Toxic Torts

Science, Law, and the Possibility of Justice

Carl F. Cranor
University of California, Riverside

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For Crystal, Chris, and Taylor

Toxic Torts

The U.S. tort, or personal injury law, cloaked behind increased judicial review of science, is changing before our eyes, except we cannot see it. U.S. Supreme Court decisions beginning with *Daubert v. Merrell Dow Pharmaceutical* altered how courts review scientific testimony and its foundation in the law. The complexity of both science and the law mask the overall social consequences of these decisions. Yet they are too important to remain hidden. Mistaken reviews of scientific evidence can decrease citizen access to the law, increase incentives for firms not to test their products, lower deterrence for wrongful conduct and harmful products, and decrease the possibility of justice for citizens injured by toxic substances. Even if courts review evidence well, greater judicial scrutiny increases litigation costs and attorney screening of clients and decreases citizens' access to the law. This book introduces these issues, reveals the relationships that can deny citizens just restitution for harms suffered, and shows how justice can be enhanced in toxic tort cases.

Carl F. Cranor is Professor of Philosophy at the University of California, Riverside. His work focuses on issues concerning the legal and scientific adjudication of risks from toxic substances and from the new genetic technologies. He has written *Regulating Toxic Substances: A Philosophy of Science and the Law* (1993), edited *Are Genes Us? The Social Consequences of the New Genetics* (1994), and coauthored the U.S. Congress' Office of Technology Assessment report, *Identifying and Regulating Carcinogens* (1987). His articles have appeared in diverse journals such as *The American Philosophical Quarterly, Ethics, Law and Contemporary Problems, Risk Analysis,* and the *American Journal of Public Health.* He is a Fellow of the American Association for the Advancement of Science and the Collegium Ramazzini and a member of the Center for Progressive Reform, a nonprofit think tank of legal scholars committed to protecting the public health and the environment.

Contents

Preface

It is tempting to say that our tort, or personal injury, law is changing before our eyes, except we cannot see it. These modifications are occurring because of Supreme Court decisions that increased the screening of expert (largely scientific) testimony in the law, but it is difficult for all but the best informed to comprehend them. Some who understand them welcome them, some do not, and some will have more mixed assessments of them. However, most citizens cannot even have an opinion on the relevant issues because they are unaware of them and because the topics themselves are not easily accessible. The barriers to understanding this important legal institution are the result of subtleties most of us never think about – issues about scientific evidence and reasoning, and legal procedures that are complex and inaccessible to most of us.

The actual and potential transformations of this part of our legal system are too important, however, to remain hidden and too important for an informed citizenry to be left in the dark about them. Citizens risk having their realistic access to the tort law and the possibility of justice within it reduced and they will not know it. Judges and lawyers are at risk of being manipulated by slogans about "sound science," not realizing there are more scientifically accurate and legitimate ways to think about science, law, and the interaction between the two. There is even a risk to the legitimacy of the law itself, if mistaken scientific arguments are used to frustrate its aims. The issues posed by the potential changes in our legal system are not easy, however. In order to "see" and come to have a better appreciation of them, we must understand more about some of the procedures in the law that occur before trial, not something most of us are aware of. We also must understand some basics of the sciences that assist in revealing human harm from exposure to toxic substances. In addition, there are subtleties about these sciences and different evidentiary patterns of harm that must be appreciated. Too simplistic a view of the subjects will inadvertently skew the science, the law, and our protections under it.

This book seeks to make some progress on these issues. I have sought to introduce those not familiar with legal procedures to some of the basics of

the law to locate the legal issues. I also have sought to introduce those not familiar with some of the basics in the relevant sciences to such information. However, in order to understand subtler points about law and science and their joint consequences for the law, the discussion must go further. Consequently, it is necessary to discuss details of legal procedure as well as legal decisions that have brought the changes or that have implemented them. We should understand what judges have said about science in adjudicating alleged personal injuries from exposure to toxic substances. However, to assess the impact of their decisions and the reasons they have given for reviewing the science as they did, we also need to appreciate some of the finer points about different kinds of scientific evidence, how it can be integrated to show harm, and how scientists utilize studies in order to arrive at judgments that a substance has contributed to harm. In short, one cannot shrink from grappling with some of the details of scientific evidence and reasoning. I have tried to address these issues, but in a way that provides the reader with an understanding of how the interaction between science and the tort law can profoundly affect our realistic access to the legal system, our possibilities of justice within it, and deterrence of wrongful behavior or harmful products.

In writing this book, I have learned and had various kinds of assistance from many. I will no doubt forget some whose comments, insights, contributions, or conversations have been of value, but I hope not. If I have, I hope they will forgive my faulty memory. Three people ably assisted research on and the preparation of the final manuscript. David Strauss provided excellent research assistance, including research on case reports (Chapter 4), many useful conversations, and fine editorial skills in earlier stages of the project. Richard Doan, Shannon Polchow, and Laura Lawrie gave excellent, detailed help in preparing the manuscript for publication. In the intellectual gestation that is needed for a project such as this, I received invitations to contribute to a variety of conferences, journals, or volumes that facilitated the development of some of the ideas that found their way into the book. Invitations from John Conley, Susan Haack, Sharon Lloyd, Michael Moore, Lee Tilson, David Shier, David Michaels, Celeste Monforton, Tom McGarity, Raphael Metzger, Wendy Wagner, and Rena Steinzor were particularly important. They provided quite helpful comments on drafts of earlier papers or on the book itself over the years. I also learned from Margaret Berger, Michael Green, Peter Graham, Paul Hoffman, Joe Sanders, Katherine Squibb, Vern Walker, Lauren Zeise, and numerous others. I had the opportunity to present much earlier versions of some of the chapters of the book (which would now be unrecognizable) to the Southern California Law and Philosophy Discussion Group. Comments by Gregory Keating, Larry Solum, Sharon Lloyd, Steve Munzer, Marshall Cohen, Aaron James, Cynthia Stark, and Chris Naticchia early on assisted the development of the ideas in the text.

I have had the good fortune to deepen my understanding of science, scientific reasoning, and aspects of the law as a result of several kinds of experiences.

