Law's Knowledge: Science for Justice in Legal Settings

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Legal developments following *Daubert v Merrell Dow Pharmaceuticals, Inc* indicate a growing need to reevaluate the decision's fundamental assumptions about law, science, and their interactions.

I argue that in *Daubert* and two successor cases, the Supreme Court misconceived both the nature of scientific practice and its links to legal fact-finding. The decisions endorsed a separatist model of law and science, presupposing a sharper boundary between the institutions than exists or should exist.

A better approach is to recognize that law and science are both knowledge-generating institutions, but that fact-making serves different functions in these two settings. The important question for the law is not how judges can best do justice to science, but rather how courts can better render justice under conditions of uncertainty and ignorance. (*Am J Public Health.* 2005;95:S49–S58. doi:10.2105/AJPH.2004.045732)

Law and science are two of the most important sources of authority for modern governments. Perhaps nowhere is this statement more transparently true than in the United States, where law often completes the work of politics and public affairs, and science as frequently underwrites the rationality of public decisions. As relatively apolitical institutions, law and science are powerful generators of trust. The findings of both are expected to be impartial, disinterested, valid without regard to the immediate context of production, and true insofar as participants in either institution are able to gauge the truth.[1] Social order in democratic nations depends on both institutions living up to this ethos, or at least strenuously attempting to do so. Together, law and science have underwritten a time-honored approach to securing legitimacy in public decisions. If their interactions are governed by flawed principles, then the capacity of either to control the arbitrariness of power is greatly weakened.

Complicating the picture is the fact that the interests of law and science—though often congruent—are neither entirely nor inevitably so. Nowhere in the western world have the conflicts between these institutions been so dramatically exposed nor so hotly debated as in the United States.[2] The 1990s witnessed a marked increase in the salience of these controversies. In 1993, in *Daubert v Merrell Dow Pharmaceuticals, Inc*,[3] the Supreme Court ruled for the first time on the admissibility of scientific evidence. Two more decisions quickly followed: *General Electric Co v Joiner*,[4] on the standard of review for admissibility decisions, and *Kumho Tire Co v Carmichael*,[5] on the admissibility standard for non-scientific technical evidence. By 1999, when *Kumho* was decided, the Court had employed its substantial authority as much to rework the role of science in delivering justice as to reshape the format of evidentiary disputes in federal courtrooms.

The Supreme Court's evidence trilogy is immensely relevant to the workings of American democracy, but the impact of these decisions may reach even farther as approaches to producing knowledge and trust are globalized through varied forums. Norms of evidence and proof are increasingly entwined with matters of international politics; two dramatic reminders in 2003 alone were the long-running stand-off between the United States and Europe over genetically modified foods,[6] and Secretary of State Colin Powell's presentation of Iraq's possession of weapons of mass destruction before the United Nations Security Council. The US position in both episodes seemed to take for granted that there are, or at least should be, globally shared norms for evaluating technical evidence in law-like settings. Reactions in other parts of the world, however, have cast doubt on this assumption. In the light of such episodes, addressing the relationship between law and science and finding workable means of coping with their frictions emerge as essential components of any good-faith attempt to create an international order.

A decade after *Daubert*, it thus seems appropriate to reflect systematically on the impact of this decision and its progeny on the relationship between law and science in America and beyond. My main purpose here is to foster such reflection by using insights from the field of science and technology studies. In brief, I argue here that *Daubert* rests on serious misconceptions about the nature of science, the goals of legal fact-finding, and the role of the judiciary. A sociologically grounded approach to science and technology calls for a different kind of jurisprudence that is better attuned to the law's primary function of doing justice.

DAUBERT'S LEGACY

Daubert was a landmark ruling for many reasons, some intended and others unintended. Doctrinally, it was the first case in which the Supreme Court addressed the admissibility of scientific evidence in federal proceedings. *Daubert* clarified the applicable law, setting aside the so-called *Frye* test adopted 70 years earlier by the DC Court of Appeals.[7] The decision formally ended disagreements that had arisen since then among the federal circuit courts. This alone would have been sufficient to ensure *Daubert*'s landmark status, but the ruling did much more.

To begin with, *Daubert* entailed not only the application of a new legal standard but also something more radical—a change in long-standing habits of judicial tolerance toward party experts, coupled with habitual judicial deference to the jury's fact-finding function. Procedurally, the case changed the rules of the game for pretrial hearings in which judges consider motions by a party (typically the defendant) to exclude the opposite party's (typically the plaintiff's) offer of scientific or technical evidence. *Daubert* instructed judges to be more proactive in their response to such motions. Judicial discrimination, the Court indicated, should act as a filter to screen away from juries any evidence that did not pass threshold tests of relevance and reliability. Judges, in short, were to act as gatekeepers, guarding the courtroom door against what some saw as an uncontrolled onslaught of "junk science." This procedural change masked a deeper intellectual shift, for the ruling sought, in effect, to reposition the epistemic foundations of admissibility. It was widely interpreted as requiring judges to "think like scientists."[8] The judge's role, according to this reading, was to bring the legal assessment of science into closer alignment with assessment of science by scientists. The Court apparently concluded that conforming judicial criteria of admissibility to scientific ones would serve the interests of reason and of justice.

Second, post-*Daubert* case law suggests that the decision has had substantial influence on legal outcomes. *Daubert* has been invoked most often to exclude plaintiffs' testimony, and it has been far more actively deployed in civil than in criminal litigation. Accordingly, the decision has begun to affect not only the use of science in individual proceedings, but also the delivery of justice more broadly, mostly by creating a more favorable legal environment for civil defendants. These developments have changed the balance between judges and constitutionally required juries and rewritten the ground rules for dealing with uncertainty or lack of evidence. I have suggested elsewhere that *Daubert*'s effort to make judicial practice more scientific, together with the increasingly powerful impetus of the law and economics movement, are part of a tectonic shift in US legal and political thought that aims to "modernize" legal decisionmaking by making it more efficient, standardized, and predictable.[9] Efficiency of systems, however, is not necessarily compatible with justice to individuals. It is therefore important to ask of any substantial legal reform such as *Daubert* whether it properly balances the rights and interests of individuals in relation to the aggregated good of society.

