Serviceable Truths: Science for Action in Law and Policy

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As the articles in this symposium issue attest, the relationship between law and science has begun to attract attention as an autonomous field of study, generating its own bodies of expertise and specialized scholarship. It is less obvious how the perspectives arising from within the community of legal practitioners and thinkers relate to a largely separate, but parallel, body of research and understanding from Science and Technology Studies (STS), a cross-disciplinary field that has for several decades been producing its own analyses of the relations between science, technology, and other authoritative institutions in society—including, of course, the law.[1] Perhaps predictably, intersections between STS and legal studies have occurred most frequently around questions of evidence, since both fields share an interest in the nature and credibility of facts.[2] Another area of topical convergence is intellectual property law, where authors may have dual training in law and STS.[3] The shared interests of the two fields, however, bear on more fundamental questions of legal and political theory: questions about the nature of legitimacy and lawfulness in the modern world, where the actions of those in power must be held accountable to epistemic as well as normative standards—in short, to facts as well as to values. How to

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1. *See generally* THE HANDBOOK OF SCIENCE AND TECHNOLOGY STUDIES (Edward J. Hackett et al. eds., 3d ed. 2008) [hereinafter Hackett HANDBOOK] (mapping and analyzing the state of the STS field); HANDBOOK OF SCIENCE AND TECHNOLOGY STUDIES (Sheila Jasanoff et al. eds., rev. ed. 1995) [hereinafter Jasanoff HANDBOOK] (same).

2. Significant linking works by STS scholars include SIMON A. COLE, SUSPECT IDENTITIES: A HISTORY OF FINGERPRINTING AND CRIMINAL IDENTIFICATION (2001); SHEILA JASANOFF, SCIENCE AT THE BAR: LAW, SCIENCE, AND TECHNOLOGY IN AMERICA (1995) [hereinafter JASANOFF, SCIENCE AT THE BAR]; MICHAEL LYNCH ET AL., TRUTH MACHINE: THE CONTENTIOUS HISTORY OF DNA FINGERPRINTING (2008); and Michael Lynch & Sheila Jasanoff, *Contested Identities: Science, Law and Forensic Practice*, 28 SOC. STUD. SCI. 675 (1998).

3. *See generally* Fiona Murray, *Patenting Life: How the Oncomouse Patent Changed the Lives of Mice and Men*, *in* MAKING AND UNMAKING INTELLECTUAL PROPERTY: CREATIVE PRODUCTION IN LEGAL AND CULTURAL PERSPECTIVE 399 (Mario Biagioli et al. eds., 2011) (illustrating how legal studies in the area of intellectual property law bear on STS questions regarding relations between legal and scientific authority); Alain Pottage, *Law Machines: Scale Models, Forensic Materiality and the Making of Modern Patent Law*, 41 SOC. STUD. SCI. 621 (2011) (same); Kara Swanson, *Biotech in Court: A Legal Lesson on the Unity of Science*, 37 SOC. STUD. SCI. 357 (2007) (same).

orchestrate that deeper engagement between STS and legal scholarship is one aim of this Article.[4]

The road there can be charted in different ways. This symposium offers a pragmatic map. One can begin with cross-cutting topics at the intersections of science and law, especially criminal justice, bioethics, and the environment. In each of these areas, one approach is to pose questions aimed at improving the quality of scientific inputs to the legal process. Specifically, what evaluative standards should apply in conflicts over substance? Who should decide when experts disagree? And how should the results of knowledge processes be implemented? Under each of these headings, legal processes could benefit from a fuller grasp of relevant insights from STS, just as STS scholarship would gain depth and relevance by addressing more directly the kinds of issues and questions that seem most challenging from the standpoint of the law. In that sense, the pragmatic map may be as useful a starting point for future STS research as for legal studies.

This Article, however, departs from the topic–theme structure of the symposium to offer a more conceptual, indeed critical, perspective on law–science interactions. Here the concerns are not so much with making good decisions and hence with developing practical guidance on how the law should use or rely on scientific evidence and expert advice. Rather, the aim is to put society's needs in the driver's seat and explore how the two institutions could operate more effectively as partners in the central projects of governance in modern democracies: how to exercise power with reason, how to make good decisions in the face of epistemic as well as normative uncertainty, and how to strike an accountable balance between the sometimes conflicting pressures of knowledge and norms. In what follows, I sketch how STS understandings might help advance this kind of socially responsible collaboration between law and science.

The central question to ask about science in legal proceedings, I suggest, is not how good it is, but how much deference the scientific community's claims deserve in specific legal contexts. The answers, in turn, can be framed in terms of a "cascade of deference," from a relatively high point, where it makes good practical sense for the law to cede epistemic primacy to claims originating in science, to a point of little or no deference, where the law's core concerns for representation, accountability,

4. This, of course, has been a continuous theme in my work for many years. For additional reflections on this point, see generally SHEILA JASANOFF, SCIENCE AND PUBLIC REASON 15–18 (2012) which examines "the intersections of law and science as sites of shared knowledge production and norms-making," and Sheila Jasanoff, *Making Order: Law and Science in Action*, *in* Hackett HANDBOOK, *supra* note 1, at 761, 768, which notes the reluctance of scientific and legal practitioners to question "each other's claims concerning the authority of their respective epistemic and normative practices" and calling for deeper studies of the dynamic of "co-production" between these institutions.

and justice, as defined by legal norms, should take precedence over science's claims to higher authority. I will identify and discuss four stopping points, or viewing platforms if one wishes for a more tangible metaphor, along that cascade: objectivity, consensus, precaution, and subsidiarity. On each platform, I argue, there is a specific role for the law, or "law work," that needs to be acknowledged and implemented, instead of uncritically accepting scientific claims as controlling.

Two moves guide this Article's analysis of law–science interactions. The first is a shift in attention from how science is done, whether or not specifically for legal purposes, to how science is put to use in legal settings: succinctly put, it is a shift of the analytic frame from science *in* action to science *for* action. The second is a move from focusing primarily on methods of fact-finding to a renewed interest in the purposes or ends of fact-finding. This represents, in short, a turn from truth pure and simple to what I have called in earlier writing "serviceable truth."[5]

I. Science *in* Action to Science *for* Action

First, however, some words are in order to clarify the connections between STS thinking about what science is and legal thinking about what the law needs from science. STS research since the 1980s has directed much of its attention toward investigating "science in action," the title of possibly the best known work by the leading STS scholar Bruno Latour.[6] Such studies typically concentrate on the production of scientific knowledge in laboratories and other technical workplaces by those engaged in making facts: scientists themselves, of course, but also the surrounding social matrix of peripheral workers such as technicians, postdocs, and students; or, in medical settings, not merely work by researchers but also by nurses, pathologists, radiologists, and so on. Other social practices and actors involved in fact making have also come under the STS lens: from journals and citation indicators to patent lawyers who prepare scientific claims generated in labs to enter one or another wider economy.[7]

Increasingly, too, STS work has focused on the role of nonhuman agents—such as equipment, instruments, reagents, microbes, or model

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5. SHEILA JASANOFF, THE FIFTH BRANCH: SCIENCE ADVISERS AS POLICYMAKERS 250 (1990) [hereinafter JASANOFF, THE FIFTH BRANCH].

6. BRUNO LATOUR, SCIENCE IN ACTION: HOW TO FOLLOW SCIENTISTS AND ENGINEERS THROUGH SOCIETY (1987).

7. From the extensive literature on these issues, one can cite, by way of example, Terry Shinn, *The Triple Helix and New Production of Knowledge: Prepackaged Thinking on Science and Technology*, 32 SOC. STUD. SCI. 599, 601–03 (2002) (using citation practices as a means to explore the impact, audiences, and geographical spread of two ideas in the sociology of knowledge) and Greg Myers, *From Discovery to Invention: The Writing and Rewriting of Two Patents*, 25 SOC. STUD. SCI. 57, 58–61 (1995) (discussing the role of patent writers). *See also supra* note 3.

animals—in scientific production. The underlying observation is that scientific claims cannot be robust or replicable unless a panoply of nonhumans cooperates, so to speak, with the researcher in what could be seen (to borrow a locution from law) as joint and several agency. Much of the work in a laboratory, on this view, amounts to disciplining the entire cast of humans and nonhumans to function harmoniously together.[8] Thus, in a forensic laboratory, for example, results will not be reliable, or even readable, unless the analyst actually conducts the requisite tests,[9] follows the proper procedures, and uses pure reagents and well-calibrated instruments. Moreover, each node in the complex network of activities known as "testing" must conform to its own professional rules and standards of practice, some of which may be regulated by law: for example, training requirements for forensic scientists, certified test protocols, and quality-control criteria for lab equipment and materials, all nested within labs that themselves must meet applicable measures of performance.[10] The functioning of all these elements together, sometimes friction free and sometimes less so, is what STS scholars call science *in* action. This way of thinking about science—stressing the heterogeneity of the resources that go into the production of knowledge and being attentive to the messy details of practice—stands worlds apart from the abstract Popperian logic of falsifiability embraced by the Supreme Court as a criterion of reliability in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*[11]

The turn to science in action liberated science studies, indeed some would say science itself, from remaining a purely philosophical abstraction. It rightfully directed the analyst's eye to science and technology as social

8. This line of thinking goes by the name of actor-network theory (ANT). For a classic article illustrating the ANT approach, though not by that name, see Michel Callon, *Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay*, *in* POWER, ACTION AND BELIEF: A NEW SOCIOLOGY OF KNOWLEDGE? 196, 211–14 (John Law ed., 1986). In the ANT framework, the heterogeneous human and nonhuman elements of the network are seen as engaged in processes of mutual enrollment, with corresponding dynamics of resistance and negotiation until harmony is achieved at each network node. If irretrievable breakdown occurs anywhere in the network, the entire network fails to cohere, the experiment or demonstration fails, and the facts or artifacts sustained by the network never achieve closure or stability. *Id.* at 219–21. *See also* Bruno Latour, *On Actor-Network Theory: A Few Clarifications*, 47 SOZIALE WELT 369, 369–70 (1996) (further describing actor-network theory).

