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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.