Third, it quickly became clear that more was at stake in *Daubert* and its immediate progeny, *Joiner* and *Kumho*, than the standard of admissibility for scientific evidence. These cases opened up a wider debate on the principles and procedures by which law and science should regulate their interactions with each other and thereby with parties seeking legal redress for the failures of science and technology. Especially powerful was *Daubert*'s assertion that scientific criteria should govern the assessment of science in legal settings. Calls were made to extend *Daubert* or *Daubert*-like criteria to other forms of technical evidence and other areas of legal practice, and to some degree such extension has already taken place. For example:

- Non-scientific expert testimony was held to *Daubert* standards in *Kumho*.
- Pressure has grown for new *Daubert*-style criteria to be developed for and applied to forensic science.
- Proposals have been made to extend *Daubert*-like principles to regulatory science used in health, safety, and environmental decisionmaking.[10] The federal Data Quality Act of 2000 and more recent proposals for peer review of regulatory science from the Office of Management and Budget can be seen as concrete moves in this direction.
- In the international arena, the United States has called for "science-based" decisionmaking on such issues as the evaluation of genetically modified foods, thereby overriding Europe's "precautionary" approaches. The term "science-based" in these contexts has been interpreted as conformance to *Daubert*-like criteria.

Collectively, these demands signal disenchantment in contemporary America with the law's capacity to resolve the manifold technical disputes of modernity and a concomitant embrace of the imagined clarity, certainty, and rationality of science.

Legal developments following *Daubert* are substantial enough, in sum, to require a reevaluation of the decision's fundamental assumptions about law, science, and their interactions. Mistakes and misapprehensions on this front threaten the integrity not only of legal proceedings but also of democratic politics writ large. How should we think through this challenge? Clearly, we should begin with a deeper understanding of how these institutions operate in practice; idealized and untested accounts of law and science provide, at best, uncertain foundation for analysis. I argue that the law's instrumental need for an autonomous and authoritative science has distorted the ways in which the evidence trilogy conceptualized both the nature of scientific practice and its links to legal fact-finding. The aforementioned decisions endorsed a radically separatist model of law and science that presupposes a sharper boundary between the fields than exists, or should exist, in practice. This characterization permitted the Supreme Court to privilege the position of science within the legal system. Yet, in an ironic turn, the "science" that the Court officially embraced remained profoundly a creation of the law's own biases, needs, and misconceptions concerning scientific inquiry; while urging judges to defer to scientific authority, the Court gave judges new resources for writing their preconceptions regarding science into the law.

Countering *Daubert*'s representation of science, I begin with the observation that law and science share numerous attributes, key to which is producing reliable knowledge. Both are knowledge-generating institutions, irreplaceably so in modern societies. Factmaking, however, serves significantly different functions in these two settings, that is, the law develops knowledge as an aid to doing justice in a particular case; by contrast, science seeks truths that are, as far as possible, detachable from their context of production. This fundamental difference in institutional commitment was not properly appreciated in *Daubert* nor acknowledged in many recent efforts to ameliorate law–science relationships—with unfortunate consequences for both individual and social justice. Additional intellectual and practical problems flow, I argue, from positioning judges as (largely unreviewable[11]) gatekeepers for the admission of scientific testimony.

This analysis casts doubt on the feasibility, and even the wisdom, of uncritical deference to scientific criteria of reliability in legal proceedings. Indeed, to make progress in retuning the relations of law and science, I suggest that we need to reframe the problem addressed by *Daubert.* The grand question for the law is not how judges can best do justice to science; the more critical concern is how courts can better render justice under conditions of endemic uncertainty and ignorance. Once we focus on the latter question, it becomes clear that the law should not see itself as a simple transcription device for science, automatically writing into legal decisions whatever facts science has—or has not—generated in relation to specific controversies. Rather, the legal process should develop a more searching, self-critical awareness of its own pivotal role in producing new knowledge (and potentially hindering its production). Only by admitting its agency, and its limitations, in this regard will the legal system position itself to use science as it should be used in legal environments: for doing justice.

FACT-MAKING IN COURTS AND LABS: THE MYTH OF TRANSCRIPTION

Many commentators, both popular and professional, have characterized law and science as "clashing cultures," painting the law's adversarial process and its insistence on resolving disputes as antithetical to science's open-ended and allegedly objective search for the truth. This characterization has led, in turn, to an asymmetrical critique that charges the law with abusing science, but never vice versa. Law, so conventional wisdom holds, is at fault when it subjugates science and the scientific process to its own unbridled, ends-driven, "win at any cost" ethic.[12] This diagnosis carries an implicit prescription: to preserve the integrity of science, one must carve out for it an essentially de-legalized space—a space in which science can be true to itself, free from the distorting influence of the adversarial process and its pressure for closure. This is what *Daubert* sought to accomplish, but, as I will show, the effort rests on shaky ground.

A careful account would find congruence as well as clashes in the processes of law and science. The formal spaces of both institutions—courts no less than labs—are claimed to be dedicated to finding the truth, though with different ends in view: the law needs facts as necessary adjuncts to doing justice; science seeks facts more as an end in itself. Legal fact-finding therefore generally remains within the framework of a specific case or controversy, whereas scientific facts must speak to wider audiences. Facts established by science are published, and so participate in further rounds of dialogue and inquiry. Facts found in litigation rarely achieve wider circulation. Nonetheless, "speaking truth" remains an unquestioned virtue in both contexts: lying (or its legal equivalent, perjury) is among the most serious offenses one can commit in either arena, because it threatens each institution's public legitimacy. Accordingly, the processes of both institutions are geared toward producing truthful claims. Each employs powerful sanctions—including punishment and ostracism—against violation of its truth regime.

Truth is found in each institutional setting by establishing a correspondence with some exogenous reality: a legally significant event in the law and a phenomenon of nature in science. Each is configured, in this sense, to produce authentic representations of events occurring outside its immediate perimeter. In creating such representations, actors in each forum test or "try" the validity of claims made by others, to ascertain not only the claim's reliability, but also its fit with particular causal stories (i.e., the theory of a legal case or the scientific hypothesis or paradigm motivating an experiment[13]). In both contexts, the reproduction of external reality happens under fairly rigid material and institutional constraints, such as available instrumentation in science and the rules of evidence in law. Mirroring reality under these conditions often requires methodological innovation, in law no less than in science. Both courts and labs can thus be thought of as experimental spaces in which assertions about reality are constructed, presented, tested, held accountable to standards, and eventually determined to be reliable or unreliable.[14]

Nor do the institutional similarities end there. To some extent, the procedures of law and science also track one another. Witnessing, in particular, is an indispensable device for securing the reliability of representations in both settings. In courts of law, expert witnesses rehearse for the jury or other fact-finder the technical details of the causal argument whose plausibility the trial seeks to adjudicate. In scientific labs, the experimentalist or clinical observer, generally aided by mechanical instruments, witnesses and creates a record of the functioning of nature. Speaking of science, the sociologist Robert K. Merton called the practice of questioning by disciplinary peers "organized skepticism." But it is well to remember that the law also conducts its fact-finding through a kind of organized skepticism, albeit orchestrated under different principles, with more heterogeneous observers asking the uncomfortable questions. Through cross-examination and peer review, moreover, witnesses in both law and science are held accountable to skeptical inquirers, who are free to question the foundation of the witnesses' claims. When objects and artifacts provide part of the foundation for claims in either law or science (e.g., material evidence, instrumental readings, etc.), the "veracity" of the "testifying" object itself must be explicitly demonstrated—in law, by establishing an unbroken "chain of custody" from the scene of the action to the courtroom, and in science (and also in law), by standardizing, calibrating, and rechecking the instruments and protocols that supplied the readings.