9. Many state forensic labs have suffered breakdowns at even this elementary level of compliance. For an especially egregious example entailing large social costs, see Sally Jacobs, *Annie Dookhan Pursued Renown Along a Path of Lies*, BOS. GLOBE, Feb. 3, 2013, http://www.bostonglobe.com/metro/2013/02/03/chasing-renown-path-paved-with-lies/Axw3AxwmD33lRwXatSvMCL/story.html, *archived at* http://perma.cc/5J5T-BJVH.

10. For example, the Centers for Disease Control and Prevention (CDC) supports the Clinical Laboratory Improvement Amendments of 1988 (CLIA) regulations, which establish federal standards applicable to all U.S. facilities or sites that perform tests on human specimens. *Clinical Laboratory Improvement Amendments (CLIA)*, CENTERS FOR DISEASE CONTROL & PREVENTION, http://wwwn.cdc.gov/clia/, *archived at* http://perma.cc/CV5H-V8V2.

11. 509 U.S. 579, 593 (1993).

activities, no different in their enrollment of human passions, interests, and material resources than any other mode of collective human behavior. This Article, however, argues that a normatively adequate understanding of how the law can fruitfully engage with science demands a further turn of analytic attention, from science *in* action to science *for* action. Though not stated in precisely these terms, it is science for action that has been the primary concern of legal thought, since the law (unlike STS) is rarely interested in fact making for its own sake but only inasmuch as facts serve the ultimate purposes of legal decision making. Thus, when the Supreme Court articulates new rules for the admissibility of expert evidence, it is grappling in effect with a problem of science for action.[12] There is, however, a dimension of STS research on science for action that supplements conventional legal analysis. In such STS work, the purpose is not, as it is in judicial or administrative decision making, to lay down rules for how science ought to be injected into legal contexts. Rather, it is to understand in a comprehensive fashion how knowledge becomes useful, and usable, in forums such as courts of law.

Whereas STS scholars interested in science in action may rest content with following a crime-scene blood sample into a testing lab and watching its conversion into a claimed DNA match (or nonmatch), the STS scholar concerned with science for action will just as naturally follow the sample into the courtroom. Once there, key problems from an STS standpoint would include how a lab-generated claim that two DNA samples match, or fail to match, is taken up by lawyers, juries, and judges; how disputes among experts are resolved; and ultimately, what influence such claims and counterclaims have on the processes of making reasoned decisions and rendering justice.[13] STS-trained students of science for action certainly share with legal analysts the sense that science is important because facts matter for how policy is made and how society behaves. But whereas legal thought has tended to put scientific reliability at the center of its field of vision, STS scholars are just as interested in the law itself as a domain of technical practice that shapes, as much as it is shaped by, its interactions with science and technology.

The project of studying science in action often concerns itself with so-called truth claims, i.e., statements that one or another claimed fact about

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12. *See generally id.* (establishing the standard for admitting expert testimony); Gen. Elec. Co. v. Joiner, 522 U.S. 136 (1997) (establishing the standard of appellate review for trial-court applications of the *Daubert* rule); Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999) (determining that in the admissibility standard for expert testimony, there is no difference between scientific knowledge and other types of specialized knowledge).

13. For a study of forensic sciences that is primarily concerned with science *in* action, see LYNCH ET AL., *supra* note 2. By contrast, a study of DNA fingerprinting that is more concerned with science *for* action is Sheila Jasanoff, *The Eye of Everyman: Witnessing DNA in the Simpson Trial*, 28 SOC. STUD. SCI. 713 (1998).

the word is unambiguously true. How, STS scholars have asked, do scientists come to accept some statements about the world as true facts? A very general answer from the sociology of scientific knowledge is that truth is what the relevant community of scientists or technical experts deems to be true.[14] What ensures the robustness of scientific truth claims, in other words, is the existence of a community of like-minded inquirers, with shared theoretical and methodological commitments, who are prepared to certify the validity of a community member's findings. This position correlates well with the admissibility test laid down in 1923 in *Frye v. United States*,[15] in which scientific evidence was held to be sufficiently reliable if it has found "general acceptance" within the relevant scientific community in which it belongs.[16] Decades of *Frye* jurisprudence, however, revealed unresolved sociological and political questions latent in the criterion of "general acceptance": acceptance in which community, as defined by whom, and subject to what modes of supervision or rules of good practice?[17] Inconsistent adjudicatory results, coupled with industry pressure to control unfriendly juries, led in time to the *Daubert* trilogy of rulings.[18] Here, the Supreme Court turned its back on general acceptance as such in favor of a hybrid approach that did not entirely abandon *Frye*, but positioned trial judges as gatekeepers, free to decide through a mix of criteria (some would say a checklist) whether proffered evidence satisfies the judiciary's sense of scientific reliability and relevance.[19] There is considerable evidence that the *Daubert* trilogy caused a rise in summary judgments precluding plaintiffs' access to trials, but opinion on the implications of the trilogy for the law's understanding of and respect for science remains more divided.[20]

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14. Many works affirm this position including, importantly, LUDWIK FLECK, GENESIS AND DEVELOPMENT OF A SCIENTIFIC FACT 157–63 (1979); LATOUR, *supra* note 6, at 26–29; and STEVEN SHAPIN, A SOCIAL HISTORY OF TRUTH: CIVILITY AND SCIENCE IN SEVENTEENTH-CENTURY ENGLAND 3 (1994). *See also* H.M. COLLINS, CHANGING ORDER: REPLICATION AND INDUCTION IN SCIENTIFIC PRACTICE 18 (1985) ("Science, like any other cultural activity, rests on a foundation of taken-for-granted reality. Usually scientists spend their time looking at things through the frame of reference that they were given when they were trained.").

15. 293 F. 1013 (D.C. Cir. 1923).

16. *Id.* at 1014.

17. *See* Paul C. Giannelli, *The Admissibility of Novel Scientific Evidence:* Frye v. United States*, a Half-Century Later*, 80 COLUM. L. REV. 1197, 1208 (1980) (discussing the inadequate or inconsistent parameters that courts have considered in applying the general acceptance test).

18. *See supra* note 12.

19. *See* Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 597 (1993) (announcing the standard for expert testimony under the Federal Rules of Evidence, which superseded *Frye*).

20. *See* LLOYD DIXON & BRIAN GILL, CHANGES IN THE STANDARDS FOR ADMITTING EXPERT EVIDENCE IN FEDERAL CIVIL CASES SINCE THE *DAUBERT* DECISION 62 (2001) (finding that "[c]hallenges to expert evidence increasingly resulted in summary judgment after *Daubert*" as "nearly 90 percent of the summary judgments went against plaintiffs"). Whether or not the trilogy succeeded remains open to debate. *See, e.g.*, Margaret A. Berger, *What Has a Decade of* Daubert *Wrought?*, 95 AM. J. PUB. HEALTH S59, S61 (2005) (noting the "numerous problems" that arise

II. Serviceable Truths: Science in Aid of Law

The science *for* action move, while more directly relevant to law's concerns than purely science *in* action, still affords a kind of primacy to the production and use of scientific knowledge. It seems to leave unquestioned the presumption that—for both science and law—achieving high-quality knowledge is the most important goal to be served. Any apparent retreat from this commitment arouses frissons of unease in an institution whose legitimacy rests as much on its ability to discern factual falsehoods as to deliver fairness and justice.[21] Those anxieties are compounded in an era when the manufacture of disinformation, with facts concocted to serve special interests, seems on the rise;[22] politicians and publics are said to have declared war on science;[23] and in the terms coined by television comedian Stephen Colbert, in public life truth has given way to "truthiness."[24] That word, which won an immediate following, "refers to the quality of preferring concepts or facts one wishes to be true, rather than concepts or facts known to be true."[25] The last thing the law wants is to be seen as a

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when courts apply the *Daubert* standard in toxic torts cases); David L. Faigman, *Where Law and Science (and Religion?) Meet*, 93 TEXAS L. REV. 1659, 1674 (2015) (concluding that the Court's "methodology–conclusion distinction is . . . useless"); Sheila Jasanoff, *Law's Knowledge: Science for Justice in Legal Settings*, 95 AM. J. PUB. HEALTH S49, S57 (2005) (characterizing *Daubert* as "[driving] a wedge between reason and justice").