Early research on risk assessment and an appointment as a Congressional Fellow in 1987, where I served at Congress's Office of Technology Assessment, provided important background. Service on California's Proposition 65 Science Panel in the early 1990s, a recent appointment to California's Electric and Magnetic Fields Science Advisory Panel (1999–2002), and membership on the University of California, Irvine's, Scholars Committee to Evaluate Perchlorate (2003–2004) gave me the opportunity to see up close numerous examples of scientific studies, scientific reasoning, interpretations of evidence, and even legitimate disagreements between well-respected scientists. I was a participant on these panels but also an observer of them. I gained much from both roles. Attendance at annual meetings of the Collegium Ramazzini and conversations with Fellows of the Collegium have kept me in touch with leading researchers and developments in cancer research. Considerable contact with members of the University of California scientific community also has been invaluable. Jerry Last, long-time director of the University of California's Toxic Substances Research and Teaching Program, should be mentioned, not so much for particular contributions to this project, but for enticing me down this path, trenchant comments along the way, and a good deal of financial and other support over the years. Raymond Neutra pointed me toward important methodological research that was ultimately quite valuable. I owe special thanks to David Eastmond, Chair of the Environmental Toxicology Program, a coauthor and collaborator. I could always call on him to provide examples or references, to make suggestions for extending the ideas, to read something I had written, and to ensure that I understood scientific points and had expressed them correctly. A joint research project with Dave funded by National Science Foundation Grant No. 99–10952 ("A Philosophic and Scientific Investigation of the Use of Scientific Evidence in Toxic Tort Law") together with grants from the University of California's Toxic Substances Research and Teaching Program greatly facilitated background research as well as work on the book itself. Intramural funds from the University of California, Riverside, assisted along the way. The writings of and many conversations with my colleague Larry Wright, a nearly career-long student of nondeductive inferences, have deepened my understanding of the forms of argument that are central to science.

Contacts with practicing lawyers and scientific witnesses and brief involvement in some litigation have provided more ground-level views of the law and some of the hurdles faced by lawyers and experts in presenting science in toxic tort cases. Many, many conversations with Joe Cecil over the years have challenged and clarified my thinking on these issues. Joe and several anonymous reviewers provided immensely valuable comments on the submitted version of the manuscript that greatly improved the final version. John Berger of Cambridge University Press has been a supportive and imaginative editor for this project. Although I have learned from many in working on this book, none of them is responsible for any errors or shortcomings in the final product. The

love and support of my family – Crystal, Chris, and Taylor – have made the task much easier (although their patience with discussions of toxicants, law, or science may be approaching a limit).

I have tried to present some of the actual and potential transformations in toxic tort law as a result of recent legal decisions and how it could better incorporate and utilize complex scientific evidence in the future to achieve its goals. I hope this helps others to think further about the issues and to better understand this part of our legal system.

1

The Veil of Science over Tort Law Policy

INTRODUCTION

A significant, unseen revolution in the tort (personal injury) law is in progress. It is hidden from the public, except for those litigating toxic tort issues and well-informed researchers. These legal changes are difficult to discern because they are veiled behind a fabric of scientific complexity and detail, as well as arcane legal procedures that are not well known and are difficult to penetrate. Yet this veil must be lifted, the scientific and legal issues understood and put into perspective in order to appreciate the policy modifications in our legal system that can substantially affect the safety of ordinary citizens, both plaintiff and defense bars, corporate behavior, and fundamental legal relationships between citizens. This revolution involves science, law, and the possibility of justice for those who have been injured by the actions or products of others. What is the relationship among science, law, and the possibility of justice that it poses a problem?

Ordinarily, science has nothing to do with justice. Science provides one of the most reliable means for investigating empirical claims and producing comparatively objective evidence about them. Scientific research has resulted in considerable accumulation of knowledge about the world,[1] in a substantial track record of predicting observable events,[2] and as a consequence in "huge advances in human understanding [of the natural world and forces in it] . . . over the ages."[3] Scientific research greatly informs our understanding of human and animal biology, our environment and the larger world around us. Moreover, certain fields of science – epidemiology, toxicology, and clinical medicine, among others – are centrally needed to inform courts of whether and to what

[1] Philip Kitcher, *The Advancement of Science: Science without Legend, Objectivity without Illusions* (New York: Oxford University Press, 1993), 1.

[2] Alvin I. Goldman, *Knowledge in a Social World* (New York: Oxford University Press, 1999), 249.

[3] Larry Wright, *Critical Thinking* (New York: Oxford University Press, 2001), 233.

extent exposure to a product might have contributed to someone's injuries. Knowledge and understanding are the dominant virtues of scientific inquiry.

Justice, by contrast, provides normative guides for assessing our institutions, our laws and our relations to one another. It assists the design of laws or institutions when it is necessary to create new ones. Justice is the "first virtue of social institutions"[4] and the preeminent virtue of the law. A central principle of justice for the law is that if one person injures another without legitimate justification or excuse, the first should "put the matter right" with the injured party.[5] Putting the matter right might "require the harm-doer to restore something to the person harmed, or to repair a damaged object, or (when the unharmed position cannot be restored, as it usually cannot be) to compensate the harm-sufferer."[6] This is a matter of corrective or rectificatory justice. Matters must be set right between the parties because "the harm-doer and harm-sufferer are to be treated as equals, neither more deserving than the other . . . one is not entitled to become relatively better off by harming the other."[7]

Personal injury or tort law is one aspect of the law that provides a forum in which those who have been wrongly injured by the actions or products of others may seek redress for their injuries. It is largely concerned with implementing corrective or rectificatory justice.

The relationship among science, law, and justice has become a pressing issue because of recent decisions by the U.S. Supreme Court in *Daubert v. Merrell Dow Pharmaceutical* and its *sequelae*, *General Electric v. Joiner* and *Kumho Tire v. Carmichael*.[8] A variety of considerations probably moved the Court to rule on the issues in these cases, most of which I do not mention. However, among other things it sought to ensure that legal cases were not based on grossly mistaken science and that legal decisions better comported with the science needed in the cases at the bar.[9] The particular mechanism it used to ensure

4 John Rawls, *A Theory of Justice* (Cambridge, MA: The Belknap Press of Harvard University Press, 1971), 3.

5 Tony Honoré, "The Morality of Tort Law – Questions and Answers," in *Philosophical Foundations of Tort Law*, ed. David G. Owen (Oxford: Clarendon Press, 1995), 79.