Turning to the knowledge developed by processes of representation in law and science, we can characterize each as *situated* and *purposive* but in dissimilar ways. Situated within the four corners of the case, the law's knowledge is conditioned not only by the facts of the case, but also by the normative principles within which a case arises and has meaning as a "cause of (legal) action." Knowledge relevant to a legal proceeding is generated for the purpose of rendering justice within that specific setting. Scientific knowledge is also situated,[15] but it is positioned chiefly so in relation to communities of theory and practice. Important as well for the law, scientists' judgments about what are significant areas or lines of inquiry bear no necessary relation to societal judgments about what ought to be studied or where there are insupportable gaps in knowledge. And as we have seen, scientific work makes claims whose purpose is to transcend time and place; to be successful, scientific results must gain a life outside the lab, winning attention and support from other researchers, other disciplines, and even from policymakers and the public at large.

There are, then, important differences as well as similarities in the mix of normative and cognitive considerations that drive knowledge production in science and the law. We may elaborate on these as follows:

- Both legal and scientific representations of reality are produced under a variety of constraints, but constraints in the law derive in part from different normative concerns than in science. Some legal principles reflect deep-seated communal judgments about values that should not be breached in the course of fact-finding, even if adherence to these values impedes the development of relevant evidence (e.g., the prohibition against forcible self-incrimination, the right to counsel and cross-examination, the protection of certain privileged communications, numerous limits on discovery, and constraints on police procedure). Other principles—such as hearsay rules, the burden of proof, the privileging of testimony by eyewitnesses or treating physicians—incorporate ancient, experientially grounded, often formally untested views about evidentiary reliability and fair process. Scientific inquiry is less constrained by exogenous ethical and experiential norms, although it too is subject to some standards of this kind (e.g., rules for research with animals and human subjects, tacit knowledge about the right ways to design experiments).
- The investigation of natural processes within the law is not an end in itself, and the finding of facts or the representation of what "actually happened" is incidental to choosing between competing narratives of causation and responsibility. As a result, legal representations, even when their focus is on the objectively determined behavior of machines, artifacts, or natural objects (e.g., a tire, a drug, a weapon, a pollutant), are always tied to subjective and normative concerns. The law's ultimate goal is to establish (or rule out) *human* responsibility, whether individual or institutional, as it relates to the behavior of nonhuman objects. Legal narratives, furthermore, are not mere abstract possibilities; they must be advanced by actual parties through a genuine case or controversy. The law is not concerned, in this respect, with truths that have no real-world advocates, nor with stories that exist in a vacuum of social significance. Scientific inquiry, too, may involve a choice between competing hypotheses, but these are not generally associated with questions of liability, blame, economic interest, or social justice
- Legal representations of events are *ad hoc* and retrospective, often focusing on one-time occurrences; such representations are embedded in particularities of time, place, and culture. Except in mass tort cases and in cases involving the same issue litigated in multiple jurisdictions, the utility of a legally determined fact is limited to the resolution of the controversy for which it was generated. Facts established by law do not generally need to travel beyond the context of the specific case. Scientific representations, by contrast, seek to capture generalities that recur in nature, are independent of places and persons, and can be relied on for future investigations. Indeed, scientific truths are not considered significant unless they provide a basis for further fact-finding. Science therefore has built-in disincentives against finding highly particularistic, context-dependent facts, which by contrast are the motors and determinants of the legal process. In addition, although fact-finding in both science and law is subject to standards, these are produced and applied within different cultures of practice (e.g., forensic labs vs research labs) and under different conceptions of what counts as reliable and how reliability should be demonstrated. In this sense, law and science operate with different credibility economies.[16]
- Legal proceedings generally are required to reach a conclusion (though not necessarily so for some types of regulatory proceedings); scientific inquiry can be more open-ended. Lawsuits, moreover, require a choice between competing claims. Courts do not normally have the freedom to reframe issues posed by litigants based on independent accounts of the facts, although out-of-court settlements offer some room for creativity. In the ordinary processes of research science, there is no compulsion to reach a definitive conclusion, apart from the fact that negative or inconclusive results do not normally merit publication or win accolades. Scientists are thus at greater liberty to accept a verdict of "not proven" with regard to a given hypothesis or question.
- The relationship between law and science is asymmetric on the axis of deference. The law has historically carved out a quasi-autonomous place for scientific knowledge and expertise, for example, by creating exemptions for expert testimony from "ordinary" rules of witnessing. Science has borrowed procedural devices from the law, but scientific processes are not formally accountable to the law except on those aspects of practice that are explicitly regulated. Among the many instruments used by the law to produce credible approximations to scientific fact-finding are scientific advice and regulatory peer review, the use of special masters and expert panels, and the hearings enabled by *Daubert*. The law, in short, claims to do justice by partially preserving the independent authority of science—by, in effect, writing science into the law. This notion of science's special status dominated the Supreme Court's evidence decisions, but neither *Daubert* nor succeeding cases took note of the law's considerable role in motivating (or hampering) the production, testing, and validation of scientific knowledge.

In sum, I have suggested that there are important parallels as well as divergences between the knowledge-producing functions of law and science. Both are fact-finding institutions, but they blend normative and epistemic considerations in different ways, according to their particular institutional imperatives. Most importantly, the law finds facts in order to settle disputes, whereas science makes claims to extend previous lines of inquiry and enable new ones to take shape. Law, therefore, takes the case as its theater of operation and seeks to answer questions arising within narrow factual contexts; science attempts to produce facts that circulate beyond the circumstances of their production. These contrasts affect which issues are deemed worthy of investigation, how questions are framed, how and by whom inquiry is pursued, and what standards of validity are applied in testing knowledge.