21. *See, e.g.*, Jasanoff, *supra* note 20, at S51 (comparing the process of fact making in law and science and asserting that "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").

22. *See, e.g.*, THOMAS O. MCGARITY & WENDY E. WAGNER, BENDING SCIENCE: HOW SPECIAL INTERESTS CORRUPT PUBLIC HEALTH RESEARCH 2 (2008) (arguing that "the institutions of science are under attack" by special interest groups, who have developed "sophisticated strategies" to "advance their ideological and economically motivated goals"); DAVID MICHAELS, DOUBT IS THEIR PRODUCT: HOW INDUSTRY'S ASSAULT ON SCIENCE THREATENS YOUR HEALTH, at xi (2008) ("Polluters and manufacturers of dangerous products tout 'sound science,' but what they are promoting just *sounds like science* but isn't."); NAOMI ORESKES & ERIK M. CONWAY, MERCHANTS OF DOUBT: HOW A HANDFUL OF SCIENTISTS OBSCURED THE TRUTH ON ISSUES FROM TOBACCO SMOKE TO GLOBAL WARMING 7 (2010) (telling the story of how special interest groups used the "Tobacco Strategy" to "attack science and scientists" and to confuse the public about global climate change).

23. CHRIS MOONEY, THE REPUBLICAN WAR ON SCIENCE 5 (2005). *See also* Joel Achenbach, *Why Do Many Reasonable People Doubt Science?*, NAT'L GEOGRAPHIC, Mar. 2015, http://ngm.nationalgeographic.com/2015/03/science-doubters/achenbach-text, *archived at* http://perma.cc/RP44-PR7P ("We live in an age when all manner of scientific knowledge . . . faces organized and often furious opposition. Empowered by their own sources of information and their own interpretations of research, doubters have declared war on the consensus of experts.").

24. *The Colbert Report: The Word–Truthiness* (Comedy Central television broadcast Oct. 17, 2005), *available at* http://thecolbertreport.cc.com/videos/63ite2/the-word---truthiness, *archived at* http://perma.cc/E8ZB-Y7K2.

25. AMERICAN DIALECT SOCIETY, *TRUTHINESS* VOTED 2005 WORD OF THE YEAR BY AMERICAN DIALECT SOCIETY 1 (2006), *available at* http://www.americandialect.org/Words_of_the_Year_2005.pdf, *archived at* http://perma.cc/W2E3-5G58. *See also 2006 Word of the Year*, MERRIAM-WEBSTER, http://www.merriam-webster.com/word-of-the-year/2006-word-of-the-year.htm, *archived at* http://perma.cc/492N-QPVP (announcing the 2006 Word of the Year as

defender of truthiness. Already under attack as promoters of "junk science,"[26] legal institutions and professionals have preferred in recent decades to try to repair their somewhat battered armor of scientific respectability, asserting that courts, and the law more generally, are entirely competent to discriminate between the gold of good science and the base metal of false claims.[27]

But what if legal thought were to set aside its somewhat one-sided obsession with the quality of the science it so readily and voraciously consumes—focusing on how law can best accommodate an imagined, independent, and preexisting science—and were instead to ask the symmetrical question of how science might best aid and advance the purposes of the law? That change in perspective would justify the second move this Article makes: to shift our inquiry from the validation of scientific claims, whether in labs, courts, or intermediate spaces such as peer-reviewed journals, to a more normative concept that I referred to in earlier work as *serviceable truth*. This I characterized at the time as "a state of knowledge that satisfies tests of scientific acceptability and supports reasoned decision making, but also assures those exposed to risk that their interests have not been sacrificed on the altar of an impossible scientific certainty."[28] The point of this move is not merely that, in interchanges between law and science, a balance needs to struck between scientific facts and reasons on the one hand and the nurture and protection of human lives and flourishing on the other. The term "serviceable" also calls attention to the fact that science's role in the legal process is not simply, even preeminently, to provide a mirror of nature. Rather, it is to be of *service* to those who come to the law with justice or welfare claims whose resolution happens to call for scientific fact-finding. As in the case of the admissibility of scientific evidence, the production of this kind of "good enough" knowledge has long been a preoccupation of the law in contemporary societies, perhaps less visibly so in administrative rulemaking than in courtroom battles of experts. Yet, as discussed in my prior work on expert advisory committees, U.S. rules of administrative procedure that demand "substantial evidence,"[29] not absolute certainty, as a basis for standard setting can be seen as expressing a core commitment to serviceable

"truthiness" and citing to the American Dialect Society definition); Dick Meyer, *The Truth of Truthiness*, CBS NEWS (Dec. 12, 2006, 12:39 PM), http://www.cbsnews.com/news/the-truth-of-truthiness/, *archived at* http://perma.cc/H68R-PYQX (describing the popularity and appropriateness of the concept among Americans).

26. PETER W. HUBER, GALILEO'S REVENGE: JUNK SCIENCE IN THE COURTROOM 2 (1991).

27. *See, e.g.*, Gen. Elec. Co. v. Joiner, 522 U.S. 136, 149 (1997) (Breyer, J., concurring) ("[J]udges have increasingly found in the Rules of Evidence and Civil Procedure ways to help them overcome the inherent difficulty of making determinations about complicated scientific, or otherwise technical, evidence.").

28. JASANOFF, THE FIFTH BRANCH, *supra* note 5, at 250.

29. Administrative Procedure Act, 5 U.S.C. § 706 (2012).

truth.[30] STS scholarship on science for action can enrich and strengthen the law's efforts to arrive at and implement such serviceable truths, in part by clarifying the mutual obligations of science and law at four crucial stopping points along the cascade of deference.

III. Judicial Deference: Fact or Fiction?

Once again, however, a brief detour is in order to see how the law has historically interpreted its relationship to science in the three topical areas that featured most prominently in this symposium: criminal law, bioethics, and environmental law. That legal norms may take precedence over factual considerations is not controversial in any of these topical domains. Many examples can be cited of just this kind of legal override of scientific claims in all of these areas. There is, for example, a deep-seated and cross-cutting legal commitment to stability in the rule of stare decisis and in the law's frequent preference for protecting settled expectations.[31] Both act as brakes against rapidly realigning legal rules with social demands for change. Scientific and technological change in particular, courts have repeatedly held, do not in and of themselves call for revisiting older legal outcomes, not even when individual liberty, that most cherished of American values, is at stake and new knowledge or technical capabilities could make a difference to how it is protected.[32] More subtly, courts have repeatedly taken it upon themselves to balance the factual assertions of science and the normative dictates of law against one another in defining categories of fundamental significance for the legal system: life or nonlife; living matter or nonliving property; natural or socially constructed; public or private.[33]

In criminal jurisprudence, for example, courts have been reluctant to reopen convictions simply because advances in science, most especially DNA fingerprinting, now offer more definitive means of establishing the facts than when a case was originally tried. Thus, in *District Attorney's*

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30. JASANOFF, THE FIFTH BRANCH, *supra* note 5, at 250.

31. For a noted statement of this commitment to stability, even on the most contested issues in U.S. politics, see the Supreme Court's opinion in *Planned Parenthood of Southeastern Pennsylvania v. Casey*:

> The ability of women to participate equally in the economic and social life of the Nation has been facilitated by their ability to control their reproductive lives. The Constitution serves human values, and while the effect of reliance on *Roe* cannot be exactly measured, neither can the certain costs of overruling *Roe* for people who have ordered their thinking and living around that case be dismissed.

505 U.S. 833, 856 (1992) (citations omitted).

32. *E.g.*, Jennifer E. Laurin, *Criminal Law's Science Lag: How Criminal Justice Meets Changed Scientific Understanding*, 93 TEXAS L. REV. 1749, 1751–52 (2015) (explaining that even in the face of new scientific evidence that could exonerate thousands of individuals convicted of arson, it is rare for courts to revisit convictions).

33. *See* Sheila Jasanoff, *Introduction: Rewriting Life, Reframing Rights*, *in* REFRAMING RIGHTS: BIOCONSTITUTIONALISM IN THE GENETIC AGE 6 (Sheila Jasanoff ed., 2011) (listing the different issues of classification that courts must address when dealing with genetic technologies).

