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The Rhetorical Burden of Expert Witnesses

Neil M. Browne
Bowling Green State University

Terri J. Keeley

W J. Hiers
Cornell University

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M. Neil Browne
Bowling Green State University
Terri J. Keeley, Esquire
Mcguire, Woods, Battle, & Boothe, L.L.P.
Richmond, Virginia
Wesley J. Hiers
Cornell University

Abstract:
When judges and juries hear from expert witnesses, what exactly do they expect to hear? In other words, as an audience what purpose do they have for the communication? Just what rhetorical burden is the expert expected to bear? The theme of our paper is that the Frye and Daubert rules that dominate legal argument about the use of expert witnesses are both flawed. Neither shows adequate respect either for what Billig calls "the argumentative aspect of social life" or the inescapable hermeneutic and perspectival problems highlighted by the rhetoric-of-the-human-sciences movement.

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The recent monograph, *Junk Science: Expert Witnesses in the Courtroom* is perhaps the most colorful version of a more general contemporary bewilderment about the role of expertise in judicial proceedings. The theme of our paper is that the *Frye* and *Daubert* rules that dominate legal argument about the use of expert witnesses in U. S. Jurisprudence are both flawed. Neither shows adequate respect for either what Billig (1987) calls "the argumentative aspects of social life" or the inescapable hermeneutic and perspectival problems highlighted by the rhetoric-of-the-human-sciences movement (Simons, 1989).

U. S. courts and all too many legal scholars apparently require from experts a certitude that permits the court to have its reasoning done for it. The epistemological stance of even the Federal Rules of Evidence suggests that the expert is to be treated as if she or he is presenting something other than an argument. Instead that worthy person is providing something lawful and dependable, a veritable rock in the midst of the adversarial theatrics of the attorneys.

Our paper first presents an analysis of the evolution of the current legal rules for admissible expertise. Next we highlight the ambivalent rhetorical burden placed on expert witnesses as suggested by that ongoing evolution. The subsequent section discusses the political nature of scientific argument and the consequent argumentative nature of whatever knowledge then emerges. Our concluding section makes the case that expertise can provide a facilitating role only when presented dialogically. We present an avenue whereby judges can use one of the rules of evidence to insist that multiple experts be heard as at least some minimal guarantee that the court will thereby

be forced to see expertise as argumentative.

I. The Evolution of Expert Testimony Admission

A. Introduction

The judicial system has long used expert knowledge to settle disputes.[1] The determination of how to most effectively use this information has been an ongoing struggle. As the discourse has evolved, courts have regulated the admission of expert testimony to varying degrees,[2] based largely upon concerns for the expert's "aura of infallibility"[3] and its resulting consequences. The designation "expert," especially "scientific expert," might lead the trier of fact to ascribe spiritual deference to the expert.[4]

What can go awry when a court asks for this kind of help from someone with allegedly specialized knowledge? The fact finder may make misplaced assumptions about the expert's often long list of credentials,[5] and give undue weight to the fact that the court has permitted the testimony.[6] A related fear is that the expert may usurp the fact finder's ultimate decision making role.[7] These apprehensions are exacerbated by the allegedly increasing availability of "hired guns" willing to testify to any position for the right price,[8] and the alleged concomitant proliferation of "junk science."[9]

Despite these concerns, however, the legal system has found the use of the expert indispensable and has permitted experts to present a broader array of evidence than the layperson.[10] It is likely because of this freedom and the perceived significance of the expert that so much controversy surrounds this facet of evidence law.[11]

B. The Common Law

1. Generally

The requirement that a lay witness testify only to that which he has personal knowledge goes back to medieval times.[12] An equally well-entrenched and related restriction prohibited the lay witness from testifying to his opinion.[13] The role of the witness was to testify to that which he had seen or heard; hence the title "witness."[14] By providing the jury with the most unadulterated access to the witness' mind possible, the jury could then most effectively use the witness' testimony.[15] Any inferences or opinions that the witness made from the observations served only to muddle the picture. The purpose of cross-examination then was to elicit any "tainted" testimony to reach its most pristine components.[16]

Experts, however, were not subject to this personal knowledge constraint.[17] It was when references to experiences not possessed by jurors was necessary for jury understanding that the expert became needed.[18] According to the early common law of evidence, expert testimony was generally admissible if it was "not within the common knowledge of the layman."[19] While still desiring to give the fact finder the greatest role that its understanding would permit, the experts were permitted wider latitude than laywitnesses to explicate for the fact finder.