These divergences cast doubt on the proposition that the law can simply transpose the project of science, without further ado, into its own projects of fact-finding and reality representation. Yet *Daubert* endorsed precisely this myth of direct transferability, assuming perfect congruence between the aims of laboratory and litigation science, and counting on trial judges to block any inappropriate transfers. As we next see, reliance on judges as *de facto* inscribers of science into law carries additional risks from the standpoint of producing impartial knowledge.

JUDICIAL DISCRETION UNDER *DAUBERT*

How to constrain its own normative discretion is a perennial concern of the judiciary. In this least democratic branch of government, legitimacy flows from applying the law as written by legislatures or as found in constitutional and common-law precedents. The appearance of making the law, rather than only applying it, undermines the neutrality that is the cornerstone of judicial authority and tars judges with the brush of bias or political interest. Alex Kosinski, a distinguished judge of the US Court of Appeals for the Ninth Circuit and a noted judicial conservative, stressed this point in criticizing the late Supreme Court Justice William J. Brennan's reformist jurisprudence:

> Recently, during a discussion of a difficult criminal case, one of my law clerks suggested a rule that might make sentencing, at least for some drug traffickers, more rational. After hearing him out, I responded, "That might be a good rule, but where are you getting it from?" I meant, where in the Constitution, in statute, or in case law? He had no source; that it was a good rule seemed to him sufficient. It is unlikely Brennan asked many of his law clerks, "Where are you getting it from?" That it was a good rule was, to him, sufficient.[17]

But if the law's aim is to minimize arbitrariness, then the question "where are you getting it from" should apply just as forcefully to factual judgments as to normative ones, that is, as much to declarations about what constitutes valid knowledge as to the articulation of new principles. Judges should not be empowered to invent the norms of science any more than the norms of law. Yet, concerns about arbitrariness in advancing knowledge claims were notably absent from *Daubert* and the other evidence decisions, which redefined the judge's role in fact-finding without any hint that it might lead to inconsistency or confusion.

This omission is not altogether surprising. Judges, by virtue of their intellectual and professional training, as well as their codes of practice,[18] have been less self-conscious and, hence, less self-regulating about subjectivity in scientific contexts than in political ones. On its face, too, *Daubert*'s injunction that judges should "think like scientists" seems to provide a powerful check on epistemic discretion. What could be more constraining, after all, than to require scientific evidence to conform to scientists' standards of validity? As long as courts can appeal to external criteria determined by the scientific community, both judges' and juries' subjective role in fact-finding appear to be suitably limited. *Daubert*, moreover, did not entrust the evaluation of scientific validity entirely to the caprice of individual judges. To assist trial courts, and perhaps to foster greater uniformity in implementation, the majority set forth the following four widely discussed *Daubert* criteria, cautioning only that these should not be regarded as "a definitive checklist or test"[19]: (1) is the evidence based on a testable theory or technique? (2) has the theory or technique been peer reviewed? (3) in the case of a particular technique, does it have a known error rate? and (4) recapitulating the *Frye* rule, is the underlying science generally accepted?

In practice, however, *Daubert* and its progeny considerably widened the federal courts' maneuvering room with respect to admissibility, offering lower-court judges a broad and largely uncontrolled grant of discretion to declare case-by-case what counts as "science." As already noted, the ruling offered trial judges increased latitude to decide in what form to conduct pretrial hearings for screening scientific evidence.[20] The list of criteria constituted another invitation to creativity, allowing judges to apply them either rigidly, regardless of context, or flexibly, by interpreting them in novel ways or adding criteria of their own choosing. These observations call into question *Daubert*'s implicit central postulate of a world of scientific activity that the law can access but that remains untouched by the law.

We can characterize the room for epistemic discretion opened up by *Daubert* in terms of two misconceptions subscribed to by the majority. First, the majority assumed that there is a well-articulated model of "good science" whose standards can be objectively applied to offers of scientific evidence (the myth of "scientific method"). Second, the decision presupposed that judges would approach the issue of scientific validity with no preconceived notions about science (the myth of "epistemological innocence"). Neither assumption holds up under scrutiny. Far from acting as gatekeepers who merely let "good science" in through the courtroom door, post-*Daubert* judges have emerged as active participants in *making* science, consistent with their lay understandings of how science should be made. This opening of space for judicial activism in knowledge-making was a major unintended consequence of *Daubert*.

THE MYTH OF SCIENTIFIC METHOD

The *Daubert* majority, as noted earlier, seemed to assume that science is so obviously *science* that judges can unproblematically recognize it as such when called upon to do so. The Supreme Court took it for granted that there is a distinct, well-demarcated "scientific method," comprising criteria that can be clearly identified and objectively applied to determine the validity of scientific evidence. Two of the criteria that the Court proposed—testability and error rate—suggest that the majority viewed experimental science as the controlling model of scientific inquiry. These assumptions greatly oversimplify the complexity of approaches and methods that characterize contemporary scientific practice.[21] They rest on an idealized conception of the scientific method that pays little attention to the diverse contexts in which scientific research is conducted, assessed, and interpreted.

Although the experimental method deservedly occupies a preeminent position within science, it is not the only technique by which scientific facts are created. To be "scientific," a theory does not necessarily have to be subjected to experimental testing. Darwin's theory of natural selection is one very widely accepted scientific theory that rests on a massive amount of empirical observation but does not easily lend itself to experimental verification. Theories of the origins of the universe have similar properties, although some aspects may be subject to experimental testing. Many theories in the human sciences—including psychology, psychiatry, anthropology, sociology, and numerous interdisciplinary fields such as climate science and risk perception—are also generally accepted as valid even though they cannot be tested through controlled experiments. Support for such theories may derive from statistical analyses of populations, reviews of long-term trend data, clinical studies of illness in individuals, observations of organizational behavior, computer simulations, and even historical, literary, or cultural records. Some types of scientific claims that are testable in principle, such as theories of disease causation, cannot be experimentally tested for ethical and practical reasons. In other fields, such as the new genomics, the advent of computers has made it possible to sort through large bodies of data in search of interesting patterns of variation; such activity is accepted as scientific within the genomics community, although it is neither hypothesis-driven nor experimental. These examples indicate that scientific validity cannot be assessed in terms of a single, universally applicable criterion of good scientific method.