6 Honoré, "The Morality of Tort Law," 79.

7 Honoré, "The Morality of Tort Law," 79.

8 *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993); *General Elec. Co. v. Joiner*, 522 U.S. 136 (1997); *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999).

9 Justice Stephen Breyer, "Introduction," *Federal Reference Manual on Scientific Evidence*, 2nd ed. (Washington, DC: Federal Judicial Center, 2000), 3–4. Other motivations included how to handle different types of evidence in toxic tort litigation, a concern that too much "junk science" entered the courtroom, a desire to foster case-processing efficiency and economy. Perhaps they were even interested in changing the balance between plaintiffs and defendants (toward defendants) and shifting decision-making power from judges to juries. See Margaret A. Berger, "Upsetting the Balance Between Interests: The Impact of Supreme Court's Trilogy on Expert Testimony in Toxic Tort Litigation," *Law and Contemporary Problems* 64 (Summer 2001): 289–326, as well as Michael H. Gottesman, "From *Barefoot* to *Daubert* to *Joiner*: Triple Play or Double Error," *Arizona Law Review* 40 (1998): 753–780, for discussions of these points.

this was to impose on judges a heightened duty to review scientific testimony and its foundation before experts could testify in a trial (this is a review of the "admissibility" of evidence). These Supreme Court decisions have wide application, but two of them concerned toxic torts, or claims for personal injuries in which the plaintiffs alleged that toxic substances had harmed them. Moreover, adjudication of toxic torts centrally needs science to ensure justice between parties. Toxic torts, thus, are the focus of this book.

Concerns about the possibility of justice for wrongfully injured parties have developed as a result of the Supreme Court decisions and how courts have subsequently reviewed scientific testimony and its foundation. Judges have probably increased their scientific sophistication as a result of the trilogy of cases.[10] They may have further to go, however. If courts do not review scientific testimony and its foundation sufficiently well, they risk denying one of the parties at the bar the possibility of justice. Plaintiffs are the litigants at greatest risk, because they have the initial burden to produce evidence. However, even if courts review evidence well, the fact and perception of greater judicial scrutiny increases litigation costs and attorney screening of clients. These, too, decrease citizen access to the law and decrease the possibility of justice for those injured by toxic substances. Together these can threaten the legitimacy of torts as an institution committed to correcting wrongs inflicted on citizens.

As citizens we cannot "see," that is, understand, the institution and the subtle changes that are occurring without appreciating some of the details of science, law, and the science-law interaction. The subjects addressed in this book arise from the fact that we live in a scientific and technological society, but we have not yet fully developed sufficient institutional expertise, norms and procedures to ensure that science and the law will function well together and to give injured parties the realistic possibility of justice.

Aspects of our collective scientific understanding have resulted in products that are among the benefits of an advanced technological society. These include not only the products of an earlier period of industrialization but also the products of the chemical revolution that was born in the nineteenth century and grew to maturity following World War II. There is also the promise of social benefits from more recent developments that have yet to fully to mature in DNA and biotechnological research, as well as nanotechnology, the science and engineering of the vanishingly small.

However, the same products that provide benefits may also carry risks of harm themselves or in their manufacture, by-products, use or disposal. In some instances the products, the processes by which they are produced, their disposal, or other of their unanticipated features result in actual harm to those who are exposed to them. The law is the main institution that aims to provide protections from risks and any harms that might result if the risks materialize.

10 Berger, "Upsetting the Balance Between Interests," 300, note 71.

Some legal institutions have the responsibility to try to prevent such harms from occurring in the first place – typically these are the *regulatory* or *administrative* institutions. Some administrative agencies, such as the Food and Drug Administration (FDA) or parts of the Environmental Protection Agency (EPA), have legal authority to screen some products or substances, for example, drugs, new food additives, cosmetics (under the FDA), or pesticides (under the EPA) *before* they enter commerce and there is substantial human exposure. Laws authorizing such interventions are so-called premarket laws. Premarket screening laws impose legally mandated testing, agency review, and some level of demonstrated safety before the products are permitted to enter commerce. Other agencies, such as the Occupational Safety and Health Administration (OSHA), the Consumer Product Safety Commission (CPSC), and parts of the FDA and EPA, operate under laws that authorize them to identify the risks of harm *after* the products are in commerce, but *in theory* might authorize the use of surrogate means to identify the risks before they materialize into actual human health and environmental harm (although this may not be carried out well in practice). These are so-called postmarket laws.

If these laws *function well*, risks to persons will largely be prevented in the first place under premarket laws or they will be identified and then reduced or eliminated under postmarket laws before they cause (too much?) harm. However, such laws in themselves or as administered too often do not catch the risks before harm occurs to the public, the workforce, or the environment. And, of course, any accidents that cause harms should be redressed as a matter of corrective justice.

If firms, regulatory agencies, and others miss toxic substances or otherwise fail to protect citizens from harm, the tort law offers the possibility of corrective justice, of post-facto setting right the matter of a victim's injuries. That is, the tort law in principle aims to provide post-injury compensation sufficient to restore the injured person to the condition he or she would have been in had the injury not occurred in the first place (this, of course, is an ideal that in many cases cannot be realized). In addition, the threat of tort suits for harmful behavior or products aims to provide deterrence, some motivation for those whose activities or substances pose risks to others to modify their behavior and products to reduce the risks.[11] Torts, thus, could serve as a kind of backup to other institutions, if it functioned well.

Postinjury compensation (or punishment in the criminal law) is a distant second to avoiding injuries in the first place; "An ounce of prevention is worth a pound of cure," for the victim, his or her family, and typically for society as a whole.

[11] In quite extreme cases, even the criminal law may be utilized to try to deter firms from acting in ways likely to injury and may be utilized to punish those who deliberately or recklessly cause harm. See, for example, *People v. O'Neill, Film Recovery Systems, et al.*, 550 N.E. 2d 1090 (1990).