To proffer testimony, the expert had to state his qualifications, state the facts underlying his opinion and explain the basis for the opinion.[20] By knowing these facts, the trier of fact could then discard the opinion if it rejected the underlying data.[21] Experts could not, however, express opinions on the ultimate issue in the case because, to

do so, would invade the province of the jury.22 An expert likewise could not base his opinions upon facts or data of which he had no firsthand knowledge,23 or upon facts, data or opinions admitted or to be admitted unless presented in the form of a hypothetical question.24

The role of expert testimony was to help jurors to evaluate information that they lacked the knowledge or experience to evaluate or to provide jurors with the necessary information with which to evaluate the evidence.25 The expert could supply this knowledge and experience, and if convincing, the juror could apply this new found wisdom to its task of resolving the questions of fact and arriving at a "just" verdict.

2. Novel Scientific Evidence: *Frye v. United States*

Starting with the decision in *Frye v. United States*, the admissibility of novel scientific testimony was governed by a separate standard than that of expert testimony generally.26 This scientific testimony presented the biggest gulf between the finder of fact's experience and the mass of knowledge required to meaningfully appraise the testimony.27 It was also this quality of testimony that elicited the most fears that jurors would use the knowledge inappropriately by reflexively adopting the view of the messenger or by compromising between two equally unintelligible witnesses.28

In 1923, the Court of Appeals of the District of Columbia fashioned what has come to be known as the "*Frye* test" or "general acceptance test" in a short, citation-free opinion.29 Without any explanation, the court established that a scientific principle must be "generally accepted" in its field to form the basis of expert testimony.30 The burden to demonstrate this acceptance was on the proponent of the evidence.31 It was this sparse opinion that dominated the admission of scientific evidence for at least the next fifty years.32

In *Frye*, the defendant, accused of murder, attempted to offer an expert witness to testify to the results of a systolic blood pressure deception test,33 conducted by the expert. The outcome of the test indicated the veracity of the defendant's innocence claim. The expert claimed that scientific experiments had demonstrated that blood pressure measurements could reliably show whether a subject was attempting to deceive the examiner.34 The lower court prohibited the admission of these results and additionally denied defendant's request for the witness to re-conduct the test in the jury's presence.35

On appeal, the Court of Appeals of the District of Columbia upheld the lower court's bar, finding that the deception test had not gained sufficient recognition among physiological and psychological authorities.36 According to the Frye rule, it was not enough that one qualified expert believed the procedure was reliable.37 Instead, the court must determine that "general acceptance" has been reached.

Until that elusive point is reached, the finders of fact will not hear the evidence. Until 1975 when the Federal Rules of Evidence (the "Rules") were enacted, and even several years beyond that for many courts,38 the Frye test was "almost universally followed" by courts in the area of scientific evidence.39

a. Advantages of a General Acceptance Standard

The justification most often advanced for this "general acceptance" standard is that the experts in the particular community are in the best position to understand and evaluate the scientific evidence as they are intimately involved with the material day to day,40 and that jurors are likewise "incompetent to evaluate scientific proof critically."41

Supporters of the Frye standard also perceive the test as a conservative, bright-line, head-counting standard that is simple and convenient to apply, resulting in uniformity in the court system.42 The test is simple, not because the science is simple, but because the scientists have already thrashed out the issues, leaving the legal system with the simple task of discerning the "winner" or "winners" left standing.43 Through the publication process, the views advanced by any scientist are subjected to criticism and replication until a general acceptance has been reached.44

By looking to an external standard for admission, a great burden is lifted off the judge to analyze often complicated scientific evidence.45 Not only is the judge saved from scientific analysis, the jurors will presumably be less confused by all of the "scientific banter,"46 and "unpublished hunches,"47 from which they will have to discern scientific "truth," and the entire judicial process will benefit from the avoidance of time-consuming hearings on the validity of various innovative techniques.48