Office for the Third Judicial District v. Osborne,[34] a 5–4 majority of the Supreme Court held that inmates do not have a constitutional right to postconviction DNA tests.[35] Justice Roberts noted, "[t]he availability of technologies not available at trial cannot mean that every criminal conviction, or even every criminal conviction involving biological evidence, is suddenly in doubt. The dilemma is how to harness DNA's power to prove innocence without unnecessarily overthrowing the established system of criminal justice."[36] Eyewitness testimony, too, has not been definitively rejected as one of several forms of permissible evidence in criminal trials, despite mounting evidence of its unreliability from psychological and other studies.[37] In *Perry v. New Hampshire*,[38] the Supreme Court allowed the introduction of eyewitness testimony as long as it was not tainted by improper police conduct.[39] In defense of its holding, the Court asserted familiar dogmas of legal process: that "the jury, not the judge, traditionally determines the reliability of evidence" and there are "other safeguards built into our adversary system that caution juries against placing undue weight on eyewitness testimony of questionable reliability."[40]

In the area of bioethics, broadly defined, judicial decisions have repeatedly put social values such as the child's best interests, the integrity of the family unit, and the judiciary's own prerogatives above claims grounded in science. In one early and still notorious judgment, a California court refused to release Charlie Chaplin from child support payments to a baby girl conclusively shown not to be his by the blood tests of the time.[41] Motivating factors may have included the child's helplessness, Chaplin's wealth, doubts about the test, and the court's unwillingness to let science take over what it felt to be the responsibility of judging.[42] Today, the idea that paternity claims should not be settled by DNA tests would be

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34. 557 U.S. 52 (2009).

35. *Id.* at 72.

36. *Id.* at 62. The Court noted that many states already had enacted laws detailing the circumstances under which defendants could claim access to DNA tests. *Id.*

37. *See generally* ELIZABETH LOFTUS ET AL., EYEWITNESS TESTIMONY: CIVIL AND CRIMINAL 1–12 (5th ed. 2013) (providing an introduction to the concerns over eyewitness testimony and methods used to come to evaluate and address those concerns). *See also* Jennifer Mnookin, *Constructing Evidence and Educating Juries: The Case for Modular, Made-in-Advance Evidence About Eyewitness Identifications and False Confessions*, 93 TEXAS L. REV. 1809, 1818–21 (2015).

38. 132 S. Ct. 716 (2012).

39. *Id.* at 721. *See also* Adam Liptak, *Eyewitness Evidence Needs No Special Cautions, Court Says*, N.Y. TIMES, Jan. 11, 2012, *available at* http://www.nytimes.com/2012/01/12/us/supreme-court-says-witness-evidence-needs-no-special-cautions.html?_r=0, *archived at* http://perma.cc/P6AU-LHU6.

40. *Perry*, 132 S. Ct. at 728.

41. Berry v. Chaplin, 169 P.2d 442, 450–52 (Cal. Dist. Ct. App. 1946).

42. *See* Michael J. Saks, *Accuracy v. Advocacy*, TECH. REV., Aug.–Sept. 1987, at 43, 48.

considered preposterous, and yet reminders recur that, when it comes to ordering life, the law does not by any means regard science as the sole arbiter of outcomes. Many states, as well as the Uniform Parentage Act, for example, have adopted a presumption that a man is a child's father if he was married to the mother at the time the child was born;[43] this rule reflects a social commitment to the idea of marital stability regardless of any empirical counterevidence regarding the sexual behavior of married couples or the frequency of children conceived by women with partners outside of the marital relationship. In the landmark case of *Johnson v. Calvert*,[44] California's high court awarded maternal rights to the genetic mother rather than to the gestational surrogate, holding that gestation was merely a service.[45] As a result of that decision, the concept of a "natural" mother in California may now exclude the ("natural") biological fact of actually carrying a baby to term. In *Buzzanca v. Buzzanca*,[46] yet another innovative California family law decision, the court ruled that parenthood depends on the intention to procreate rather than on a necessary biological relationship between the father, the mother, and the child.[47]

Science and law confront each other less directly in the area of environmental decision making, where expert inputs arrive not through a polarizing adversarial process that pits lawyers against testifying experts and experts against one another, but through the work of advisory committees that function as first-line mediators between facts and values.[48] Questions raised during environmental litigation therefore tend to center on the agency–advisory relationship: is the expert advice on a given issue adequate for the purposes it is intended to serve, and are the regulatory agency's justifications good enough to support the decisions it ultimately reaches? Broadly speaking, landmark decisions on these issues show judges grappling not so much with the production of expert knowledge per se as with questions about the separation of powers and the extent of the judiciary's responsibility to make sure that underrepresented voices make

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43. UNIF. PARENTAGE ACT § 204 (amended 2002), 9B U.L.A. 27 (Supp. 2014).

44. 851 P.2d 776 (Cal. 1993) (in bank).

45. *Id.* at 778, 787. This decision may be contrasted, of course, with the landmark New Jersey case *In re Baby M*, 537 A.2d 1227 (N.J. 1988), in which the genetic and gestational mother, Mary Beth Whitehead, was denied custody of the baby girl to whom she had given birth based on an analysis of the best interests of the child. *Id.* at 1234–35. Though the facts and rulings were not identical, in both cases it was social values that controlled how each court weighed the competing claims of motherhood.

46. 72 Cal. Rptr. 2d 280 (Cal. Ct. App. 1998).

47. *Id.* at 282.

48. For an extended treatment of how that mediation works in practice, see JASANOFF, THE FIFTH BRANCH, *supra* note 5, at 85–100, discussing the cooperative relationship between the EPA and the Science Advisory Board.

their way into environmental proceedings.[49] Overall, the trend in administrative law has been to reduce the influence of environmentalist intervenors and to defer to agency discretion on matters involving its expert judgment.

Three examples are indicative. First, in *Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council, Inc.*,[50] the Supreme Court refused to demand additional procedures from the Atomic Energy Commission (AEC) despite a strong showing that the agency had paid only cursory attention to the risks of high-level radioactive-waste disposal.[51] Only Congress, the Court unanimously held, could stipulate the minimum procedures an agency needs to follow, and in this case the AEC had complied with, even exceeded, statutory requirements.[52] Second, six years later in *Chevron U.S.A. Inc. v. Natural Resources Defense Council, Inc.*,[53] the Court reaffirmed and strengthened its posture of deference in a holding that has become one of the most cited in administrative law.[54] *Chevron* offers a two-step solution to resolving the respective roles of Congress, the agencies, and the courts: first, where Congress has legislated on a specific issue and its intent is clear, both agencies and courts must defer to that intent; second, "if the statute is silent or ambiguous with respect to the specific issue, the question for the court is whether the agency's answer is based on a permissible construction of the statute."[55] As long as the agency's answer is so grounded, courts must defer to the agency's discretion.[56]

The third example consists of two Supreme Court decisions regarding the regulation of greenhouse gases responsible for climate change: *Massachusetts v. Environmental Protection Agency*[57] and *Utility Air Regulatory Group v. Environmental Protection Agency*.[58] Both cases revolved around the triadic relationship among Congress, the EPA, and the courts. In *Massachusetts v. EPA*, the Supreme Court held that the EPA has the

49. For more extended discussion, see generally JASANOFF, SCIENCE AT THE BAR, *supra* note 2, at 87–91 (describing factors outside of expert knowledge that courts have emphasized in landmark environmental cases).

50. 435 U.S. 519 (1978).

51. *Id.* at 543–45, 548.

52. *Id.* at 519–20, 549 n.21.

53. 467 U.S. 837 (1984).

54. Chris Walker, *Most Cited Supreme Court Administrative Law Decisions*, YALE J. ON REG. BLOG (Oct. 9, 2014), http://www.yalejreg.com/blog/most-cited-supreme-court-administrative-law-decisions-by-chris-walker, *archived at* http://perma.cc/N58D-3BHT. For an empirical analysis of *Chevron* deference in the Supreme Court's jurisprudence, see generally Connor N. Raso & William N. Eskridge, Jr., Chevron *As a Canon, Not a Precedent: An Empirical Study of What Motivates Justices in Agency Deference Cases*, 110 COLUM. L. REV. 1727 (2010).

55. *Chevron*, 467 U.S. at 842–43.

56. *Id.* at 843–44.

57. 549 U.S. 497 (2007).

58. 134 S. Ct. 2427 (2014).

authority to regulate greenhouse gases as an air pollutant under the broad language of the Clean Air Act (CAA).[59] Failure to exercise that authority, the Court further concluded, requires the agency to provide adequate reasons as to why it was refusing a petition for rulemaking.[60] The EPA had not provided such reasons, for example reasons based on lack of sufficient knowledge: "If the scientific uncertainty is so profound that it precludes EPA from making a reasoned judgment as to whether greenhouse gases contribute to global warming, EPA must say so."[61] The holding thus turned not on the strength of the findings of climate science in and of themselves, but on the Court's assessment of the clarity of the congressional mandate to EPA and the quality of the agency's justification for not regulating greenhouse gases. The Court's view that climate science had made distinct advances in the decades since the CAA's enactment no doubt affected its appraisal of EPA's reasons, but it was not in itself the basis for holding the agency to higher explanatory standards.