At its best, the tort law has probably functioned imperfectly. Indeed, a number of researchers have pointed out that in order for torts to serve the aims of justice and deterrence better there should be much more claiming on behalf of injured parties than typically occurs.[12] How federal and state courts review the use of expert testimony and its scientific foundation in the aftermath of these decisions profoundly affects the possibility of justice for citizens injured without legitimate excuse or justification. I will argue that the Supreme Court decisions concerning the review of scientific testimony and its foundation have further hampered the functioning of torts.

It is difficult to overestimate the social and legal importance of *Daubert*, its progeny, and their implementation by lower courts, which pose substantial philosophic and social issues. For example, following this decision the percentage of cases ending in summary judgments before trial more than doubled with 90 percent of them going against plaintiffs.[13] The Federal Judicial Center surveyed federal judges and attorneys about expert testimony in 1991 and 1998. Although in 1991 75 percent of the judges reported admitting all proffered expert testimony, by 1998 59 percent indicated that they admitted all proffered expert testimony without limitation.[14] Significantly, what little research has been done suggests that when trial courts have excluded scientific experts and litigants appealed, federal appellate courts decided more cases against plaintiffs than against defendants. Appellate courts also tend to rule more against plaintiffs than did the trial courts of origin.[15]

Some courts' *implementation* of *Daubert* and its progeny have erected unreasonably high or scientifically mistaken barriers for admitting expert testimony based on scientific evidence into tort trials. Scientific evidence and reasoning appear to be more complex than judges were prepared for when the Supreme Court enhanced their responsibilities. Such decisions result in a factually inaccurate basis on which to base further legal proceedings and, thus may deny the victims of toxic exposures the possibility of a public trial for their claims of wrongfully inflicted injuries and the possibility of justice. More rarely, they can deny defendants a reasonable defense.[16] In many cases, courts are setting

[12] Michael J. Saks, "Do We Really Know Anything about the Behavior of the Tort Litigation System – and Why Not?" *Pennsylvania Law Review* 140 (1992): 1183–1190, 1284–1286; Clayton P. Gillette and James E. Krier, "Risk, Courts and Agencies," *University of Pennsylvania Law Review*, 38 (1999): 1077–1109.

[13] L. Dixon and B. Gill, *Changes in the Standards for Admitting Expert Evidence in Federal Civil Cases Since the Daubert Decision* (Santa Monica, CA: RAND Institute for Civil Justice, 2002).

[14] Molly Treadway Johnson, Carol Krafka, and Joe S. Cecil, *Expert Testimony in Federal Civil Trials: A Preliminary Analysis* (Federal Judicial Center ed., 2000).

[15] Kevin M. Clermont and Theodore Eisenberg, "Anti-Plaintiff Bias in the Federal Appellate Courts," *Judicature* 84 (2000): 128. (New research "reveals an unlevel appellate playing field: defendants succeed significantly more often than plaintiffs on appeal from civil trials – especially from jury trials" (128).)

[16] Recently, the City of Chicago was required to compensate a man for brain-stem injuries following an encounter with the police. The city was unable to mount a defense based on an

substantive policies in tort law but disguising it behind a veil of scientific rulings. How courts conduct evidentiary reviews also may threaten the constitutional right to a jury trial, if a trial judge overreaches his or her authority to review the scientific foundation of expert evidence and mistakenly keeps a plaintiff from receiving a jury trial.[17] Poor implementation of *Daubert* and its progeny will also decrease plaintiffs' access to the legal system, because of courts' dismissal of cases or attorneys' screening out all but the most winnable of cases.[18] As a result, there will be fewer settlements and fewer successful trials for deserving plaintiffs, further weakening any tort law deterrence to those who create use and distribute toxic products.[19] Poor implementation of *Daubert* may tempt firms to be less responsible than they might otherwise be in testing their products or to hide the results of studies showing adverse effects, lead to more toxic substances entering commerce, and drive good scientists from participating in the legal system, a task they are reluctant to undertake in any case. Of course, if courts admit too many experts who testify beyond the evidence or their expertise or, worse, are dishonest, this can lead to overdeterrence and keep beneficial products from the market or increase their costs. At a minimum, then, it is important for courts to be quite accurate in reviewing expert testimony in order to serve both sides of the bar and justice in torts.

However, even if judicial admissibility decisions were *implemented well* within the *Daubert* framework, there remains a concern about whether this would be adequate. Heightened judicial screening of scientific experts increases the pre-trial costs and procedural hurdles of bringing a case. This almost

alternative theory of injury because its expert's theory was judged "too speculative" and the expert was not admitted for trial. (Margaret Cronin Fisk, "Chicago Hope: A $28M Verdict," *National Law Journal*, 10 Nov. 1999, A10.)

17 Raphael Metzger, "The Demise Of *Daubert* In State Courts," Commentary for Lexis Nexis MEALEY'S Emerging Toxic Torts 14 (5) (June 3, 2005): located at http://www.mealeys.com. Some state and federal courts also have expressed such views: *Howerton v. Arai Helmet, Ltd.* (2004) 348 N.C. 440, 697 S.E.2d 674, 692 (Under the authority of *Daubert* courts "may unnecessarily encroach upon the constitutionally mandated function of the jury to decide issues of fact and to assess the weight of the evidence."); *Brasher v. Sandoz Pharmaceuticals Corp.* (N.D. Ala. 2001) 160 F. Supp. 2d 1291, 1295 (applying *Daubert*, but noting that "[f]or the trial court to overreach in the gatekeeping function and determine whether the opinion evidence is correct or worthy of credence is to usurp the jury's right to decide the facts of the case"); *Logerquist v. McVey*, 196 Ariz. 470, 488, 1 P.3d 113, 131 (2000) ("The Daubert/Joiner/Kumho trilogy of cases . . . puts the judge in the position of passing on the weight or credibility of the expert's testimony, something we believe crosses the line between the legal task of ruling on the foundation and relevance of evidence and the jury's function of whom to believe and why, whose testimony to accept, and on what basis."); *Bunting v. Jamieson*, 984 P.2d 467, 472 (Wyo. 1999) (adopting *Daubert*, but nonetheless expressing concern that "application of the Daubert approach to exclude evidence has been criticized as a misappropriation of the jury's responsibilities. . . . '[I]t is imperative that the jury retain its fact-finding function.' ").