Champions of the Frye standard concede that the test will result in valid theories not reaching the fact finder, both because of the time lag between the introduction of an idea and its general acceptance,49 and through simple errors in the appraisal process.50 These advocates maintain, however, that, on balance, the benefits outweigh any disagreeable side effects.51 The amount of testimony that is erroneously excluded and the resulting consequences are less deleterious than the converse result of admitting more questionable testimony.52

b. The Demerits of the Frye Test

The biggest criticism of Frye is the alleged difficulty in applying the standard and the confusion created thereby.53 To apply the general acceptance standard the judge must determine in what community should the judge "count heads,"54 who should be counted in that community and how should the votes be weighted. In addition, the judge must resolve the questions of what constitutes "general acceptance" and how may it be proved.55 The general acceptance of several techniques or principles might be problematic, as disputes over contrasting interpretations of the same data frequently span decades.56

Another condemnation of the Frye approach is that it is unduly conservative and the majoritarian standard excludes valid evidence and thus abandons evidentiary principles of relevance and tyrannizes the minority.57 According to this argument, the definition of relevance is not so stringent as to require general acceptance in the relevant community.58

According to the Frye test, a theory or principle could not make the existence of a fact more or less probable, until it has received general acceptance or majority approval.59 Opponents of *Frye* argue that this conservatism also infringes on the rights to a jury trial accorded by the Seventh Amendment.60 The greater the role of the expert and judge, the more hollow the right to the jury trial.61

The perceived "undemocratic" aspect of this standard is especially criticized when applied to the criminal defendant.62 The accused has a constitutional right to present exculpatory evidence.63 To limit the defendant to defenses comprised only of generally accepted principles infringes on this right.64 In fact, this constitutional right might justify a more liberal standard in this setting.65

Opponents have further criticized that the Frye test encourages courts to rely on prior judicial determinations of reliability instead of scientific determinations.66 Part of the source for the uniformity lauded by the Frye supporters is thus seen as a detriment by opponents. This extensive debate illustrates the struggles in determining what standard will best assure the most just results.

3. Judicial Application of Frye

The court in Frye mandated only that the "thing" from which the expert's testimony was derived must have received "general acceptance" in the relevant community of scientists. The Frye decision was created in the criminal context and involved scientific evidence. The application of the standard beyond these two settings has been debated. Most courts initially limited the applicability of the Frye test to the criminal law setting.67

In 1984, however, the Frye test was first applied in the civil context.68 Frye was also initially limited to novel scientific evidence.69 The majority of courts continued to limit the test to the scientific setting.70

Once the court grapples with these issues of scope and determines that the disputed evidence falls under Frye's umbrella, the court must assess whether the evidence passes the Frye test. First, the court must determine to what aspect of the testimony the standard should be applied.71 For example, the scientific testimony might entail the application of a particular scientific principle, a particular scientific technique, an instrument of measurement and an evaluative technique.72 The language of Frye suggested that both the technique employed and the principles upon which the technique rested must be valid.73

The court must then determine whether the technique and principles employed have received general acceptance in the community. Frye left unanswered what constitutes general acceptance, leaving subsequent courts to define the parameters. Courts generally agreed that unanimity was not required.74 What percentage below unanimity was never established, but instead courts defined the standard more generally or did not define the standard at all. Thus, whether a majority of scientists in that particular community needed to accept the technique and principles was never established.75 The fuzzy and nebulous standard enunciated in Frye would support a variety of interpretations.76

In determining whether a technique or principle is generally accepted, courts can look to several sources. First, a court can rely on prior legal precedent as to the existence of general acceptance.77 This reliance on previous judicial decisions is inappropriate if the judge does not examine the previous court's inquiry as well as its conclusions.78 Further, depending on the time since the last decision, the court must update its research to ensure that the status of the research has not changed.79

Courts also upheld the use of expert testimony to establish the general acceptance in a particular field.80 This use of experts to demonstrate general acceptance raised the issues of whether these experts had to be impartial and how many were necessary to establish the requisite endorsement.81 Lastly, general acceptance can be established through review of scientific and legal writings.82 This method is another type of judicial notice. This practice has been criticized for not adequately accounting for the relevant articles.83

Before seeking out these resources, the court has to establish the scientific field from which the technique or principles belonged and how to define the parameters of that community.84 Novel interdisciplinary techniques were especially problematic.85 Again, the Frye test provides little help, forcing courts to decipher or manipulate, on their own. The adoption of the Federal Rules of Evidence was in response to these difficulties.