The Supreme Court's decision in *Utility Air Regulatory Group* (*UARG*) again turned on a concern with the right forms and limits of legal interpretation rather than on any deference to expert claims. At issue in that case was EPA's so-called Tailoring Rule, with which the agency sought to set a threshold limit for facilities that were not major polluters with respect to other airborne substances but had the potential to be significant emitters of greenhouse gases.[62] Justice Scalia, a dissenting voice in *Massachusetts*,[63] authored an opinion that for the most part upheld EPA's regulation of greenhouse-gas emissions from large stationary sources but struck down EPA's attempt to extend control to smaller sources that were not emitting other pollutants at high enough levels to warrant regulation.[64] Here, Scalia turned to *Chevron*'s first prong, arguing that EPA had subverted clear congressional intent: "We reaffirm the core administrative-law principle that an agency may not rewrite clear statutory terms to suit its own sense of how the statute should operate. EPA therefore lacked authority to 'tailor' the Act's unambiguous numerical thresholds to accommodate its greenhouse-gas-inclusive interpretation of the permitting triggers."[65] That interpretation shows Justice Scalia bowing to the decision in *Massachusetts*

59. Massachusetts v. EPA, 549 U.S. at 532. S*ee also* Clean Air Act, 42 U.S.C. §§ 7401–7671 (2012). As defined in 42 U.S.C. § 7602(g), "[t]he term 'air pollutant' means any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive (including source material, special nuclear material, and byproduct material) substance or matter which is emitted into or otherwise enters the ambient air."

60. *See* Massachusetts v. EPA, 549 U.S. at 533 ("But once EPA has responded to a petition for rulemaking, its reasons for action or inaction must conform to the authorizing statute.").

61. *Id.* at 534.

62. *Util. Air Regulatory Grp.*, 134 S. Ct. at 2437.

63. Massachusetts v. EPA, 549 U.S. at 549.

64. *Util. Air Regulatory Grp.*, 134 S. Ct. at 2446.

65. *Id.*

to extend the definition of air pollutant to include greenhouse gases, while still opting for as narrow as possible a reading of the CAA so as to limit EPA's regulatory reach over this class of emissions.

Justice Breyer's partial concurrence in *UARG* also turned on the limits of permissible statutory construction, but in a way that would have expanded EPA's rulemaking jurisdiction. Illustrating the sometimes arcane metaphysical bent of constitutional jurisprudence, Breyer focused on the interpretive latitude conferred by the word "any" in the statute.[66] Ultimately, he indicated, his difference with the majority lay in the assignment of "interpretive flexibility"[67] to the word "any" as a modifier of sources rather than pollutants.[68] The passage is worth quoting in full for our purposes:

> The implicit exception I propose reads almost word for word the same as the Court's, except that the location of the exception has shifted. To repeat, the Court reads the definition of "major emitting facility" as if it referred to "any source with the potential to emit two hundred fifty tons per year or more of any air pollutant *except for those air pollutants, such as carbon dioxide, with respect to which regulation at that threshold would be impractical or absurd or would sweep in smaller sources that Congress did not mean to cover*." I would simply move the implicit exception, which I've italicized, so that it applies to "source" rather than "air pollutant": "any *source* with the potential to emit two hundred fifty tons per year or more of any air pollutant *except for those sources, such as those emitting unmanageably small amounts of greenhouse gases, with respect to which regulation at that threshold would be impractical or absurd or would sweep in smaller sources that Congress did not mean to cover*."[69]

This exchange between Breyer and Scalia, paralleling the lines of disagreement laid out in *Massachusetts v. EPA*, illustrates once more how the law accords precedence to its own institutional self-understandings—in this case, to rules of statutory construction—over and above any deference accorded to science.

IV. The Cascade of Deference

In an article reflecting on thirty years of *Chevron* jurisprudence, Abbe Gluck comments that the most influential administrative law case of all

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66. *Id.* at 2451–53 (Breyer, J., concurring in part and dissenting in part).

67. This term was popularized by STS scholar Harry Collins to describe the fact that scientific observations lend themselves to many different interpretations, leading to multiple possible conclusions. H. M. Collins, *Stages in the Empirical Programme of Relativism*, 11 SOC. STUD. SCI. 3, 4–5 (1981).

68. *Util. Air Regulatory Grp.*, 134 S. Ct. at 2452–53 (Breyer, J., concurring in part and dissenting in part).

69. *Id.*

time is founded on a cartoonish, "Schoolhouse Rock!" version of the legislative process: "The doctrines generally assume that statutes are drafted by a single or cohesive group of people; that when there is a delegation it is to one, federal, agency; and that statutes progress from committee, to floor, to vote, to conference just as the cartoon taught us."[70] Gluck implies that a goal for the next thirty years would be a more realistic judicial acknowledgment of "unorthodox" legislation, taking account of variability and incoherence in the context and content of legislation—although, as she notes, such evolution on the part of the courts would undermine their current monopoly power over "*court-created* presumptions of interpretation."[71]

Interestingly, this otherwise thoughtful analysis of the interpretive flexibility of statutory texts pays no heed to the varied ways in which statutes incorporate a different delegation, that to technical experts. The remainder of this Article considers how a mature understanding of the nature of scientific fact making might influence the law's constructions of its supervisory mission with respect to inputs from science. How in particular might judicial responses change if the legal system abandoned its cartoonish, or at the very least idealized, views of the scientific method? Of course, *some* stylization, or simplification, of science may be necessary for practical reasons when the law is seeking to define its responsibilities vis-à-vis science. It is reasonable to suppose, for instance, that more deference is warranted when scientific claims are very strong, whereas greater intrusion of legal judgment is justified when claims are weak.[72] To prompt more systematic thinking about the relationship between scientific authority and legal responsibility, I propose a cascade of deference as science moves from high to low degrees of certainty and reliability. Four stopping points can be identified for critical reflection on the law-science relationship: objectivity, consensus, precaution, and subsidiarity.

A. Objectivity

Objectivity occupies a special place in all discussions of science. Philosophers and sociologists of science have long asked what makes

70. Abbe R. Gluck, *What 30 Years of* Chevron *Teach Us About the Rest of Statutory Interpretation*, 83 FORDHAM L. REV. 607, 628 (2014).

71. *Id.* at 630.

72. The terms "strong" and "weak" call out for further analysis, but one can see *Daubert* and its progeny in part as an ongoing effort on the part of the courts to do just that. Besides the *Daubert* criteria themselves, widely accepted indicators of the strength of scientific claims include replication, repeated review of conclusions (for example, in the case of IPCC reports on climate science), and demonstration through applications to technology. *See, e.g.*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, GUIDANCE NOTE FOR LEAD AUTHORS OF THE IPCC FIFTH ASSESSMENT REPORT ON CONSISTENT TREATMENT OF UNCERTAINTIES 1 (2010) (identifying mechanistic understanding, theory, data, models, and expert judgment as well as degree of agreement as appropriate qualitative metrics for expressing certainty in findings).

science special. How does science produce truthful accounts of nature, and what in turn accounts for its rise in stature to the point where no modern societies could think of living without its services? One answer is that only science produces objective knowledge—facts that can be relied upon by all people everywhere regardless of their cultural affiliations or interests. Objectivity almost by definition demands a high degree of deference, since once a factual claim on an issue is established as objective, all competing claims must necessarily be seen as biased or distorted. Explanations of how science establishes its objectivity vary, however, with dramatically different accounts coming from different disciplines, historical periods, and cultural contexts. The law has traditionally looked to philosophy of science for authoritative insights into the nature of science, but for the law's purposes, sociological insights that illuminate the processes of doing science hold greater promise.[73]

Where philosophers sought to ground their explanations of objectivity in abstract ideas of theoretical adequacy and logical coherence, sociologists turned instead to the empirical details of how scientists function as members of organized communities who are at the same time embedded in wider social and cultural networks. A particularly influential analysis was that of Robert K. Merton, who posited in a 1942 article that science depends for its success, and its capacity to resist assaults on its authority, on a strong set of internal norms that scientists practice because of their shared commitment to discovering the facts of nature.[74] Merton identified four such norms: communalism (findings are shared by all scientists), universalism (facts are the same everywhere), disinterestedness (scientists do not work for external interests), and organized skepticism (claims and findings are skeptically reviewed).[75] He did not explicitly address the objectivity of scientific claims, but the account he provided—of scientists working for the advancement of universal understanding under the sharp, critical gaze of their peers—also functioned as an explanation for science's objectivity. In Merton's view, nonobjective scientific findings would get weeded out through shared findings, demands for universal validity, and responsible peer review. Science's institutional need for certifiably reliable knowledge would ensure that these processes would function effectively to produce a science largely untainted by subjective bias.