18 Gillette and Krier, "Risk, Courts and Agencies," 1077–1109.

19 Carl F. Cranor, "Scientific Reasoning in the Laboratory and the Law," *American Journal of Public Health, Supplement* 95:S1 (2004): S121–S128.

certainly reduces plaintiffs' *realistic* access to the law because of greater attorney and expert screening of the merit of victims' cases. Without access injured parties are denied the possibility of justice. It also is likely to exacerbate existing perverse incentives for defendants not to test and not to monitor their products. Finally, it does not adequately address more fundamental science-law problems. Within existing legal structures, there is insufficient legal concern with the safety of products before they enter commerce. There is too little legally required testing of products prior to commercialization and significant human exposure. Thus, too many products and substances enter commerce without adequate scientific understanding of their properties and consequences. Once products are in commerce there also appears to be too little monitoring of products for adverse effects. In addition, in the tort law, legally the burden of proof is on injured parties to show that the substances caused their harm, not an easy task. Moreover, scientific efforts to show such harm are hindered by the kinds of risks and harms involved, by human studies that too frequently fail to detect real adverse effects, by scientific procedures, and by the need to identify risks and harms on the frontiers of scientific disciplines. In many instances, the public and workforce, as well as the environment, become guinea pigs for determining which substances are harmful and which not.

Understanding these issues necessitates some understanding of details of two complex "institutions": science and the law. One must understand their procedures and practices, as well as how they can interact to produce such unfortunate outcomes and how they could interact better in order to provide reasonable protections against the risks and harms that can arise from the products of a modern technological society.

I sketch these issues and then develop them in the remainder of the book.

THE LEGAL ADMISSIBILITY OF EXPERT TESTIMONY AND SCIENTIFIC EVIDENCE

In establishing a legal case for compensating an injured party, the plaintiff must show that a defendant, who the plaintiff believed harmed her, had a legal duty to prevent harm, defendant breached that legal duty, plaintiff suffered a legally compensable injury, and defendant's action was the factual and legal cause of the injury in question. In many cases, the requisite legal action is in products liability, typically a strict liability body of law (in which defendant's negligence or carelessness need not be shown). However, it is critical that plaintiffs show that defendant's action or products *caused* or *contributed* to plaintiffs' injuries. In federal toxic tort cases, plaintiffs typically must establish that a defendant's substance "can cause" the adverse effect in question (so-called general causation) as well as that defendant's action or product "did cause" plaintiff's injury (so-called specific causation). Litigants seek to show such claims by means

of scientific evidence and expert testimony, with experts testifying about what scientific studies show concerning alleged causal connections. However, for scientific experts to perform this function, they must be permitted to testify at trial; in legal argot, they must be "admitted" to give that testimony.

Before 1993, introducing scientific evidence and having experts admitted tended not to be overly difficult. If a litigant had well-qualified experts whose testimony was *relevant* to the scientific and technological issues, would assist a jury in understanding them, and was based on studies "generally accepted in the relevant scientific community," judges tended to admit them and let cross-examination during trial determine whose experts the jury believed.[20]

Since the 1993 *Daubert* decision, judges have conducted much more searching reviews of expert testimony and its foundation before trials commence. After initial complaint(s) and answer(s) have initiated a legal case, and after discovery (including depositions of the parties and experts involved), during *pretrial* hearings a judge hears from both parties and reviews whether the experts will be permitted to testify before a jury. If an expert critical to a litigant's case is not admitted, the litigant (typically the plaintiff) may be unable to establish factual premises needed for causation, in which case the judge would dismiss the attempted legal action because there would be no factual issue for the jury to decide.[21] (All of these issues are developed in more detail in Chapter 2.)

Thus, "preliminary" reviews of experts can result in dismissal of the case without a trial. Consequently, *how* and *how well* judges conduct their preliminary review of experts can determine the outcome of a legal action, affect the possibility of justice between parties and strongly influence wider social effects of the tort law.

The Need for Scientific Studies

The same scientific institutions, some of whose results have led to beneficial technological products, have developed investigative procedures, standards of proof, and research methods designed to produce comparatively objective knowledge that will stand the test of time. These are important features of the scientific enterprise and part of what provides its honorific standing among empirical inquiries. A subset of the health and biological sciences assists in identifying risks and harms to persons on which parties to litigation must rely

[20] David L. Faigman, David H. Kaye, Michael J. Saks, and Joseph Sanders, *Modern Scientific Evidence: The Law and Science of Expert Testimony* (St. Paul, MN: West Publishing Co., 2002), 7–8; Michael Gottesman, Georgetown Law Center, presentation at "Science, the Courts, and Protective Justice," February 27, 2003, sponsored by the Science and Environmental Health Network and Georgetown Environmental Law and Policy Institute.

[21] Fleming James, Jr. and Geoffrey C. Hazard, Jr., *Civil Procedure*, 2d ed. (Boston: Little, Brown and Company, 1977), 149. (Defendant is entitled to judgment as a matter of law, when there is no genuine issue of fact between the litigants.)

to argue for or defend against claims that a product has harmed someone. These include, *inter alia*, epidemiology, toxicology, genetic studies, and clinical medicine. Science is known for controlled studies (or studies which sufficiently mimic controlled studies) in which a variable in question is identified and studied in isolation from other effects to see if it makes a causal contribution to an effect. Ideally, such studies would involve large numbers of experimental and control subjects. Researchers seek to ensure that any results are not merely the result of accidental relationships but are appropriate representatives of more general features of substances and the affected population. Moreover, scientists take care to ensure that results are not mere artifacts of the studies themselves.

The careful design of studies, winnowing of data, and presentation of results that are the hallmark of scientific research transposed into the context of the tort law, perhaps surprisingly, can pose problems. There must be information available for study. There must be funding in order for studies to be conducted. Scientists must design sufficiently sensitive studies and have sufficient time to conduct them properly to detect the risk or harm in question. Procedures internal to science may slow the discovery of harm. Any scientific results to be utilized in a court case must be pertinent to the legal issues involved (but usually they are not designed for such purposes). There must be effective communication between scientists and judges, but conventions of science hinder this.

The preceding comments are merely an *abstract* statement of some of the problems concerning scientific studies needed for the tort law, but the practical use of them for a particular legal issue is often not straightforward; these conditions are not always easy to satisfy. Courts and many commentators may have underestimated these problems in toxic tort cases (issues I take up in Chapters 5 and 6).