B. The Enactment of the Federal Rules of Evidence

Congress enacted the Federal Rules of Evidence in 1975.86 These Rules explicitly addressed the admissibility of expert testimony, impelling the courts toward a liberal policy of admissibility.87 In the process, the Rules eliminated many common law barriers against the admission of expert testimony.88 For example, the Rules

relaxed the standard for expert qualification,89 eliminated the requirement that counsel use hypotheticals in certain circumstances,90 and abolished the restriction against testifying to the ultimate issue.91

Provisions in the Rules governing the admission of evidence layout the general ground work for expert testimony admission. Rule 401 defines "relevant evidence" as evidence having any tendency to make the existence of a material fact more or less probable;92 a very liberal standard.93 Rule 402 then provides that all relevant evidence is generally admissible.94 Under Rule 403, courts can exclude otherwise relevant evidence, if its probative value is outweighed by considerations of prejudice, confusion, or wastefulness.95

Rule 104(a) requires the judge to determine whether an expert can testify.96 Rule 702 provides the specific guidelines for this task, stating that a witness qualified as an expert may testify to scientific, technical, or specialized knowledge, in the form of opinion or otherwise, if it "will assist" the trier of fact.97 This facially more lenient standard is in contrast to the common law rule that evidence must be beyond the ken of the average juror and the restrictions accompanying this rule.98

Rule 703 permits the facts or data on which an expert bases his opinion to be admitted as long as they are of a type reasonably relied upon by experts in their field in forming opinions or inferences outside the litigation context.99 Lastly, Rule 706 provides the judge with discretion to appoint an expert for assistance.100 This rule allows a neutral player to enter the "game" and clarify any remaining confusions.

The omission of any mention of the status of Frye in the Rules created significant debate as to the impact of those provisions pertaining to the admissibility of expert testimony on previous common law restrictions.101 The most strident argument advanced for the proposition that the Rules overruled Frye is that Frye is inconsistent with the Rules' liberal approach,102 in that evidence can be relevant and of assistance to the trier of fact even if it does not meet the Frye general acceptance standard.103 The language of Rule 702 also suggests a more liberal, carte blanche approach.

Those still adhering to the Frye test argue that the drafters would have explicitly overruled Frye if that were their intention,104 and that the Rules were not intended to be a comprehensive codification of the entire common law of evidence.105 Prior to the Supreme Court decision in *Daubert*, a majority of the federal circuit courts interpreted the Rules as continuing the existence of Frye, asserting that the two standards were intended to coexist.106 It took until 1993 for the Supreme Court to resolve this issue in *Daubert v. Merrell Dow Pharmaceuticals*.107

C. Current Law: *Daubert v. Merrell Pharmaceuticals*

In 1993, the Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals* ended the controversy over whether the amendments to the Rules overruled the long-standing Frye standard. *Daubert* involved allegations that the prescription drug Bendectin, given to pregnant mothers to reduce nausea, caused the birth defects of two children whose mother had ingested the drug during pregnancy.108 The defendant manufacturer of the drug, Merrell Dow, proffered a "well-credentialed expert" who testified that, based on his review of all the literature on Bendectin and human birth defects, there was no study that found the asserted causation.109

The plaintiffs responded with eight "experts" of their own, also with "impressive credentials,"110 who testified to test tube and live animal studies that found a link between the drug and deformities.111 The District Court for the Southern District of California granted the defendant's summary judgment, finding the animal study evidence inadmissible as it was not " 'sufficiently established to have general acceptance in the field to which it belongs.'

"112 Three other circuits had determined that animal and chemical studies were insufficient to demonstrate a link between Bendectin and birth defects.113 Plaintiff's epidemiological analyses of the previously published studies was inadmissible because the results had not been published or subjected to peer review.114

On appeal, the Ninth Circuit affirmed the trial court's decision. The Ninth Circuit agreed that the in vivo, in vitro, and chemical structure studies did not provide a sufficient basis to form an opinion on causation.115 The Court justified the standard based on the assessment that such evidence would create a "substantial danger [of undue prejudice or of confusing the issues or]... of misleading the jury."116 The Supreme Court granted certiorari to determine whether Frye's general acceptance test had survived the enactment of the Rules, thus reconciling disputes as to the proper standard for the admission of expert testimony in federal courts.117