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73. An earlier, somewhat differently focused version of this argument appeared in Sheila Jasanoff, *What Judges Should Know About the Sociology of Science*, 32 JURIMETRICS J. 345 (1992).

74. ROBERT K. MERTON, *The Normative Structure of Science*, *in* THE SOCIOLOGY OF SCIENCE: THEORETICAL AND EMPIRICAL INVESTIGATIONS 267, 267–68 (Norman W. Storer ed., 1973). Merton's article was initially written when European science was under attack from totalitarian political forces of the left and right.

75. *Id.* at 270.

STS scholarship today regards Merton's norms less as an authoritative account of how science is actually practiced than as a compelling statement of the ideology of science.[76] This shift in perspective derives from a confluence of many streams of observation and critique. To begin with, empirical studies of science in action display a field rife with ego, competitiveness, secrecy, and interest[77]—a far cry from the idealized sharing for the collective good posited by Merton. Further, as science became a pervasive feature of modern culture, inquiry for inquiry's sake receded in significance. Even publicly funded basic research, conducted without thought of immediate financial gain, must be justified with plausible demonstrations of its broader impacts on society.[78] It is widely accepted that the great bulk of scientific activity today is conducted to support some sort of social need.[79] At the same time, the growth of interdisciplinarity and the dispersal of scientific work across varied types of nonacademic institutions (e.g., national labs, industry, spin-offs and start-ups, and consulting companies) have eroded the notion of "organized skepticism."[80] Much science today is conducted without the cross-checks of established disciplinary standards and the supervision of clearly identifiable communities of peers.[81] Against this backdrop, objectivity itself is better understood not as an intrinsic attribute of science but as a perceived characteristic of scientific knowledge, arrived at through

76. *See* Michael J. Mulkay, *Norms and Ideology in Science*, 15 SOC. SCI. INFO. 637, 640 (1976) (characterizing Merton's work as a "grossly misleading" depiction of how science is practiced).

77. *See, e.g.*, WILLIAM BROAD & NICHOLAS WADE, BETRAYERS OF THE TRUTH 212–13 (1982) (summarizing the reasons why a scientist might commit fraud); DANIEL S. GREENBERG, SCIENCE, MONEY, AND POLITICS: POLITICAL TRIUMPH AND ETHICAL EROSION 1–3 (2001) (describing the bureaucracy of science as a "clever, well-financed claimant for money" whose values have been "eroded" and explaining the presence and importance of money in the politics of science); SHELDON KRIMSKY, SCIENCE IN THE PRIVATE INTEREST: HAS THE LURE OF PROFITS CORRUPTED BIOMEDICAL RESEARCH? 179 (2003) (characterizing the trend in academic science as moving toward "trade secrecy, intellectual property, . . . conflict of interest . . . [and] erosion of public trust"). *See generally* LATOUR, *supra* note 6 (conducting a classic laboratory study debunking the myth of disinterestedness in science).

78. The National Science Foundation, the principal funder of basic scientific research in the United States, requires all grant applicants to address two criteria in their proposals: intellectual merit and broader impacts. NAT'L SCI. FOUND., PROPOSAL AND AWARD POLICIES AND PROCEDURES: PART I – GRANT PROPOSAL GUIDE, at II-9 (2014).

79. *See, e.g.*, MICHAEL GIBBONS ET AL., THE NEW PRODUCTION OF KNOWLEDGE: THE DYNAMICS OF SCIENCE AND RESEARCH IN CONTEMPORARY SOCIETIES 30–31 (1994) (summarizing the shift in knowledge production toward a new framework with transdisciplinary contexts).

80. *See* Gary Edmond, *Merton and the Hot Tub: Scientific Conventions and Expert Evidence in Australian Civil Procedure*, LAW & CONTEMP. PROBS., Winter 2009, at 159, 170 (2009) ("Norms such as . . . 'organized skepticism' encounter more fundamental difficulties when considered in the context of changes to the organization and funding of scientific and biomedical research in the post-war era.").

81. *Id.* at 171.

culturally conditioned practices. The objectivity of science, in short, is socially constructed.

Comparative work across national regulatory systems underscores these conclusions. Although democratic societies generally demand that public decisions should rest as far as possible on a bedrock of objective knowledge, the ways in which that demand is met vary considerably across political systems. In particular, national administrative procedures have tended to pay different degrees of attention to three bodies whose roles are crucial to the production of reliable public knowledge: the "body" of the individual expert; the body of relevant knowledge; and the advisory body charged with assessing science for action.[82] Table 1 presents a summary of these findings for the United States, United Kingdom, and Germany. While these differences are necessarily schematic, and do not account for considerable within-country variations, this comparison highlights the very different mechanisms through which it is possible to achieve the appearance of objectivity in a decision-making system.

Table 1: Three Bodies of Expertise: a Cross-National Comparison

	United States	**United Kingdom**	**Germany**
Embodied experts	Most technically qualified experts	Experienced "safe hands"	Authorized institutional representatives
Bodies of knowledge	Formally grounded knowledge ("sound science")	Empirically demonstrated facts (common knowledge)	Collectively reasoned knowledge (public knowledge)
Advisory bodies	Pluralistic, interested, but fairly balanced (stakeholder)	Members capable of discerning the public good (civil service)	Representative and inclusive of all relevant views (public sphere)

The law for the most part has paid little heed to these kinds of systemic variations in the production of public knowledge, preferring to maintain as

82. *See generally* Sheila Jasanoff, *Judgment Under Siege: The Three-Body Problem of Expert Legitimacy*, *in* DEMOCRATIZATION OF EXPERTISE?: EXPLORING NOVEL FORMS OF SCIENTIFIC ADVICE IN POLITICAL DECISION-MAKING 209, 211 (Sabine Maasen & Peter Weingart eds., 2005) (describing the "three bodies that are relevant to the effective integration of science and politics"); Sheila Jasanoff, *The Practices of Objectivity in Regulatory Science*, *in* SOCIAL KNOWLEDGE IN THE MAKING 307 (Charles Camic et al. eds., 2011) (summarizing how knowledge created to serve policy needs differs from other forms of knowledge).

stylized a view of science in the making as *Chevron* does of statutes in the making. Yet, acknowledging the constructedness of objectivity would permit the law to fill in gaps and deficiencies that science on its own has failed to remedy. Law work in relation to claims of scientific objectivity then would consist of asking hard questions about the processual hinterland of expert claims. Were the procedures sufficiently attentive to the legitimacy of all three "bodies," that is, to individual, disciplinary, and group integrity? In effect, these are the kinds of questions that Judge David Bazelon of the D.C. Circuit Court of Appeals urged should be posed to regulatory agencies in the late 1970s, including in the lead-up to *Vermont Yankee*.[83] The blanket rule of deferring to Congress with regard to the minimum procedures required of agencies may achieve repose, but as Judge Bazelon intuitively appreciated it disregards the complex, discretionary, even intentionally political moves by which agencies gather knowledge to support their regulatory actions.

B. Consensus

Scientific authority is on strongest ground when it lays claim to objectivity (i.e., unbiased knowledge of how things *are*), but consensus remains an only slightly weaker basis for demanding deference. Here, the argument is not that science has been able to access unvarnished truth, but rather that relevant scientific communities have been able to set aside all theoretical and methodological disagreements to come together on a shared position. If most or all members of the relevant thought collective are in agreement, then that collective judgment surely demands a high degree of respect from society in general and the law more particularly.