Special Features of Toxic Substances

Properties of toxic substances exacerbate some of these problems, as well as stressing and straining the law. In order to show that exposure to toxic substances caused or contributed to human harm substantial, time-consuming, often long-term scientific studies are needed. Human epidemiological studies are among the best kinds of evidence of human harm from toxic exposure. However, these often have not been conducted on a substance or product at issue in a tort case. It is difficult to identify who has been exposed and how much exposure they received. The studies can be expensive to conduct. More seriously, judges and the larger public may not appreciate how insensitive they can be (that is, they do not detect comparatively rare diseases or subtle effects at all well). Regrettably, too frequently they cannot detect an adverse effect, even if it is present.

Scientists very often utilize studies in experimental animals, usually rats or mice, to provide evidence that substances cause or contribute to human

harm. Although there is some disagreement about animal studies, most scientists, and especially toxicologists, view animal studies as quite good evidence for identifying toxicants and their adverse effects. The main reason is that the pathological development of tumors in other mammals is believed to resemble that in humans. Molecular, cellular, tissue and organ functions are believed to be similar between different species of mammals, including rodents and humans.[22] This is a feature of the "vertical integrity" of organisms.[23] Moreover, animal studies tend to have some advantages over human studies, as few epidemiological studies have been done and it is wrong deliberately to expose humans to toxicants to test for adverse effects.[24] However, animal studies are time-consuming and costly to conduct, taking at a minimum five years and costing $2 million to $5 million dollars.[25] In addition, often because of the rareness of disease effects, it is difficult to determine adverse effects at exposures to which humans are subject (exposures in animal research tend to be higher than human exposures to create studies sufficiently sensitive to detect diseases). As a result, extrapolation from adverse effects in animals to adverse effects in humans provides an opening for criticisms of them. Because of properties of toxicants, subtleties of their effects, and often rareness of diseases, there are enough needed scientific inferences to invite critiques. Animal studies (and other kinds of toxicological evidence) that can point to human harms are often denigrated and dismissed, although these kinds of evidence are better than many federal judges have said they are and usually much better than defendants will admit in court.

Any difficulties utilizing the different kinds of evidence for inferring causal relationships in the law are exacerbated by several specific features of typical biochemical risks that pose scientific difficulties. These problems in turn can

22 D. P. Rall, M. D. Hogan, J. E. Huff, B. A. Schwetz, and R. W. Tennant, "Alternatives to Using Human Experience in Assessing Health Risks," *Annual Review of Public Health* 8 (1987): 355, 362–363 (noting that biological processes are quite similar from one species to another); James Huff and David P. Rall, "Relevance to Humans of Carcinogenesis Results from Laboratory Animal Toxicology Studies," in *Maxcy-Rosenau-Last Public Health & Preventive Medicine*, 12th ed., ed. John M. Last and Robert B. Wallace (Norwalk, CT: Appleton & Lange, 1992), 433, 439 (noting that significant scientific understanding of neural transmission, renal function, and cell replication and development of cancer have come from non-human species, often species far removed phylogenetically from humans [434]). James Huff makes somewhat stronger claims in "Chemicals and Cancer in Humans: First Evidence in Experimental Animals," *Environmental Health Perspectives* 100 (1993): 201, 204 (stating that the array and multiplicity of carcinogenic processes are virtually common among mammals, for instance between laboratory rodents and humans).

23 Ellen K. Silbergeld, "The Role of Toxicology in Causation: A Scientific Perspective," *Courts, Health Science and the Law*, 1, 3 (1991): 374.

24 Rall et al., "Alternatives to Using Human Experience in Assessing Health Risks," 362–63 (noting that for most chemicals, particularly environmental and occupational chemicals, epidemiologic data are insufficient to confirm the absence or presence of significant risk).

25 Jerold Last, Director, University of California Toxic Substances Research and Teaching Program, personal communication, 18 Apr. 2004.

be exacerbated by the practices of scientific inquiry. The end result can stress and strain the legal system.

Carcinogens, reproductive toxicants, and neurotoxicants are invisible, undetectable intruders that can have long latency periods (e.g., from a few months to more than forty years for cancer[26]), rarely leave signature diseases, 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. The results can be catastrophic for affected individuals.[27] Understanding the properties of such substances and assessing any risks they pose, requires even more subtle scientific expertise and studies than for other areas of inquiry. And they usually must be conducted on the frontiers of existing scientific knowledge.[28]

The problems posed by the properties of molecular invaders are exacerbated by the effort, difficulties, costs, and time it takes to establish toxicity effects. Scientific studies for determining risks and harms can be comparatively insensitive (human epidemiological studies), not fully understood (animal studies used for inferring toxicity effects on humans), in their infancy (some short-term tests that hold some promise), or yet to be developed (molecular or DNA techniques that might aid etiological investigations).[29] Often researchers must assemble various kinds of evidence, most of which taken individually will not be decisive by itself, in order to identify a substance as toxic to humans. This can be subtle, arcane work, and some courts appear to have struggled to assess it.

These problems are aggravated in the circumstances of most toxic tort suits. Plaintiffs, needing to show that a substance causally contributed to a disease, often start at a substantial disadvantage for two reasons: first, in general little is known about the properties of potentially toxic substances, and, second, the tort law is in effect a post-market response to toxic injury. Consider these in turn.

There are about 100,000 chemical substances or their derivatives and metabolites registered for use in commerce. About one-third likely result in little exposure and another 23 percent are polymers, thus probably presenting only minimal risks (because they are large molecules).[30] Nonetheless, there remains substantial ignorance about this universe. The National Research Council in 1984 found that for the vast majority of substances there was no toxicity data

26 Carl F. Cranor and David A. Eastmond, "Scientific Ignorance and Reliable Patterns of Evidence in Toxic Tort Causation: Is There a Need for Liability Reform?" *Law and Contemporary Problems* 64 (2001): 6, 12–13.

