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Respecting Pandora's Box

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In *Barely Opening, Then Slamming Shut, Science's "Black Box" in Law: A Response to Beecher-Monas'* Heuristics,[1] David Caudill's thoughtful critique of my article, *The Heuristics of Intellectual Due Process: A Primer for Triers of Science,*[2] he makes a significant point: the social aspects of science are important. He applauds my attempt to "rise[] above the 'science wars'"[3] by emphasizing both that "science is a social enterprise" *and* that it is "a relatively reliable, predictive endeavor."[4] However, he questions whether my heuristic incorporated the social concerns.

Professor Caudill criticizes my opening the "black box of science" by acknowledging social construction of scientific argument, but then slamming it shut by failing to incorporate these social aspects of science into the proffered framework for analysis. To help judges make decisions about scientific validity, Professor Caudill would have them fully explore "the impact on science of, for example, values, funding, government policy, discursive regimes, governing metaphors, race and gender bias, rhetorical conventions, and interpretive frameworks"[5] as well as the nuances of disagreement between various philosophers of science.[6] My response is twofold: First, my perception is that lawyers already vociferously inform judges about these factors; and second,

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[1] David S. Caudill, *Barely Opening, Then Slamming Shut, Science's "Black Box" in Law: A Response to Beecher-Monas's* Heuristics, 23 CARDOZO L. REV. 1795 (2002).

[2] Erica Beecher-Monas, *The Heuristics of Intellectual Due Process: A Primer for Triers of Science*, 75 N.Y.U. L. REV. 1563 (2000).

[3] Caudill, *supra* note 1, at 1795.

[4] *Id.* at 1796.

[5] *Id.* at 1799.

[6] *Id.* at 1800-04. *But see* Beecher-Monas, *supra* note 2, at 1568 n.12 (acknowledging disagreements, but emphasizing areas of common understanding as well as "insights about particular aspects of the validity determination").

focusing on contingencies without emphasizing commonalities gives judges a lopsided understanding of the scientific enterprise.

With regard to the effects of social context on science, Professor Caudill acknowledges that "[s]uch effects are not necessarily or even usually indicative of error or invalidity, and understanding their functions in a particular field of expertise is not always significant,"[7] but does not explain how such effects become significant, or how to distinguish the significant from the insignificant. Where such effects are significant, I suspect that lawyers pounce on them, as a familiar exercise in deconstruction, and a welcome relief from having to examine the substance of the scientific argument.[8] After all, most textbooks on trial techniques include inquiries into bias, interest, and professional disagreements as traditional cross-examination tools.[9]

More importantly, an exclusive focus on deconstructing cultural contingencies—however accurate the focus—may eclipse useful and helpful information with needless controversy.[10] A recurring problem in scientific evidence is that judges misread minor disagreements over nuance as invalidating an entire area of research.[11] For example, many judges are blinded by debate over the analogic worth of animal studies for human effects.[12] This is not really controversial in science, although it is an imperfect analogy and may occasionally be inapt.[13]

Unfortunately, judges often fail to see the forest of agreement for the trees of controversy. Rather than focus on differences, disagreements and imperfections, I chose to acknowledge them and look for common ideas about what distinguishes good from bad scientific argument. My point in organizing the heuristic was

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[7] Caudill, *supra* note 1, at 1806.

[8] For an argument about how judges frequently attempt to circumvent the science in scientific evidence, see Erica Beecher-Monas, *Blinded by Science: How Judges Avoid the Science in Scientific Evidence*, 71 TEMPLE L. REV. 55 (1998).

[9] *See, e.g.*, THOMAS A. MAUET, FUNDAMENTALS OF TRIAL TECHNIQUES 254, 288-90 (1980) (advising that "cross-examination must, bit by bit, make mountains out of molehills" and suggesting that fruitful areas of cross-examination include the expert's motives, biases, and professional disagreements in the field).

[10] *See* Beecher-Monas, *supra* note 2, at 1609-10.