Many governance processes in modern societies contain built-in mechanisms for producing scientific or technical consensus. In the regulatory system, this is the task of expert advisory committees who gather and assess information with the explicit aim of generating a group position on contested facts.[84] One of the most pressing environmental issues of our time, climate change, commands as much global attention as it does at present because the body responsible for assessing the science, the Intergovernmental Panel on Climate Change (IPCC), worked over five successive report cycles to create a consensus on the anthropogenic origins of climate change and some of the dire implications of unchecked global-mean-temperature rise.[85] Despite its enormous influence on the climate

83. JASANOFF, SCIENCE AT THE BAR, *supra* note 2, at 76–77.

84. JASANOFF, THE FIFTH BRANCH, *supra* note 5, at 1.

85. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, FIFTH ASSESSMENT REPORT (2014), *available at* http://www.ipcc.ch/report/ar5/, *archived at* http://perma.cc/R7QA-8AAZ.

debate, the IPCC insists that its findings are "policy-relevant and yet policy-neutral, never policy-prescriptive."[86]

It is tempting for the legal system to take evidence of consensus as sufficient reason to back off from further inquiry into science's internal processes, which are taken to be adequately self-reflective and responsible. Indeed, when a consensus has formed, attempts to destabilize that consensus tend to appear wasteful, even illegitimate,[87] especially when dissenting voices are funded by those with an interest in evading the implications of an "inconvenient truth."[88] Undoubtedly the most notorious of these efforts was the attempt by the tobacco industry to subvert massive epidemiological evidence that smoking has disastrous implications for public health; indeed, "tobacco science" became a national byword for fraudulent science in the service of money.[89] A spate of critical writing in recent years has drawn attention to varied industry efforts to head off regulation by generating flawed science to sow doubt where none should have existed.[90]

The existence of a strong scientific consensus may dilute the need to scrutinize scientific claims, but it is not an invitation for the law to abdicate its normative responsibilities. Those begin with the threshold question of delegation. If scientific consensus should serve as a prod to social choice, then what gives experts standing to exercise such policy-shaping authority? Are they acting in accordance with transparent and understandable rules of delegation? Answers to these questions are far from self-evident, as evidenced by cross-national differences in approaches to soliciting expert advice. For example, since the dissolution of the Office of Technology Assessment,[91] the U.S. Congress has had no institutionalized means of obtaining expert advice on specific legislative issues or problems. By contrast, when the German *Bundestag* (Parliament) wishes to legislate on an issue of technical complexity, it frequently establishes an Inquiry

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86. *Organization*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, http://www.ipcc.ch/organization/organization.shtml, *archived at* http://perma.cc/Y7SJ-M8H8.

87. *See, e.g.*, Naomi Oreskes, *Beyond the Ivory Tower: The Scientific Consensus on Climate Change*, 306 SCIENCE 1686, 1686 (2004) (insisting on the immediate policy relevance of the consensus position on climate change, despite many details of climate dynamics not being well understood).

88. Former Vice President Al Gore's Nobel Prize-winning 2006 documentary on climate change was named *An Inconvenient Truth*, implicitly calling attention to the political implications of the emerging climate consensus. AN INCONVENIENT TRUTH (Paramount Classics 2006).

89. *See, e.g.*, Erica Etelson, *Move to Limit and Tax Soda is the New Tobacco Fight*, S.F. EXAMINER, Sept. 30, 2014, http://www.sfexaminer.com/sanfrancisco/move-to-limit-and-tax-soda-is-the-new-tobacco-fight/Content?oid=2907697, *archived at* http://perma.cc/6K59-9D4E (noting how tobacco science was distorted by the tobacco industry for years to the point of being known as junk science).

90. *See supra* note 22.

91. BRUCE BIMBER, THE POLITICS OF EXPERTISE IN CONGRESS: THE RISE AND FALL OF THE OFFICE OF TECHNOLOGY ASSESSMENT 69 (1996).

Commission (Enquete Kommission) to look into the matter and offer guidance.[92] Membership on these committees is determined by the political parties in accordance with their fractional representation in the legislature.[93] That approach, Germans believe, leads to a reliable and actionable consensus, legitimate because it respects all important political positions and stable because no one is excluded.[94] Yet, this mixing of science and politics struck a U.S. National Research Council (NRC) study group as a flawed way to proceed.[95] Calling this a weakness of the German system, the NRC commented: "Experts selected by the factions of Parliament were not nominated by scientific bodies but directly appointed by a political party, which could have some significant ramifications in terms of the credibility and legitimacy of the process."[96]

Yet from an STS-informed point of view, nomination by scientific bodies is no less a political choice than selection by political parties. The difference is that, in the U.S. case, the political dimensions are less openly visible because of the strategic boundary work and staging done to present science as apolitical.[97] Indeed, one might conclude that the German process makes explicit and transparent the fact that for the legislature to seek an expert consensus is itself a form of political delegation; legislative appointment of experts simply holds the appointees accountable to ordinary norms of democratic representation. The exercise of expert judgment, moreover, necessarily involves making value choices, from the framing of relevant questions to the weight accorded to specific pieces of evidence.[98] An inquiry into the dynamics of scientific consensus during legal proceedings may help bring these moments of tacit normative choice to light in ways that foster greater accountability.

C. Precaution

Next down on the cascade of deference is a position where science is marked by significant uncertainty and a potential exists for severe and irreversible harm if policy makers follow what turns out to be the wrong

92. NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., ANALYSIS OF GLOBAL CHANGE ASSESSMENTS: LESSONS LEARNED 90 (2007).

93. *Id.* at 90.

94. *Id.* at 90–92.

95. *Id.* at 92.

96. *Id.*

97. *See, e.g.*, STEPHEN HILGARTNER, SCIENCE ON STAGE: EXPERT ADVICE AS PUBLIC DRAMA 51–54 (2000) (describing how the National Academy of Sciences tries in its authoritative reports to use an "impartial tone" with regard to "sensitive policy issues" and how such reports are carefully crafted behind the scenes to present an "impression of objectivity, unity, and credibility" despite differing opinions).

98. *See, e.g.*, NAT'L RESEARCH COUNCIL, UNDERSTANDING RISK: INFORMING DECISIONS IN A DEMOCRATIC SOCIETY 103–04 (Paul C. Stern & Harvey V. Fineberg eds., 1996) (describing how analytic techniques to reduce risk "necessarily embed value choices").

course. These two policy triggers—scientific uncertainty and the likelihood of serious harm—are consistent with a number of statements and definitions of the precautionary approach from public and private bodies, including Principle 15 of the 1992 Rio Declaration[99] and the 1998 Wingspread Consensus Statement on the Precautionary Principle.[100] In Europe, precaution is endorsed by the 1992 Maastricht Treaty, one of the constitutive documents of the European Union (EU).[101] Article 130r(2) provides that

> [c]ommunity policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Community. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay.[102]

While not defined in the Treaty itself, the principle was construed in a EU Communication of 2000 as covering not only environmental protection but

> those specific circumstances where scientific evidence is insufficient, inconclusive or uncertain and there are indications through preliminary objective scientific evaluation that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the chosen level of protection.[103]

If the preconditions for precaution are met, the EU Communication demands three forms of action: an evaluation of the degree of scientific uncertainty carried out by an independent authority; an assessment of the risks and consequences of inaction; and participation by interested parties under conditions of transparency.[104]

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99. Principle 15 states, "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." United Nations Conference on Environment and Development, Rio de Janeiro, Braz., June 3–14, 1992, *Rio Declaration on Environment and Development*, princ. 15, U.N. Doc. A/CONF.151/26/Rev.1 (Vol. I), Annex I (Aug. 12, 1992).

100. The Wingspread Statement emerged from a 1998 conference on the precautionary principle and its formulation has been widely cited by advocates for the environment and public health: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically." *Wingspread Statement on the Precautionary Principle*, SCI. & ENVTL. HEALTH NETWORK, Jan. 1998, http://www.sehn.org/state.html#w, *archived at* http://perma.cc/7Y4H-XB3Z.

101. Treaty on European Union art. 130r(2), Feb. 7, 1992, 1992 O.J. (C 191) 28.

102. *Id.*

103. *Communication from the Commission on the Precautionary Principle*, at 10, COM (2000) 1 final (Feb. 2, 2000).

104. *Id.* at 17.

The precautionary approach also has diverse roots in U.S. environmental and health and safety law, most notably in the National Environmental Policy Act (NEPA) requirement that federal agencies should assess the environmental impacts of "major Federal actions significantly affecting the quality of the human environment," and consider both unavoidable adverse effects and alternatives to the proposed action.[105] Nevertheless, many U.S. commentators dismiss the precautionary principle as antitechnology, unworkable, and even unprincipled.[106] Attempts to evaluate the practical application of the precautionary principle in the United States and Europe have led others to conclude that there is no transatlantic divide in aggregate levels of precaution but that different issues are treated differently in the two regions.[107]

While these findings could be questioned and refined through STS analysis, that is not the purpose of this Article. It is more important for us to ask how the law should position itself vis-à-vis science when the widely accepted preconditions for precaution are met, that is, when knowledge is uncertain and there is a significant probability of grave, possibly irreparable, harm. Rather than deconstruct the fact-finding process, or try to press experts toward greater consensus, it makes more sense for the law to assert its fundamental concern for justice when science is weak.

This can be done by insisting that decision makers employ what I have elsewhere called "technologies of humility"[108]—techniques that shift attention from what can be done to what should be done when unequal distributive outcomes are at stake. Such analysis can be organized under four headings:

- Framing: How was the policy issue framed and would other framings be more inclusive or responsive to society's needs?
- Vulnerability: What factors render some groups more vulnerable to harm than others and can those factors be mitigated?
- Distribution: What distributive consequences will the proposed action have and what can be done to ensure that negative consequences will not be unequally distributed?
- Learning: What can be learned from the multiplicity of stories and explanations that diverse social groups offer for

105. 42 U.S.C. § 4332(2)(C) (2012).