27 Carl F. Cranor, *Regulating Toxic Substances* (New York: Oxford University Press, 1993), 3–5.

28 Cranor, *Regulating*, 12–48.

29 Cranor, *Regulating*, 12–48.

30 James Huff and David Hoel, "Perspective and Overview of the Concepts and Value of Hazard Identification as the Initial Phase of Risk Assessment for Cancer and Human Health," *Scandinavian Journal of Work Environment and Health* 18 (1992): 83–89.

in the public record.[31] In the early 1990s there was insufficient change in the data to justify updating the National Academy Report.[32] For the three thousand substances produced in the *highest volume*, there remained substantial knowledge-gaps for about 75 percent of them as recently as 1998 (only 7 percent had complete toxicity information) when the U.S. EPA entered into a voluntary agreement with the producers to close these gaps.[33] There were another one to twelve thousand high-production-volume substances for which extensive toxicological information would be quite important but that was not available.[34]

Thus, in general, the probability is that for any given substance little is likely to be known about it. Consequently, someone who alleges that they have been harmed by exposure to the substance must find experts who have studied or are aware of studies about such substances, but pertinent research may not have been done.

Secondly, the postmarket context of the tort law poses several issues. The law imposes the burden of proof on the plaintiff seeking to rectify the injuries from which she suffers. The plaintiff has the burden to produce enough evidence to justify a legal trial and the burden to persuade a jury that she more likely than not has been harmed by exposure to the substance. Equally or more important, however, plaintiff's experts may have to overcome implicit scientific burdens and standards of proof to establish that the substance in question can cause the harm that plaintiff suffered (scientific standards of proof tend to be much higher than legal standards of proof). This can be especially difficult for harms caused by molecules.

Moreover, plaintiffs are in a poor position to ferret out the evidence to toxicity and present it. The firms creating and using such substances are in a much better position to develop and investigate the properties of such substances. However, as the above generic data suggest, companies appear not to have done a good job of understanding and providing public information about the toxicity of their own products.[35] Thus, plaintiffs are substantially disadvantaged

31 National Research Council, *Toxicity Testing: Strategies to Determine Needs and Priorities* (Washington, DC: U.S. Government Printing Office, 1984), 84.

32 John C. Bailor, University of Chicago, and Eula Bingham, University of Cincinnati, members of the 1984 NRC Committee, personal communications at Collegium Ramazzini, Bologna, Italy, 2002.

33 "EPA, EDF, CMA Agree on Testing Program Targeting 2,800 Chemicals," *Environmental Health Newsletter* (Business Publishers, Silver Spring, MD), 37 (Oct. 1998): 193; Elaine M. Faustman and Gilbert S. Omenn, "Risk Assessment," in *Casarett and Doull's Toxicology*, 6th ed., ed. Curtis D. Klaassen (New York: McGraw-Hill, 2001), 85–86.

34 U.S. Congress, Office of Technology Assessment, *Screening and Testing Chemicals in Commerce* (Washington, DC: U.S. Government Printing Office, 1995), 3.

35 See Cranor and Eastmond, "Scientific Ignorance," 14; Margaret A. Berger, "Eliminating General Causation: Notes Towards a New Theory of Justice and Toxic Torts," *Columbia Law Review* 97 (1997): 2135; Gerald Markowitz and David Rosner, *Deceit and Deception: The Deadly Politics of Industrial Pollution* (Berkeley: University of California Press, 2002);

as a result of factors beyond their control and often because of the failures of others.

In addition, with the exception of some products subject to pre-market testing, such as drugs, food additives and pesticides, most substances and products enter the marketplace without any *legally required* toxicity testing.[36] This almost ensures there will be poor data on the substance or product, about which plaintiffs then have the legal and scientific burdens to find and produce evidence. Because the regulation of suspect substances that enter the market without legally required testing will occur only if a governmental agency bears a burden of proof to show a *risk of harm* and a tort action will proceed only if a plaintiff shows *actual harm*, firms have incentives to resist testing their products and monitoring them for adverse effects and often they have not. (Governmental entities also have not always been forthcoming.[37])

The legal and scientific burdens and standards of proof in postmarket contexts can be exacerbated by inferential practices within science. In research for its own sake there is a standing temptation to do more research, gather more data, deepen understanding, and adopt standards of proof to ensure conclusions with greater certainty. If these are inappropriately or deliberately adopted by judges in reviewing expert testimony and scientific evidence, or exploited by those defending substances, this greatly increases already substantial barriers to tort law access and admissibility of experts.

INJURIES MAY LONG PRECEDE THE SCIENTIFIC UNDERSTANDING OF THE CAUSES OF INJURY

Ignorance about substances, corporate failure in assessing the toxicity of their products, some features of substances, and problems in establishing toxicity

Ricardo Alonso-Zaldivar & Davan Maharaj, "Tests Show Firestone 'Had to Know,' Probers Say," *Los Angeles Times*, 21 Sept. 2000, C1; "Safety: Congress Cites New Evidence Against Tire Maker as Sentiment Swings in Favor of Criminal Penalties in Such Cases," *Los Angeles Times*, 21 Sept. 2000, C1; Richard A. Oppel, Jr., "Environmental Tests 'Falsified,' U.S. Says," *New York Times*, 22 Sept. 2000, A14; Melody Petersen, "Settlement Is Approved in Diet Drug Case," *New York Times*, 29 Aug. 2000, C2; David Willman, "The Rise and Fall of the Killer Drug Rezulin; People Were Dying as Specialists Waged War Against Their FDA Superiors," *Los Angeles Times*, 4 June 2000, A1; David Willman, "Risk Was Known as FDA Ok'd Fatal Drug," *Los Angeles Times*, 11 March 2001, A1; and *In re: Phenylpropanolamine (PPA) Products Liability Litigation*, 289 F. Supp. 2d 1230 (2003) (W.D. Washington).

36 U.S. Congress, Office of Technology Assessment, *Identifying and Regulating Carcinogens* (Washington, DC: U.S. Government Printing Office, 1987), 126–127.

