of evidence.

At least on the federal level, *Daubert*'s admissibility standards will remain relevant for the foreseeable future. District court judges will continue to be called upon to wade into scientific controversies and to evaluate the methodologies of experts in fields with which they likely have little, if any, familiarity. If justice is to be done in those cases, courts must become more sensitive to the differences between legal and scientific reasoning. They must also begin to appreciate that scientific treatment of evidence differs from the way the legal system evaluates it. Given the mixed results thus far,⁷⁵ it is clear that policy or procedural responses are required in order to ensure that substantial justice is preserved. Even were courts to adopt Cranor's heuristic and base admissibility decisions on the question of whether an expert's testimony falls within a zone of reasonable scientific disagreement, however, they would still need considerable fluency in scientific modes of analysis,⁷⁶ although that knowl-

⁷⁰ See CRANOR, *supra* note 1, at 363 ("Frye does nothing to encourage greater scientific testing of substances . . . except perhaps to have a somewhat more liberal court review of expert testimony.").

⁷¹ *Id.* at 363 n.93 (noting that ten states have rejected the *Daubert* standard).

⁷² This limitation has become even more important after the recent passage of the Class Action Fairness Act of 2005, which gives federal courts much broader jurisdiction over class action suits. Pub. L. No. 109-2, 119 Stat. 4 (2005). Such suits are relevant in the toxic tort context because the small risk of great harm from toxic substances can be distributed over a wide-ranging population of susceptible individuals. See, e.g., Anthony DePalma, *Debate Revives as 9/11 Dust Is Called Fatal*, N.Y. TIMES, Apr. 14, 2006, at B1.

⁷³ See Joëlle Anne Moreno, *What Happens When Dirty Harry Becomes an (Expert) Witness for the Prosecution?*, 79 TUL. L. REV. 1, 12 (2004) ("The new rule codifies the judicial 'gatekeeping' role created in *Daubert*."). See also *supra* notes 14-19 and accompanying text (noting that, in *Daubert*, the Supreme Court created a new standard of admissibility based on the then-valid version of Rule 702). Note that the actual "reliability" factors enumerated in *Daubert* were not codified by the Rule. See FED. R. EVID. 702 advisory committee's note (2000) ("No attempt has been made to 'codify' these specific factors.").

⁷⁴ See 28 U.S.C. § 2074 (2005) (requiring an "Act of Congress" before any rule proposed by the Supreme Court "creating, abolishing, or modifying an evidentiary privilege" may take effect).

⁷⁵ See *supra* notes 20-32 and accompanying text.

⁷⁶ Cranor acknowledges this concern: "Of course, this does not dispose of the problem Judges who must review scientific issues on their own must still assess the *substantive basis* of scientific reasoning compared with other experts in the field, a task for which they are not trained and in all likelihood lack the substantive background." CRANOR, *supra* note 1 at 291-92.

edge could in part be derived from an examination of judicial precedent or the work of consensus scientific committees.⁷⁷

The discussion in *Toxic Torts* represents a good first step in preparing judges and other legal practitioners to use these sources in order to make informed evaluations of scientific reasoning and scientific patterns of evidence. Perhaps its most important function, however, is to remind such professionals to tread carefully in those areas where they remain non-expert, and especially when making admissibility decisions, where the inquiry is not about correctness, but rather reliability, and thus requires the parties to meet only a rather low threshold.⁷⁸

Toxic Torts makes a substantial contribution to the ongoing debate concerning the admissibility of expert witness testimony and its role in proving causation in toxic tort suits. Because of the growing importance of scientific evidence in the judicial process, it is critical that legal practitioners come to understand the norms and methodologies employed by scientists. *Toxic Torts*' nuanced critique of the differing norms in scientific and legal reasoning reveals the subtle epistemological hazards that confront legal practitioners when they work with the opinion testimony of experts. Researchers and scientists will also come away from reading the book with a greater understanding of how the judicial system incorporates their work into its quest to make justice, perhaps encouraging "greater acceptance of legal decisions in the scientific community [and] greater scientific participation in the legal system."⁷⁹ This increased familiarity on the part of both legal practitioners and scientists will help to "ensur[e] that science better informs our legal institutions and social decisions consistent with preventing harm and ensuring just compensation to those wrongfully injured."⁸⁰

—Devin Brennan***

⁷⁷ See *id.* at 292–94.

⁷⁸ *Id.* at 286 (citing *In re TMI Litigation*, 193 F.3d 613, 665 (3d Cir. 1999)).

⁷⁹ *Id.* at 294.

⁸⁰ *Id.* at 369.

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