Scientific inquiry conforms most basically to historically and culturally situated standards of valid reasoning, persuasion, and proof. These standards can and do change over time. For example, nineteenth century biologists believed assertions about the relatively larger size of male brains than female brains because they took for granted the link between gendered differences in size and human mental capacity.[22] Systematic physiological investigation might have shaken their beliefs, but the need for such observations was not acknowledged in that era. Today, similar arguments about the biological basis for gender or racial differences would encounter significantly more skepticism, and the demand for proof might be correspondingly higher. By contrast, genetic arguments for behavioral differences between individuals and groups may be an early 21st century orthodoxy that is not energetically questioned now, but that will encounter sharper criticism as our knowledge of gene–environment interactions advances.

Observations about the lack of methodological unity in science have been strengthened in recent years by a growing body of scholarship that examines science as a form of organized social activity. This work illuminates, often in minute detail, the practices through which scientists produce their authoritative understandings of the world.[23] The "facts" that scientists discover about physical and social phenomena are brought forth by using instruments, institutions, and processes that are themselves the creations of human ingenuity, interest, and resources. Facts, in other words, are not pure, unmediated renditions of an external reality whose objectivity is secured by a single, transcendent scientific method.[24] In producing scientific facts, especially on previously unstudied problems, scientists must engage in complex debates about the correctness of particular theories, experimental methods, instrumental techniques, validation procedures, statistical analyses, review processes, and the like. To resolve a question about the causes of environmental degradation, for example, a host of observational, classificatory, and analytic skills must be pieced together, often by practitioners trained in different traditions and possibly affiliated with different political interests. Firm understandings on such matters are derived, if at all, through continual negotiation and renegotiation among scientists, who are only partially insulated from economic, social, and political influences in the world around them. As a result, the scientific knowledge that the law needs for its purposes is frequently unavailable until the legal process itself creates the incentives for generating it; nor are methods that technical communities regard as valid necessarily at hand until interested litigants seek out the expertise to help them win their case.

When negotiations over method are successfully concluded, the resulting science looks secure not because it necessarily presents a better picture of reality but because most or all conflicts among relevant investigators have been resolved. But cessation of conflict does not in itself guarantee the validity or objectivity (in the sense of lack of identifiable bias) of the methods underlying the prevailing consensus. Conflicts may end simply because the minority viewpoint is too costly, difficult, or time-consuming to pursue further. Similarly, the existence of controversy does not mean in and of itself that one or the other side has adopted an "unscientific" method or is propagating "junk science"; it could simply mean that uncertainties are unresolvable in the present state of knowledge.

Even in relatively well-established areas of research—those that conform to the *Frye* standard of general acceptability, for example—the line between proper and unacceptable methodology cannot always be cleanly drawn. Methods viewed as risky or daring by some scientists may be regarded as downright improper by others in the same discipline. For example, a lengthy investigation of alleged misconduct in the laboratory of Robert Gallo, the noted co-discoverer of the AIDS virus, led to inconclusive results that ultimately exonerated him. The investigation oscillated for a long time between the charge that Gallo and his assistants had used scientifically unacceptable methods to appropriate the virus from their French colleagues and the countercharge that their methods, though unorthodox, were characteristic of cutting-edge work in virology.[25] One may doubt whether prolonged investigation changed the minds of either side in the controversy.

It is instructive that, although *Daubert* asked judges to be familiar with aspects of the scientific method, even naming a few that the Court saw as relevant, the decision demanded little sophistication with regard to the diversity of methods that constitute and shore up the authority of science. The decision did not acknowledge that methods of testing or peer review might be variable across disciplines, situation-dependent, or influenced by interests. Nor did it address the problem of temporality, namely, that much relevant scientific knowledge does not preexist litigation but rather comes into being through the very action of the law. Lawsuits serve as incentives for producing knowledge. In all these respects, *Daubert* projected an unrealistic picture of both the autonomy and uniformity of science and of judges' capacity to find and translate good science into law. In the name of a universally valid and impartially accessible method, *Daubert* not only increased judicial discretion but also raised barriers against useful inquiry that could perhaps only come about through unorthodox means, under the powerful prod of litigation.

THE MYTH OF EPISTEMOLOGICAL INNOCENCE

In urging trial judges to act as evidentiary gatekeepers, the *Daubert* majority seemingly conceived the judicial mind as a *tabula rasa* on which science, represented by legitimate experts, would inscribe only those criteria that can validly be used to distinguish genuine from spurious claims. In reality, federal judges cannot be expected to approach their task with minds so empty of preconceived notions about science. As members of a highly educated, professional elite in an industrial society, they bring to the bench a variety of understandings inculcated since childhood about the nature of facts, rationality, proof, and method in science. These background beliefs provide a resource that judges selectively draw on, particularly when the *Daubert* criteria fail to provide clear guidance about the proper course of action.

The open-ended character of the criteria offered by the Supreme Court became apparent as soon as the Court of Appeals for the Ninth Circuit reconsidered *Daubert* on remand. In its first ruling in the case, the Ninth Circuit had upheld the district court's decision to exclude the scientific testimony offered by the plaintiffs on the basis of the *Frye* rule. Because *Frye* no longer applied, a three-judge panel headed by the restraint-favoring Judge Kosinski had to determine whether the plaintiffs' evidence met the new test of scientific reliability. At issue in the second phase (hereafter referred to as *Daubert II*), as before, was the claim that Bendectin, a drug prescribed to control morning sickness, had caused limb defects in two minor children of mothers who had taken the drug during pregnancy. The plaintiffs offered three types of evidence to support their claim: structural comparisons between Bendectin and other drugs suspected of causing birth defects; studies showing that Bendectin caused birth defects in laboratory animals; and statistical evidence purporting to link Bendectin ingestion to birth defects. The question on remand was whether any of this testimony satisfied the *Daubert* standard. *Daubert II* held that none of it met the mark.[26]

The Ninth Circuit cannot be faulted for adhering too slavishly to the *Daubert* criteria. Cognizant of its new responsibilities and "taking a deep breath," the appellate court added a test of its own, namely, the timing of the research underlying the proffered expert testimony. It was extremely significant, the court observed, whether "the experts are proposing to testify about matters growing naturally and directly out of research they have conducted independent of the litigation, or whether they have developed their opinions expressly for purposes of testifying."[27] When the research relied on by an expert witness predates litigation, the court went on to say, there is "important, objective proof that the research comports with the dictates of good science."[27] In *Daubert II*, the court found dispositive the fact that none of the plaintiffs' experts had engaged in pre-litigation research on Bendectin. Furthermore, none had published their results in peer-reviewed journals, thus falling short of one of *Daubert*'s explicit criteria. Failure to publish, the court conjectured, reflected "a tacit understanding [among the researchers' peers] that what's going on here is not science at all, but litigation."[28]

Although these statements may appear innocuous on the surface, it is important to recognize that they represent not systematically tested truths, but rather unverified statements about the social dynamics of scientific knowledge production. By making such assertions, Judge Kosinski and his colleagues on the Ninth Circuit patterned, in effect, as amateur sociologists of science, without being called to account for the basis of their expertise in such matters. Indeed, because judicial opinions are not peer reviewed and, especially in the case of trial court opinions, are also often unpublished, sociological observations by the courts cannot be held to either academic or legal standards of quality control. "Thinking like scientists" thus leads judges into conjecturing about the practices of science without the disciplining benefits of empirical study or peer review.