[11] *See* Joseph Sanders, *From Science to Evidence: The Testimony on Causation in the Bendectin Cases*, 46 STAN. L. REV. 1, 47 (1993) (noting the problem of the "one-eyed factfinders" who, lacking "depth perception" tend to give all scientific evidence "equal value and relevance"). Professor Sanders observed that in the litigation over the anti-nausea drug Bendectin, factfinders "learned little about the accumulation of scientific knowledge" because the lawyers spent their time trying to undermine the credibility of the witnesses. *Id*; *see also* Margaret A. Berger, *Eliminating General Causation: Notes Towards a New Theory of Justice and Toxic Torts*, 97 COLUM. L. REV. 2117, 2129 (1997) (noting that "the deconstructed evidence all tends to sound alike").

[12] Beecher-Monas, *supra* note 2, at 1609, 1611-12.

[13] *Id.* at 1611-13 (on extrapolating animal models to humans).

to build a useful model from the deconstructed parts. As Pandora discovered, once the box has been opened it cannot be shut, and opening the box may have untoward consequences.[14] But, like hope remaining in Pandora's box, shared perceptions about valid scientific argument can illuminate the task for judges making admissibility decisions.

My purpose in writing the article, as Professor Caudill correctly discerns, was to set out the underlying principles that scientists themselves use to critique each others work, and thereby to illuminate for judges those factors that make science relatively reliable and predictive. I wanted judges (and the lawyers who inform them) to be able to distinguish the wheat of solidly based scientific argument (even when it comes from opposing experts with opposite conclusions) from the chaff of chicanery.[15] Far from trying to sanitize science,[16] I emphasize that science is a socially constructed form of argument.

Professor Caudill acknowledges the emphasis placed on "the social, institutional, and rhetorical aspects of science"[17] throughout my article, but contends that I have neglected to incorporate these concerns in the heuristic itself. On this point we differ. Indeed, a review of my heuristic, as well as the examples I use of its application, reveals that I do incorporate social contingencies—not in a single prong as Professor Caudill has suggested—but in every aspect of my discussion.

For example, the first component of my five-part heuristic is "Examine the Explanatory Power of Theory and Hypothesis" (which Professor Caudill identifies as "(i) hypothesis"[18]). In this section, I emphasize the creative process in science, and explain that neither judges nor scientists can decide whether a scientific theory or hypothesis is correct.[19] The most either can do is to

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[14] Curious, Pandora opened a box that Zeus had given her (with instructions not to look inside) and so loosed all human ills upon the earth; hope was all that remained in the box.

[15] Chillingly, it was as recently as the Twentieth Century that "enormous jaws, frontal sinuses, and zygomata, thin upper lip, huge incisors, unusually large head" were the subject of expert scientific testimony on the physical signs of criminality resulting in numerous convictions. STEPHEN JAY GOULD, THE MISMEASURE OF MAN 151-73 (2d ed. 1996) (detailing the illogical abuses of expert witnesses such as Lambroso and the criminal anthropologists, whose circularity of logic and lack of falsifiability made a mockery of the rational ideals of science). Less deference to so-called scientific expertise and more willingness to examine the basis for such assertions could have prevented such injustice.

[16] Caudill, *supra* note 1, at 1799.

[17] *Id.* at 1796.

[18] *Id.* at 1797.

[19] Beecher-Monas, *supra* note 2, at 1590. "Understanding science as a process of idea construction rather than mere description makes it possible for a judge to examine the logic of the ideas about which the expert proposes to testify and how those ideas are

assess whether there are sound supporting arguments. Inherently, assessment of this creative process involves the consideration of societal factors that influence it.

In both the toxic tort case and the criminal case to which I applied my heuristic, the courts had to grapple with the underlying theory and the unavailability of studies that they would have preferred to see. For example, in *Wright*,[20] a toxic tort case involving formaldehyde exposure, the appellate court was stymied by the (undoubtedly socially constructed[21]) absence of experiments expressly designed to prove the plaintiffs' hypothesis that formaldehyde attached to particle board would have similar effects to gaseous formaldehyde when inhaled.[22] Unable to reason by analogy, and lost among the trees of controversy, the court overturned a jury verdict on grounds of admissibility, and in the process made needless blunders in assessing the validity of the evidence. Had the court used the basic principles outlined in my heuristic, it could have resolved its conundrum in an intellectually defensible way.