106. *E.g.*, Jonathan Adler, *The Problems with Precaution: A Principle without Principle*, AM. ENTERPRISE INST. (May 25, 2011), http://www.aei.org/publication/the-problems-with-precaution-a-principle-without-principle/, *archived at* http://perma.cc/U3EK-YDL8.

107. Jonathan B. Wiener, *The Rhetoric of Precaution*, *in* THE REALITY OF PRECAUTION: COMPARING RISK REGULATION IN THE UNITED STATES AND EUROPE 3, 28 (Jonathan B. Wiener et al. eds., 2011).

108. Sheila Jasanoff, *Technologies of Humility: Citizen Participation in Governing Science*, 41 MINERVA 223 (2003).

> harms that have befallen them, and can the narratives of marginalized groups be given greater weight?

One example of such a technology of humility in existing U.S. administrative practice is President Clinton's Executive Order 12,898 of 1994, which required federal agencies to identify and address "disproportionately high and adverse human health or environmental effects of [their] programs, policies, and activities on minority populations and low-income populations."[109] This mandate to consider the distributive impacts of federal policy applies to all federal programs, policies, and actions and operates independently of parallel debates about the policy's scientific foundations. It exemplifies a turn toward justice that does not require any prior move through the eye of the needle of scientific reason.

D. Subsidiarity

Fourth and finally, law and science sometimes interact in situations where facts are either nonexistent or else profoundly contested and nothing remotely approaching an epistemic consensus exists. Sometimes such situations reflect participants' inability to agree on a common framing of a problem that would allow parties to engage in rational technical debate. For example, those who believe that nuclear power, because of its need for secrecy and high security, poses insurmountable challenges for democratic governance will not easily find common ground with those who believe power-plant risks are largely physical and can be reduced to acceptable levels. Opponents of genetically engineered crops who fear loss of biodiversity, the rise of resistant pests, or threats to their nation's food security will find it difficult if not impossible to make common cause with those who believe there is no evidence of risk from plant genetic modification (GM) and that the technology is indispensable for meeting the world's growing food needs. Other times there simply may not be sufficient available knowledge to rule out either of two competing beliefs as invalid, much as in the case of the wave theory and the particle theory of light.[110]

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109. Exec. Order No. 12,898, 59 Fed. Reg. 7629 (Feb. 11, 1994).

110. *See* Rhett Allain, *Is Light a Wave or a Particle?*, WIRED, July 11, 2013, http://www.wired.com/2013/07/is-light-a-wave-or-a-particle, *archived at* http://perma.cc/CUV6-FE6P (discussing the key concepts and main differences of the light and particle theories). Note that American creationists have raised just this kind of claim in demanding that schools be allowed to teach both evolution and creationism of intelligent design. *See, e.g.*, Edwards v. Aguillard, 482 U.S. 578, 581 (1987) (considering the constitutionality of a Louisiana statute, passed on a theory of academic freedom, that mandated the teaching of both creation science and evolution where either was to be taught). Similarly, parents wishing to protect children against vaccines they consider dangerous have in effect raised issues of epistemic subsidiarity. *See, e.g.*, James G. Hodge, Jr. & Lawrence O. Gostin, *School Vaccination Requirements: Historical, Social, and Legal Perspectives*, 90 KY. L.J. 831, 844–49 (2002) (noting how vaccination opponents express valid scientific objections about their effectiveness and other harmful effects). Critiquing these

Under such conditions of nonreconcilable frames or nonknowledge, it may be necessary for modern societies to recognize a principle of epistemic subsidiarity, on the grounds that "in an increasingly secular age, people's preference for styles of reasoning ought to be accorded the same kind of protection that we accord, for example, to a state's constitutional choices regarding how to organize the branches of government or how to vote in popular elections."[111] Just as political subsidiarity devolves decision-making power to the lowest levels of responsible government, so epistemic subsidiarity would in principle allow subordinate segments of a polity, such as states in a federal union or nations in the international order, to hold on to their own ways of knowing and their own collective knowledge on contested issues.

Recognizing a subsidiarity principle, however, marks the beginning rather than the endpoint of law work, as conceived here. First, subsidiarity itself may take numerous different forms, such as coexistence, cosmopolitanism, and constitutionalism. In a regime of coexistence, each autonomous polity can maintain its beliefs without needing to respect the other party's position. A paradigm case is the freedom to use or not use GM crops, only with an obligation on the part of GM users to prevent contamination of non-GM fields.[112] A regime of cosmopolitanism demands that all parties agree to respect each other's judgments even though they do not adopt each other's norms or reasoning. A paradigm case from the domain of bioethics, broadly speaking, would be a willingness on the part of those who see in vitro fertilization (IVF) as "unnatural" nevertheless to accept other peoples' IVF children as equal to their own naturally conceived offspring.[113] Finally, in a regime of constitutional subsidiarity, supra-arching principles and processes of reflection would help harmonize divergent epistemic positions. In such a system, epistemic differences

kinds of claims is beyond the purposes of this Article, but it should be emphasized that they do not meet the threshold test laid out above for making epistemic subsidiarity claims—namely, that strong and tested science consensus does not exist on relevant issues or the science is so deeply contested as to provide no common ground for reasoning.

111. Sheila Jasanoff, *Epistemic Subsidiarity–Coexistence, Cosmopolitanism, Constitutionalism*, 2013 EUR. J. RISK REG. 133, 136.

112. *See Genetic Engineering, Plants, and Food: The European Regulatory System*, GMO COMPASS (June 2, 2006), http://www.gmo-compass.org/eng/regulation/regulatory_process/156.european_regulatory_system_genetic_engineering.html, *archived at* http://perma.cc/VSX7-RKWK (discussing European regulations that allow for freedom of choice, but that require "[g]enetically modified plants must be grown and handled in such a way that prevents uncontrolled mixing with conventional products").

113. A controversy in the world of celebrity fashion and art in early 2015 illustrates a lack of such ethical cosmopolitanism. Isla Binnie, *Elton John Slams Dolce & Gabbana Over "Synthetic Baby" Comments*, REUTERS, Mar. 15, 2015, *available at* http://www.reuters.com/article/2015/03/15/us-people-eltonjohn-d-g-idUSKBN0MB0VV20150315, *archived at* http://perma.cc/X4Y9-Z2VM. The designer team Dolce and Gabbana and the singer–songwriter Elton John called for a boycott of each other's artistic creations when the former referred to IVF children as "chemical" and "synthetic," eliciting angry reactions from John, the father of two such children. *Id.*

might still persist, but members of the polity would agree on principles of accountability to ensure that experts and officials everywhere are held comparably accountable for their beliefs and decisions.

V. Conclusion

Questions about the appropriate relationship between law and science are often posed, as they were for this symposium, in terms of improving the flow of scientific knowledge into legal proceedings. That framing of the issues is importantly asymmetric in that it downplays the law's institutional responsibility to maintain order and stability in scientifically and technologically advanced societies, while also protecting liberty and delivering justice. A less one-sided analysis of law's interactions with science leads, as argued above, to a different mapping of the terrain, one more attentive to appropriate and inappropriate forms of deference than to making judges more competent to assess the principles and methods used by scientists.

Two initial moves laid the groundwork for the symmetrical treatment of law and science advocated here: first, a focus on science *for* action rather than science *in* action; and, second, a turn from truth in the abstract to serviceable truths, so as to strike a better balance between the law's epistemic and normative functions. Making these moves not only helps improve the law's capacity to reflect on its own considerable role in producing and transmitting new scientific and technical expertise, it also permits legal scholarship to become more conversant with work in STS that has analyzed how scientific claims become intelligible and useful in contexts beyond their original sites of production. More specifically, these moves permit legal analysts to operate with a sociologically inflected understanding of how science is made in practice, which in turn helps clarify the kinds of questions the law should put to science before deferring to science's putative epistemic authority.

The cascade of deference framework laid out above reveals first and foremost that there is significant law work to be done even when science claims to be objective and hence speaks with utmost authority. STS research has shown objectivity to be a historical and cultural construct; in the interests of both truth and justice, questions need to be asked about the process by which the appearance of objectivity was produced. Consensus claims similarly should not simply be taken on faith but rather as invitations to an inquiry into the legitimacy of the consensus-building process, with a particular focus on who was at and who was not at the tables where consensus was achieved. When science rests on weaker foundations, the work of the law can reasonably shift toward more normative concerns. Thus, in situations where knowledge is uncertain and precaution is warranted, the law can serve society's needs best by ensuring decision makers' use of technologies of humility. And in cases where little or no basis exists to prefer one interpretation of the facts over another, the law can play a valuable role by laying down workable rules of epistemic subsidiarity.

In sum, by taking up the complex and nuanced picture of science that has emerged from STS scholarship over the past several decades, legal institutions can sharpen their powers of normative reflection and intelligent rulemaking. The result would be a culture of genuine enlightenment in which neither law nor science plays second fiddle to the other, but both are equally engaged in building just and knowledgeable societies.