The Ninth Circuit engaged as well in a form of cognitive line-drawing that social scientists have termed "boundary work."[29] This is a pragmatic classifying routine through which social actors sort out aspects of their knowledge and experience as belonging within or outside recognizable ordering categories, such as "biased" rather than "unbiased" science, or (as in *Daubert II*) "science" rather than "litigation." Without such boundaries, complex social interactions would rapidly lose meaning and become chaotic and uninterpretable. Boundaries, then, are social constructs essential to preserving order. Yet boundaries created in this way, by authoritative actors, routinely come to be perceived as features of the way the world really *is*, even though they incorporate myriad tacit assumptions about the way in which the world *ought* to be organized.

The boundary between science and litigation, for example, is significantly messier in practice, and more obviously the product of social and cultural negotiation, than was imagined by the Ninth Circuit. In any legal proceeding involving scientific and technical evidence, it is far from self-evident where (if at all) the space of law ends and the space of science begins. If such a line ever makes sense, it is only after the interacting institutions of law and science have concluded their potent boundary work.[30] Seen in this light, Judge Kosinski's observation that science is more biased if it emerges from post-litigation rather than pre-litigation research (assuming a clear distinction between "post" and "pre") helped to construct and reaffirm the very boundary whose existence and effects he took for granted. This particular boundary, too, tends to be asymmetrically applied in practice, most often to exclude research commissioned by plaintiffs. Because of the practical dynamics of *Daubert* hearings, industry-sponsored science is seldom held to equal scrutiny.

DOING JUSTICE: TO SCIENCE, FOR SOCIETY?

I have suggested thus far that *Daubert*'s central doctrinal thrust, that is, the attempt to transcribe exogenous standards of scientific quality directly into legal fact-finding, was misguided for two reasons: (1) it did not take adequate note of the institutional convergences, disparities, and links between science and law, which make knowledge relevant to the law's needs different in kind from knowledge produced through orthodox scientific research; and (2) it unrealistically conceived judges as impersonal instruments for ushering objectively reliable science into the courtroom. I turn now to the deeper normative issue that *Daubert* also elided, or failed to address, in its quest for scientifically reliable evidence. *Should* scientific standards of validity (assuming these can be discerned) always and automatically be applied to legal evidence? Is doing justice to science, which was *Daubert*'s main preoccupation, consistent with the law's primary function of doing justice for society? Only the outlines of an answer can be attempted here, but reflective engagement with *Daubert* requires us at least to broach these questions.

To begin, we note that in American law levels of proof that are considered sufficient for legal and regulatory action vary from context to context. Proof beyond a reasonable doubt is thought to be necessary in criminal cases, in which a person's life or liberty may be at stake. By contrast, plaintiffs in civil cases are only required to produce enough evidence to build a "more probable than not" case against defendants. Shoddy forensic evidence that could extinguish innocent lives is feared more than shoddy evidence that serves merely to redistribute wealth.[31] Regulatory agencies, working to protect public health and safety, are held to even laxer proofs of harm, as expressed in the administrative law standard of "substantial evidence." When Congress makes law, even in highly technical areas, legislators are not held to any explicit standard of rationality; indeed, to many scientists' dismay, Congress in 1995 eliminated its own technical advisory body, the Office of Technology Assessment. These discrepant practices suggest that in American legal culture, it is considered right and proper to tailor the stringency of proof to the total circumstances of lawmaking and adjudication. How much evidence is needed to settle different kinds of legal disputes is not a question the legal system addresses in the abstract. Rather, the answer depends on the nature of the interests the law seeks to serve or protect; part of doing justice is to raise or lower the evidentiary burden in different legal environments.

Jury trials have served a similar function in litigation by allowing the adequacy of evidence to be considered in relation to other factors affecting the rendering of justice. Once evidence is admitted, the jury is free to weigh the strength and reliability of scientific evidence against wider issues of causation and responsibility. Thus, weaker evidence may justify a finding of liability in a jury's eyes if it appears that those responsible for generating or communicating knowledge egregiously failed to carry out their duties. Asbestos manufacturers, for example, had known for decades that workers were suffering from a range of severe health problems without informing the victims or taking steps to make public what they knew. In everyday litigation contexts, resource differentials between private plaintiffs and corporate defendants may prevent such sins of commission or omission from coming to light. The quality of lawyering, no less than the quality of science, depends on the resources available to the parties.

Unlike *Daubert* judges, juries are not required to split off the evaluation of scientific evidence from questions about the *morality* of the knowledge order within which a case arises. By "knowledge order," I mean the set of institutional and economic arrangements that determine, within any society, who is responsible for producing knowledge, by what means, about which issues, with what resources, and under what rules for allocating the costs of uncertainty and ignorance. By reviewing scientific and technical evidence together with other possible determinants of liability, US juries have an opportunity to integrate the evaluation of expert testimony with their civic sensibilities about what counts as justice in the community at a given moment in time.[32]

In America's strongly libertarian culture, where litigation serves many of the remedial functions of the welfare state, this fine-grained calibration of the adequacy of knowledge (rationality) in relation to the responsibility for knowledge production (norms) is of extreme importance. Only by contextualizing available knowledge with respect to what could or should have been known can the legal process make meaningful decisions on ultimate issues of responsibility and blame. *Daubert* hearings may actually impede the cause of justice by preventing such contextualization and—while focusing on the technical merits of what is known—denying equal time to normative concerns about the absence or inadequacy of relevant knowledge.