37 See, e.g., Gayle Greene, *The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation* (Ann Arbor: University of Michigan Press, 1999) and Matthew L. Wald, "U.S. Acknowledges Radiation Killed Weapons, Workers," *New York Times*, 29 Jan. 2000, A1. The production of rocket fuel caused contamination in some of the nation's groundwater with perchlorate and other known toxicants (*In re: Redlands Tort Litigation* (2001), referenced in *Lockheed Martin Co. v. Superior Court*, 109 Cal. App.4th 24 (2003)).

effects together suggest that for any randomly selected substance it is unlikely that scientists will understand its toxicity properties well. Simply conducting the studies and accumulating the missing scientific information can be quite slow. As a consequence *injuries* from a substance might easily precede scientific understanding and documentation of that fact, and they might precede it by years, sometimes decades. Tort law compensation is retrospective. This poses a substantial problem: the possibility of justice for injured parties cannot be attained until there is sufficient legally recognized scientific evidence that exposure to a substance causes or contributes to disease. The comparatively sparse health and safety data about the vast majority of substances in the chemical universe substantially burdens the tort law in its aims of justice and deterrence.

However, there is a much deeper and more intractable issue: in many cases, it can take years to have clues that substances cause harm, and even longer to document the cause of damage. Whether scientists will ever have a full understanding of the toxicity of a given substance is an even more open issue (if they ever do). Consider benzene, an important industrial product and by now a well-known human carcinogen. Benzene was implicated in the 1890s of causing various blood diseases.[38] In the 1920s, it was reported to cause leukemia. By 1939 a number of investigators recommended substituting other products for benzene because of its known toxicity. In 1948 even the American Petroleum Institute "concluded that the only safe level from exposure to benzene was zero."[39] However, substantial regulation of benzene did not come for another sixty years. In 1974 the World Health Organization's International Agency for Research on Cancer, shortly after it was established in 1970, noted that it could only indicate that a relationship between benzene exposure and the development of leukemia was "suggested" by case reports and one case-control epidemiological study.[40] By 1982 the same organization judged that there was sufficient evidence that benzene was carcinogenic to man,[41] and by 1987 it found that benzene "*is* carcinogenic to man."[42] Surely people were

[38] R. Snyder, "The Benzene Problem in Perspective," *Fundamental and Applied Toxicology* 4 (1984): 692–699; H.G.S. van Raalte and P. Grasso, "Hematological, Myelotoxic, Clastogenic, Carcinogenic, and Leukemogenic Effects of Benzene," *Regulatory Toxicology and Pharmacology* 2 (1982): 153–176; *Casarett and Doull's Toxicology*, 4th ed., ed. Mary O. Amdur, John Doull, and Curtis D. Klaassen (New York: Pergamon Press, 1991), 686.

[39] European Environmental Agency, *Late Lessons from Early Warnings: The Precautionary Principle 1896–2000, Environmental Issue Report no.* 22 (Luxembourg: Office for Official Publication of the European Communities, 2001), 38–51, esp. 39.

[40] International Agency for Research on Cancer, "Benzene," *Monographs on the Evaluation of Carcinogenic Risks to Humans* 7 (1974): 203. Rev. 19 March 1998. Available: http://www-cie.iarc.fr/htdocs/monographs/vol07/benzene.html.

[41] *International Agency for Research on Cancer* 29 (1982): 93. Available: http//www-cie.iarc.fr/htdocs/monographs/htdocs/Vol29/Benzene.html.

[42] International Agency for Research on Cancer, "Benzene," *Monographs, Supplement 7* (1987): 120. Rev. 6 Feb. 1998. Available: http://www-cie.iarc.fr/htdocs/monographs/suppl7/benzene.html (visited November 19, 2000) (emphasis added).

contracting leukemia long before 1982 or 1987, and probably at higher rates than were seen in the 1970s and 1980s. However, until the last two decades there would have been limited scientific consensus on it. Thus, there would have been no compensation for anyone who contracted leukemia from benzene exposure until there was "appropriate" documentation of the injuries in question.[43]

Benzene is not an isolated case; similar problems have attended the scientific discovery of the adverse health effects of arsenic, dioxin, lead, asbestos, benzidine, and betanaphthalamine dyes and other substances.[44] (Often, the failure of the scientific community to understand the toxicity of substances is not accidental – firms who control much of the information have been known to stonewall for years or decades.[45])

The future might not be quite as bad as the past in this regard: scientists and the general public are more aware now than they were in the past that products can be toxic; there are now better scientific procedures available for identifying toxicants; and there are more scientists performing such studies. However, one should not be a Pollyanna on this issue, because, although there is little systematic evidence, benzene may be more representative than a substance such as Bendectin, which occasioned the Supreme Court's change in how scientific evidence in the tort law is treated. For Bendectin there was a relatively quick scientific evaluation of some of its effects, because alleged birth defects (shortened limbs) would appear at birth and there were good hospital and pharmaceutical records that facilitated the identification and quantification of exposure to Bendectin. Such good evidence is quite rare and different from most substances – those with long latency periods, subtle adverse effects, or for which human evidence is not readily available.[46] Thus, slow knowledge accumulation poses a serious barrier to the production of information needed

[43] For example, Marvin Sakol, a hematologist testified during the OSHA hearings on benzene that for one leukemia patient with an occupational history of benzene exposure the discharge diagnosis was changed from leukemia to aplastic anemia so his "widow would receive $10,000 in industrial compensation." "Occupational Exposure to Benzene; Proposed Rule and Notice Hearing," *Federal Register* 50, no. 239 (10 Dec. 1985), 50518–19.

[44] See, for example, Robert A. Goyer and Thomas W. Clarkson, "Toxic Effects of Metals," in *Casarett and Doull's Toxicology*, 6th ed., 818–821 (arsenic); Paul Brodeur, *Outrageous Misconduct* (New York: Pantheon Books, 1985) (asbestos); and David Michaels, "Waiting For The Body Count: Corporate Decision Making and Bladder Cancer in the U.S. Dye Industry," *Medical Anthropology Quarterly* 2 (1988): 215, 218–221 (on benzidine and betanaphthalamine dyes).

[45] Markowitz and Rosner, *Deceit and Deception* (lead and vinyl chloride); Paul Brodeur, *Outrageous Misconduct* (asbestos).

[46] W. J. Nicholson, "IARC Evaluations in the Light of Limitations of Human Epidemiologic Data," *Annals of the New York Academy of Sciences* 534 (1988): 44–54 (showing for about 18 substances, exposure conditions or processes that are carcinogenic (and that have quite high relative risks), there has been evidence of their human carcinogenicity for many decades, but action on them occurred only recently).