POLICY: SCIENCE AND SOCIETY

The Interdependence of Science and Law

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The practice of science depends on sound law—law that at a minimum supports science by offering the scientist breathing space, within which he or she may search freely for the truth on which all knowledge depends. It is equally true that the law itself increasingly requires access to sound science. This need arises because society is becoming more dependent for its well-being on scientifically complex technology, so, to an increasing degree, this technology underlies legal issues of importance to all of us. We see this conclusion illustrated throughout the legal system.

Consider, for example, the U.S. Supreme Court's docket. Two cases the Court heard last year concerned the right to die (*1*). The specific legal question was whether the federal Constitution, which prohibits government from depriving "any person" of "liberty" without "due process of law," requires a state to permit a doctor's assistance in the suicide of a terminally ill patient. Is that "right to assisted suicide" part of the liberty that the Constitution protects? Underlying the legal question was a medical question: To what extent can medical technology reduce or eliminate the risk of dying in severe pain? The medical question did not determine the answer to the legal question, but to do our legal job properly we needed to develop an informed—although necessarily approximate—understanding of the state of that relevant scientific art.

Nor is the right-to-die case unique in this respect. A different case in 1992 challenged the constitutionality of a state sexual psychopath statute. The law required a determination of when a person is both dangerous and mentally ill to the point that the public safety may justify indefinite noncriminal confinement, a question that implicates science and medicine as well as law (*2*). One case on our docket this year concerns the sharing of responsibility—by juries, trial judges, and appellate judges—for determining such scientific matters as the potential toxicity or carcinogenicity of chemical substances, such as Bendectin or PCBs. A different criminal case involves the reliability of polygraph lie detector tests. A third case investigates whether scientific advances in proving paternity may influence statutes that confer citizenship on children born out of wedlock.

The U.S. Supreme Court's docket is only illustrative. Scientific issues permeate the law. Criminal courts consider the scientific validity of, say, DNA sampling, or voice prints, or expert predictions of defendants' "future dangerousness," which can lead courts or juries to authorize or to withhold the punishment of death. Courts review the reasonableness of administrative agency conclusions about the safety of a drug, the risks attending nuclear waste disposal, the leakage potential of a toxic waste dump, or the risks to wildlife associated with the building of a dam. Patent law cases can turn almost entirely on an understanding of the underlying technical or scientific subject matter. And, of course, tort law, which assesses civil liability for injury or death, often requires difficult determinations about the degree of risk of death or injury associated with a chemical ingredient of a pesticide or other product.

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The importance of scientific accuracy in the decision of such cases reaches well beyond the case itself. A decision wrongly denying compensation in a toxic substance case, for example, can deprive not only the plaintiff of warranted compensation but can discourage other similarly situated individuals from even trying to obtain compensation and can encourage the continued use of a dangerous substance. On the other hand, a decision wrongly granting compensation, although of immediate benefit to the plaintiff, through the strong financial disincentives that accompany a finding of tort liability, can improperly force abandonment of the substance. Thus if the decision is wrong, it will improperly deprive the public of what can be far more important benefits—those surrounding a drug that cures many while subjecting a few to less serious risk, for example. The upshot is that we must search for law that reflects an understanding of the relevant underlying science, not for law that frees companies to cause serious harm or forces them unnecessarily to abandon the thousands of artificial substances on which modern life depends.

That search is not a search for scientific precision. One could not hope to replicate the subtleties and uncertainties that characterize good scientific work. A judge is not a scientist, and a courtroom is not a scientific laboratory. Consider the remark made by the physicist Wolfgang Pauli. After a colleague asked whether a certain scientific paper was wrong, Pauli replied (*3*), "Oh, no. Certainly not. That paper is not good enough to be wrong." That is our objective. It is to avoid legal decisions that reflect that paper's so-called science. Rather, the law must seek decisions that fall within the boundaries of scientifically sound knowledge and approximately reflect the scientific state of the art.

This objective is sometimes difficult to achieve in practice. The most obvious reason is that most judges lack the scientific training that might facilitate the evaluation of scientific claims or the evaluation of expert witnesses who make such claims. They typically are generalists, dealing with cases that can vary widely in subject matter. Their primary objective is usually process-related: that of seeing that a decision is reached fairly and in a timely way. And the decision in a court of law typically (though not always) focuses on a particular event and specific individualized evidence.

Furthermore, science itself may be highly uncertain and controversial with respect to many of the matters that come before the courts. Scientists often express considerable uncertainty about the dangers of a particular substance. And their views may differ about many related questions that courts may have to answer. What, for example, is the relevance to human cancer of studies showing that a substance causes some cancers, perhaps only a few, in test groups of mice or rats? What is the significance of extrapolations from toxicity studies with high doses of a substance to situations where the doses are much much smaller? Can lawyers or judges or anyone else expect scientists always to be certain or always to have uniform views with

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respect to an extrapolation from a large to a small dose, when the causes of and mechanisms related to cancer are generally not well known? Many difficult legal cases fall within the heartland of this kind of scientific uncertainty.

Finally, a court proceeding, such as a trial, is not simply a search for dispassionate truth. The law must be fair. In our country, it must always seek to protect basic human liberties. One important procedural safeguard, guaranteed by our Constitution's Seventh Amendment, is the right to a trial by jury. Any effort to bring better science into the courtroom must respect the jury's constitutionally specified role—even if doing so means that, from a scientific perspective, an incorrect result is sometimes produced.