The second prong of my heuristic, the section on examining data, similarly emphasizes the interaction of experimental design and logic with context. As I explain, "Facts alone, even scientific facts are not knowledge. They become scientific knowledge only in conjunction with coherent answers to the following questions: What range of facts deserves investigation? What is the proper way to investigate them? And what do the results of the investigation mean?"[23]

The third prong, the section on assumptions, does not rank expert assumptions as Professor Caudill claims,[24] but instead explains why—and under which circumstances—such rankings are commonly fallacious.[25] The fourth prong, on examining the

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rationally related to what they are intended to show." *Id.* at 1591.

[20] Wright v. Willamette Indus., Inc., 91 F.3d 1105 (8th Cir. 1996).

[21] The reasons for the absence of research in a given area are legion: it may be unethical, funding may be unavailable, or it may not have been perceived as necessary. Scientific experiments are generally not designed with litigation in mind. For whatever reason, experiments on inhaled formaldehyde-laced particle board had simply not been performed—whether from lack of funding, lack of political will, lack of perceived necessity, or whatever other socially constructed reason (none of which is apparent from the record). The experiments judges would prefer to rely on are rarely available, scientific information is of necessity always incomplete, but that does not mean that judges can discard the information that is available. I attempted to show how the necessarily imperfect information can be assessed for its validity.

[22] *Wright*, 91 F.3d at 1107.

[23] Beecher-Monas, *supra* note 2, at 1595.

[24] Caudill, *supra* note 1, at 1800.

[25] Beecher-Monas, *supra* note 2, at 1598 (noting that, in science as in law, rules of thumb are full of "caveats, exceptions, and countervailing notions").

methodology, explains that "proper" methodology depends on the socially contingent aspects of a given discipline,[26] and although no experiment can be performed perfectly, imperfections need to be acknowledged.[27] This explanation inescapably includes the context of scientific process.[28] The fifth prong, "Probabilistic Assessment of Expert Conclusions: Putting it All Together,"[29] exhorts the judge to look at the four previous inquiries as pieces of a puzzle, and to inquire into "those tests 'that might have been performed but were not.'"[30] In this section, I give an example of how social context can affect this prong by explaining the strong disincentive of chemical manufacturers to engage in safety research that could later be used against them in toxic tort actions.[31] This section also points out rhetorical differences between scientific and legal argument— surely a cultural consideration.[32]

Each of the sections of the heuristic incorporates the idea of science as social construction, and acknowledges the "uncertainties inherent in scientific studies."[33] Notwithstanding these uncertainties, I strongly believe that most judges are capable of understanding the logic and evaluating the merit of scientific arguments. Why this fails to do what Kitcher advocates—doing justice to both realist/rationalist and social/historical aspects of science[34]—is unclear to me, as is where or how Professor Caudill has demonstrated that I set aside values, policy, metaphor, or rhetoric in favor of an "idealised norm[] of scientific conduct."[35] I set out to show how intertwined these factors are with the creation of scientific knowledge.

I agree with Professor Caudill that,

> the standards as to (i) whether a 'theory is supported adequately enough by facts and logic to be reliable,' (ii) whether the data is based on 'well-performed studies,' (iii) whether basic assumptions '[ensure] scientific validity,' (iv)

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[26] *Id.* at 1630.

[27] *Id.* at 1626-30.

[28] "Different approaches to data analysis may lead to radically different conclusions depending on the researcher's underlying assumptions and strategies." *Id.* at 1596. That does not mean that one researcher is right and the other wrong, but that they legitimately differ in the interpretation of data. This approach is hardly uncontroversial. Nor does it neglect the social construction of knowledge.

[29] *Id.* at 1631-36.

[30] *Id.* at 1631 (quoting DAVID A. SCHUM, THE EVIDENTIAL FOUNDATION OF PROBABILISTIC REASONING 243-44 (1994)).

[31] *Id.* at 1632.

[32] *Id.* at 1635.