An example of this dynamic occurred in litigation over the lactation-suppressing drug Parlodel, manufactured by Sandoz (now Novartis) Pharmaceuticals Corporation. Used at one time to treat milk-flow dysfunctions in women, the drug attracted adverse attention in the 1980s through reports of seizure and stroke. The Food and Drug Administration took these reports seriously enough to require the risk to be stated on Parlodel package inserts, and the manufacturer eventually withdrew the drug for this use. Epidemiological evidence, however, established no definitive link between Parlodel and strokes and seizures, and courts split in their decisions to admit other expert evidence implicating Parlodel as the cause of these problems.[33] Generally, courts ruling negatively on admissibility argued that only epidemiological evidence was good enough to establish general causation between a drug and its reported adverse reactions. Against this position, plaintiffs and their experts insisted that epidemiological evidence is often difficult and expensive to generate and does not exist in many personal injury cases involving pharmaceuticals. In such circumstances, they argued, justice considerations require courts to be receptive to less persuasive forms of evidence that exist in the scientific literature (e.g., animal studies, clinical differential diagnosis, biological mechanisms, and chemistry). A further argument advanced by plaintiffs' attorneys and some legal scholars was that clinicians routinely use non-epidemiological evidence to establish the causes of disease in their patients. Hence, courts, too, ought to remain receptive to such evidence in keeping with *Daubert*'s injunction to respect the judgments of relevant expert communities.

Contextual factors that may affect our sense of justice, and that may therefore legitimately lead to different evaluations of the same science in different contexts, include the following:

- the costs and repercussions of wrongly deciding liability, including possible negative effects on innovation (e.g., as may have happened in vaccine and contraceptive research)
- the relative economic or social power of plaintiffs in relation to defendants (e.g., chemical workers in industry or soldiers serving in war) and the relative ability of parties to sustain the costs of injury
- the distributive impacts of injury (e.g., disproportionate harm to vulnerable groups

such as children, the elderly, women, or soldiers) and the availability of other remedies
- the responsibility for failure to produce relevant knowledge in time (e.g., in the case of breast implants, where an unregulated environment allowed millions of women to undergo surgical implantation of an untested medical device)
- the possible knowledge-forcing impacts of the judgment (e.g., on environmental hazards or inadequately tested consumer products and their components)

CONCLUSIONS

Daubert assumed that there is an irreducible core of scientific method that should set the threshold for the admissibility of scientific evidence. This uncontestable aspect of science—often termed "good science"—was to be insisted upon by judges, who would act as gatekeepers, shearing away claims that fail to meet science's criteria of validity. This was the implicit justification for removing certain evidentiary issues from the jury's consideration, even in cases where jury determination of facts is constitutionally mandated. Claims of technical experts that do not meet relevant quality criteria were held to fall below the threshold of facticity that may properly trigger a jury assessment. It became a question of law, to be decided by judges, whether expert evidence is sufficiently scientific to merit consideration in legal fact-finding.

I have developed three arguments for why this transcription model of the law—as simply writing the standards of science into legal decision—does not work well in practice. First, contrary to much popular writing on law and science, the two institutions are not as much opposed as partially overlapping in their objectives with regard to fact-making. The law is at once a producer and a user of scientific knowledge, but its institutional aims and needs are not identical with those of science. Law's knowledge serves the resolution of normative as well as cognitive conflicts. Legal fact-finding accordingly subscribes, and legitimately so, to ethical and practical constraints that have no exact counterparts in science. Second, pretrial proceedings to identify and apply the allegedly irreducible core of the scientific method turn judges into naïve epistemologists, a role they are poorly suited to assume by training, skills, or knowledge. The transcription of science that occurs in *Daubert* hearings is therefore as likely to import into the law lay misapprehensions concerning the scientific method as valid methodological arguments concerning the development of evidence. The unthinking application of the *Daubert* criteria as a checklist exacerbates this tendency. Third, *Daubert* arguably has disrupted America's implicit social contract with science and technology, under which the courts have an obligation to make whole the uncared-for victims of a robust culture of risk-taking. Too much concern for the goodness of science runs the risk of tilting the law away from its core concern with doing justice in a modern, high-tech economy. In particular, a mechanical adherence to *Daubert* inhibits courts from asking why relevant knowledge does *not* exist and who should bear the costs of collective ignorance. Failure to factor in these issues may impede fair distribution of the costs of uncertainty between the producers and the unwitting consumers of risk.

In conclusion, the criteria that make scientific claims valid within scientific settings are not necessarily transferable to legal settings without further deliberation. Uncritical reliance on "good science" in the law is not only practically problematic but also may be inappropriate as a means of doing justice. Reordering law–science relations demands a more symmetrical inquiry into the nature and purposes of legal as well as scientific fact-finding. Only through such inquiry can we hope to arrive at a judicious balance between those aspects of evidentiary practice on which it is appropriate to defer to exogenous scientific authority and those on which it is not. Put differently, using science for justice demands as much attention to the normative assessment of expert knowledge, and ignorance, as to the rational basis for making normative judgments. By privileging the latter at the expense of the former, *Daubert* detached science from its human and social context and drove a wedge between reason and justice. ■

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1. The late sociologist Robert K. Merton explicitly attributed such norms to science, although very similar norms could also be attributed to judging. See Merton RK. The normative structure of science. In: Merton RK, ed. *The Sociology of Science: Theoretical and Empirical Investigations.* Chicago, Ill: University of Chicago Press; 1973, 267–278. To be sure, legal decisions are always case-specific in that they are grounded in the facts of a specific case; at the same time, the case stands for a rule of general application, the validity of which is not ordinarily limited to the facts of that individual case. It is important to both law and science that the rules they generate are able to travel beyond the specificities of the context in which they were articulated.

2. Writings on the topic of law and science include the following: Foster KR, Huber PW. *Judging Science: Scientific Knowledge and the Federal Courts.* Cambridge, Mass: MIT Press; 1997; Angell M. *Science on Trial: The Clash of Medical Evidence and the Law in the Breast Implant Case.* New York, NY: Norton; 1996; Jasanoff S. *Science at the Bar: Law, Science and Technology in America.* Cambridge, Mass: Harvard University Press; 1995; Huber PW. *Galileo's Revenge: Junk Science in the Courtroom.* New York, NY: Basic Books; 1991.

3. *Daubert v Merrell Dow*, 509 US 579 (1993).

4. *General Electric Co v Joiner*, 522 US 136 (1997).

5. *Kumho Tire Co v Carmichael*, 526 US 137 (1999).

6. In May 2003, the United States, joined by several producer nations, brought a case in the World Trade Organization challenging Europe's "illegal" moratorium on the importation of genetically modified foods. See Loewenberg S. Precaution is for Europeans. *New York Times.* May 18, 2003;sect 4:14.

7. The earlier admissibility rule was named after a federal appellate court decision to exclude lie detector testimony in a murder trial. Evidence was deemed admissible if it was "generally accepted" by the relevant scientific community. *Frye v United States*, 293 F 1013 (DC Cir 1923).