Despite the difficulties, I believe there is an increasingly important need for law to reflect sound science. I remain optimistic about the likelihood that it will do so. It is common to find cooperation between governmental institutions and the scientific community where the need for that cooperation is apparent. Today, as a matter of course, the president works with a science adviser, Congress solicits advice on the potential dangers of food additives from the National Academy of Sciences, and a scientific regulatory agency will often work with outside scientists, as well as their own, to develop a product that reflects good science.

The judiciary, too, has begun to look for ways to improve the quality of the science on which scientifically related judicial determinations will rest. In the U.S. Supreme Court, as a matter of course, we hear not only from the parties to a case but also from outside groups, which file briefs—30-page *amicus curiae* briefs—that help us to become more informed about the relevant science. In the "right-to-die" case, we received about 60 such documents from organizations of doctors, psychologists, nurses, hospice workers, and handicapped persons, among others. Many discussed pain control technology, thereby helping us to identify areas of technical consensus and disagreement. Such briefs help to educate the judges on potentially relevant technical matters, helping to make us, not experts, but moderately educated laypersons, and that education improves the quality of our decisions.

Moreover, our Court recently made clear (4) that the law imposes on trial judges the duty, with respect to scientific evidence, to become evidentiary gatekeepers. The judge, without interfering with the jury's role as trier of fact, must determine whether purported scientific evidence is "reliable" and will "assist the trier of fact," thereby keeping from juries testimony that, in Pauli's sense, isn't even good enough to be wrong. Trial judges, looking for ways to perform this function better, increasingly have used pretrial conferences to narrow the scientific issues in dispute, pretrial hearings where potential experts are subject to examination by the court, and the appointment of specially trained law clerks or scientific special masters.

Judge Weinstein of New York suggests that courts sometimes "go beyond the experts proffered by the parties" and "appoint independent experts" as the federal Rules of Evidence allow (5). Judge Rosen of Michigan recently appointed a University of Michigan Medical School professor to testify as an expert witness for the court, helping to determine the relevant facts in a case challenging a Michigan law prohibiting partial-birth abortions (6). Judge Stearns of Massachusetts, acting with the consent of the parties in a recent, highly technical, genetic engineering patent case (7), appointed a Harvard Medical School professor to serve "as a sounding board for the court to think through the scientific significance of the evidence," to "assist the court in determining the validity of any scientific evidence," and to "assist the court in determining the validity of any scientific evidence, hypothesis or theory on which the experts base their economy."

These techniques are neutral, in principle favoring neither plaintiffs nor defendants. When used, they have typically proved successful. Nonetheless, judges have not often invoked their Rules-provided authority to appoint their own experts. They may hesitate simply because the process is unfamiliar or because the use of this kind of technique inevitably raises questions. Will use of an independent expert, in effect, substitute that expert's judgment for that of the court? Will it inappropriately deprive the parties of control over the presentation of the case? Will it improperly intrude on the proper function of the jury? Where is one to find a truly neutral expert? After all, different experts, in total honesty, often can interpret the same data differently. Will the search for the expert create inordinate delay or significantly increase costs? Who will pay the expert? Judge Acker of Alabama writes (8): "Unless and until there is a national register of experts on various subjects and a method by which they can be fairly compensated, the federal amateurs wearing black robes will have to overlook their new gatekeeping function lest they assume the intolerable burden of becoming experts themselves in every discipline known to the physical and social sciences, and some as yet unknown but sure to blossom."

The AAAS, working with the American Bar Association and Federal Judicial Center, has begun to explore these matters with an eye toward finding practical ways to provide scientific help: a pilot project to test the feasibility of increased use of court-appointed experts in cases that present technical issues. The project "will provide a slate of candidates to serve as court-appointed experts in cases in which the court has determined that the traditional means of clarifying issues under the adversarial system are unlikely to yield the information that is necessary for a reasoned and principled resolution of the disputed issues." The project might also examine in some detail instances in which courts have successfully used their own outside experts. How were those experts identified? How might this better be done? How did the court, while protecting the interests of the lawyers and the parties they represent, also protect the experts from unreasonable demands, say on their time? How did the court prepare the expert to encounter what may be an unfamiliar and sometimes hostile legal environment?

The project might also ask whether criteria emerge that help to determine when a court-appointed expert will prove useful and whether that expert might better serve in an adviser-type or witness-like capacity. It would undoubtedly also be helpful to recommend methods for efficiently educating (that is, in a few hours) willing scientists in the ways of the courts, just as it would be helpful to develop training that might better equip judges to understand the ways of science and the ethical, as well as the practical and legal, aspects of the matter (9). The answers to some of these questions will help determine the practicality of promising methods to help bring science and law closer together.

I believe that in this age of science we must build legal foundations that are sound in science as well as in law. Scientists have offered their help. We in the legal community should accept that offer, and we are in the process of doing so. The result, in my view, will further not only the interests of truth but also those of justice. The law will work better to resolve many of the most important human problems of our time.

References

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4. *General Electric Co. v. Joiner*, 118 S. Ct. 512 (1997).
5. J. Weinstein, in *Individual Justice in Mass Tort Litigation* (Northwestern Univ. Press, Evanston, IL, 1995), p. 116.
6. *Evans v. Kelley*, 977 F. Supp. 1283 (E. D. Mich. 1997).
7. *Amgen v. Biogen*, 973 F. Supp. 39 (D. Mass. 1997).
8. Letter from Judge Acker to the Judicial Conference of the United States, *et al.*, 2 January 1998.
9. G. Omenn, *Environ. Health Perspect.* **102**, 674 (1994).