[33] *Id.* at 1635 (in the section on probabilistic assessment).

[34] Caudill, *supra* note 1, at 1803.

[35] Gary Edmond, *Judicial Representation of Scientific Evidence*, 63 MOD. L. REV. 216, 220 (2000) (quoted in Caudill, *supra* note 1, at 1799).

> whether the methodology is 'sound,' and (v) whether the empirical content is 'high' enough, all involve socially-constructed scientific conventions that are as tentative, probabilistic and uncertain as science itself.[36]

I endeavored to say so throughout my article, at the same time being careful to emphasize that there are constraints both of reality and criticism that prevent throwing everything up for grabs. We disagree on our choice of philosophers of science—he prefers Kitcher, I prefer Popper—although Professor Caudill acknowledges that there is no clear successor to Popper.[37] More basically, we disagree about how useful knowing the details of philosophical debates can be to judges absent an understanding of fundamental areas of agreement.

Professor Caudill suggests adding two steps to my five part analysis. In step six the expert would be cross-examined "about why a study was done, what was expected, reputational considerations, funding, corporate associations, and so forth."[38] The information on which this cross-examination would be based would come from:

> depositions before trial [which] could proceed like an ethnographic project in science studies, wherein taped conversations with scientists—about their background, training, career, research interests, views of science in general, funding experiences, experimental conventions, and terminology—are analyzed to get a clearer picture of what "makes" science, *apart from* theory, data, basic assumptions, method, and probabilistic conclusion.[39]

I do not believe that, as socially constructed, science exists *apart* from theory, data, basic assumptions, method, and probabilistic conclusion. Rather, I believe that social constraints inhere in each of these facets of scientific argument. In other words, I am not convinced that what "makes" science a social endeavor is separable from theory, data, assumptions, method and probabilistic assessments. Instead, they are inextricably intertwined.

In step seven, Professor Caudill would try to get the judge to acknowledge that admissibility is "an exercise in the social and rhetorical construction of reality even while attending to the constraints of nature."[40] Good luck! My entire article emphasizes the interplay of social and rhetorical construction with the

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[36] Caudill, *supra* note 1, at 1808.
[37] *Id.* at 1802.
[38] *Id.* at 1806.
[39] *Id.*
[40] *Id.* at 1808.

constraints of nature, and I want judges to understand this in their admissibility decisions. Nonetheless, while I recognize that what counts as knowledge in courts of law is socially constructed and—up to a point ("constrained by reality")—contingent, and while some judges may know it, I sincerely doubt that many judges would be willing to say so out loud. It makes what they do sound too much like an exercise in unconstrained power.

Hopefully, using my framework for analysis will help judges and lawyers to understand that, although all knowledge is contingent and socially constructed, they can still evaluate "whether a descriptive claim about the world has sufficient indicia of reliability and relevance to the case at hand to enter the courtroom."[41] This can be done by examining imperfections in the proffered argument, discarding unjustifiable inferences, and weighing the cumulative force of justifiable inferences. My heuristic attempted to show them how.

These are quibbles over trifles. Professor Caudill and I do not disagree over the fundamental premise that science is a creative process and that understanding the process of science is important in evaluating scientific argument. His emphasis may differ from mine, but we are in agreement that one must get beyond the "science wars" to advance the service of science in legal process. We agree that science is both contingent and constrained by reality. We agree that some cultural effects are irrelevant. We agree that it's not all up for grabs, and I believe that we agree that some scientific arguments are better than others, and that—with some guidance—judges will be able to tell the difference.

Perhaps the real problem is that Professor Caudill and I are coming at the admissibility of scientific evidence from two different (might I say socially constructed?) viewpoints. I am seeking to solve a problem caused when science, which is not generally designed for use in the legal system, must be used in court by judges equally ill-equipped to deal with science. Professor Caudill makes his argument from the standpoint of philosophy, a view I heed in my article but do not intend to be my sole focus. Thus, our disagreement may be one of emphasis, a distinction that, in the long run, may amount to very little difference.

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[41] Beecher-Monas, *supra* note 2, at 1569.