8. More accurately perhaps, the authors of the *Daubert* majority opinion asked trial court judges to think like scientists as *they* imagined scientists think.

9. Jasanoff S. Science and the statistical victim: modernizing knowledge in breast implant litigation. *Soc Studies Sci.* 2002;32:37–70.

10. For a discussion of the term "regulatory science," contrasting it with research science, see Jasanoff S. *The Fifth Branch: Science Advisers as Policymaker.* Cambridge, Mass: Harvard University Press; 1990.

11. The Supreme Court ruled in *General Electric Co. v Joiner* that admissibility decisions by trial judges are reviewable only for abuse of discretion. This is a high

standard that virtually immunizes trial judges against review of routine admissibility decisions.

12. See, for example, Faigman DL. *Legal Alchemy: The Use and Misuse of Science in the Law.* New York, NY: Freeman, 2000.

13. "Paradigm" was the term used by the philosopher of science Thomas Kuhn to designate the system of assumptions within which scientific work is always conducted. See Kuhn T. *The Structure of Scientific Revolutions.* Chicago, Ill: Chicago University Press; 1962.

14. This is not a surprising coincidence because the early experimental traditions that launched the scientific revolution borrowed their core procedural devices from the law. Historians of early modern science have shown that experimental scientists in that period drew on legal models in creating processes for testing scientific claims. See Shapin S, Schaffer S. *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life.* Princeton, NJ: Princeton University Press; 1985.

15. The observation that science, too, is "situated knowledge," despite efforts to attain universalism, is most clearly articulated in the work of feminist critic of science Donna J. Haraway. See Haraway DJ. *Simians, Cyborgs, and Women: The Reinvention of Nature.* New York, NY: Routledge; 1991.

16. Researchers in science and technology studies have called attention to the fact that credibility is produced within de facto exchange systems, or economies, that operate differently inside different specialized scientific communities, as well as between experts and the public. See Shapin S. Cordelia's love: credibility and the social studies of science. *Perspect Sci.* 1995;3:255–275.

17. Kosinski A. The great dissenter. *The New York Times Book Review.* July 6, 1997:19.

18. Lower court judges are reviewed and may be overruled on their interpretations of the law. A trial court's determinations of fact, including scientific facts, are not ordinarily reviewable, nor after *Joiner* and *Kumho* are most rulings on the admissibility of scientific and technical evidence.

19. *Daubert v Merrell Dow*, 509 US 579,593 (1993).

20. It is instructive to contrast in this regard the procedures employed by federal district judges Sam Pointer of Alabama and Robert Jones of Washington in cases involving claims of injury from silicone gel breast implants. For additional details, see Jasanoff S. Expert games in silicone gel breast implant litigation. In: Freeman M, Reece H, eds. *Science and Law.* London, UK: Dartmouth; 1998:92–103.

21. See Knorr-Cetina K. *Epistemic Cultures: How the Sciences Make Knowledge* Cambridge, Mass: Harvard University Press; 1999; Pickering A, ed. *Science as Practice and Culture.* Chicago, Ill: University of Chicago Press; 1992; Latour B, *Science in Action: How to Follow Scientists and Engineers through Society.* Cambridge, Ill: University of Chicago Press; 1987; Collins HM, *Changing Order: Replication and Induction in Scientific Practice.* Beverley Hills & London: Sage; 1985.

22. See Gould SJ. *The Mismeasure of Man.* New York, NY: Norton; 1981.

23. For an overview of this literature, see Jasanoff S, Markle G, Petersen J, Pinch T, eds. *Handbook of Science and Technology Studies.* Thousand Oaks, Calif: Sage; 1995.

24. For a lucid discussion of the historical and social embeddedness of science, see Kitcher P. *Science, Truth, and Democracy.* Oxford, UK: Oxford University Press; 2001.

25. For further details of this case, see Jasanoff S. Research subpoenas and the sociology of knowledge. *Law Contemp Prob.* 1996;59:95–118.

26. *Daubert v Merrell Dow Pharmaceuticals, Inc*, 43 F3d 1311 (9th Cir 1995).

27. *Daubert v Merrell Dow Pharmaceuticals, Inc*, 43 F3d F.3d 1311,1317 (9th Cir 1995).

28. *Daubert v Merrell Dow Pharmaceuticals, Inc*, 43 F3d 43 F.3d 1311,1318 (9th Cir 1995).

29. See, in particular, Gieryn T. *Cultural Boundaries of Science: Credibility on the Line.* Chicago, Ill: University of Chicago Press; 1999; Jasanoff S. *The Fifth Branch: Science Advisers as Policymakers.* Cambridge, Mass: Harvard University Press; 1990.

30. For detailed empirical studies making this point, see Jasanoff S. Science and the statistical victim: modernizing knowledge in breast implant litigation. *Soc Studies Sci.* 2002;32:37–70; also see Smith R, Wynne B, eds. *Expert Evidence: Interpreting Science in the Law.* London, UK: Routledge; 1989.

31. Of course, it is a legitimate societal concern that irrational legal outcomes may have a chilling effect on technological innovation and, at the limit, cost more lives and cause wider damage. An appropriate response, however, would be to take such concerns into account in the design of remedies rather than in decisions on the admissibility of evidence.

32. One reading (albeit possibly a too charitable one) of the O.J. Simpson case, for instance, is that no amount of scientific evidence could have persuaded the jury in the criminal trial that an African American could receive justice in Los Angeles. On this reading, the initial "not guilty" verdict was just, even if scientifically ill supported. Another reading is that the jury's negative assessment of the L.A. Police Department's integrity fatally infected their evaluation of the DNA evidence; on this reading, too, arguably justice was done even if science was disregarded.

33. Contested scientific evidence was excluded in *Hollander v Sandoz Pharmaceuticals Corp*, 95 FSupp2d 1230 (WD Okla 2000), *Siharath v Sandoz Pharmaceuticals Corp*, 131 FSupp2d 1347 (ND Ga 2001), and *Glastetter v Novartis Pharmaceuticals Corp*, 107 FSupp2d 1015 (ED MO 2000), aff'd 252 F3d 986 (8th Cir) (per curiam). Plaintiffs' testimony was admitted in the state courts of Kansas and Kentucky, for example, *Kuhn v Sandoz Pharmaceuticals Corp*, 14 P3d 1170 (Kan 2000) and *Sandoz Pharmaceuticals Corp v Roberts*, 89-CI-653 (Ky Ct App 1996).