The plaintiffs argued to the Supreme Court that the enactment of the Federal Rules of Evidence had superseded the general acceptance standard in Frye.118 According to the plaintiffs, the Court should instead look to Rule 402 of the Rules, which allowed for all evidence that is relevant unless otherwise provided in the Constitution, statutes or rules.119 In response, Merrell Dow argued that Rule 702 created a general acceptance standard, arguing that rule 702 required that "the specific testimony of each expert have an adequate foundation, judged by the accepted standards of the expert's field."120

In a simple majority opinion written by Justice Blackmun,121 the Daubert Court rejected the traditional test for the admissibility of scientific evidence, moving away from deference to external groups to a standard that requires the judges, themselves, to make determinations of validity.122 The Supreme Court in *Daubert* first found that the *Frye* court's exclusive reliance on the general acceptance standard was improper.123 Evidence could be admitted under the Rules even if its scientific basis was not generally accepted in the relevant scientific community.124 According to the Court, Rule 702 displaced Frye, emphasizing the liberal intent behind the Rules for admitting expert testimony.125 As support for this determination, the Court found it significant that nothing in the Rules, nor the drafting history, mentioned "general acceptance."126

The *Daubert* Court however, found limitations in the Rules regarding the admissibility of expert testimony and thus determined that the judges were responsible for ensuring that evidence is admitted only if it is both relevant and reliable.127 The petitioners had argued that Rule 702 imposes only two requirements to admit expert testimony. First, the court must make a general determination whether the expert is proposing to testify to scientific knowledge,128 and whether that testimony will assist the jury, and second, the court must determine whether the witness is qualified as an expert.

The Supreme Court rejected this liberal position finding that it overlooked the requirement that expert testimony must have an adequate foundation.129 The Court thus determined that a judge still has an independent duty to screen evidence for a rationally reliable basis.130 To guide the trial judges in this two-step inquiry, the Court made four observations. These nondefinitive considerations are whether the expert used the scientific method,131 whether the theory or technique had been subjected to peer review and publication, whether a particular scientific technique had a significant rate of error and whether the methodology was generally accepted in the relevant scientific community.132 The Court was careful to articulate standards that focused on the methodology or principle and not on the conclusions the technique may generate.133 As the Court did not apply these factors to the *Daubert* facts, but instead remanded, the opinion lacks any guidance in this regard.134

Daubert thus purported to adopt a more liberal approach to expert testimony admission by reaffirming the permissive approach adopted in the Rules.135 The Court's approach did however reflect strong concerns about the danger of unreliable evidence's reaching the jury. The Court moved away from the approach that relied on

particular experts in the community as the gatekeeper to expert testimony and partially shifted that role to the judge.136

In contrast to Frye's focus on the general acceptance of the "thing" from which the deduction is made, *Daubert* focuses on the reasoning and methodology.137 In subscribing to an assertedly more liberal approach to admissibility, the *Daubert* Court placed enormous faith in the ability of cross-examination, contrary evidence, carefully crafted jury instructions, directed verdicts, summary judgment and court-appointed experts to safeguard from the alleged deleterious consequences of the more permissive standard.138

One of the issues left unaddressed by the *Daubert* Court was the proper scope of "technical and other specialized knowledge" in Rule 702. The opinion did not resolve whether this category was sufficiently wide to cover such fields as psychiatry, economics, sociology and medicine.139 Decisions since *Daubert* suggest that the "technical and other specialized knowledge" can run the gamut.140

The Daubert standard, however, may not conform easily to a nonscientific subject matter or to a less traditional science.141 *Daubert* created a standard with the assumption that the proffered science would be susceptible to empirical proof. The general overarching theme in *Daubert* that an expert's testimony must be based on "good grounds," should, however, transfer to any substantive context.142 In any event, the fall back test would be the standards enunciated in the Rules, which form the basis of the Daubert analysis.

II. Tensions, Conflicts and Objectives Underlying the Admission of Expert Testimony

The question of how to most effectively use the expert in the legal system is immensely complex. Resolution of this issue necessarily requires the interplay of assorted goals, values and assumptions about the legal process, its integral players and society in general. To insure that no unreliable evidence made its way into the courtroom, a rule of admissibility would have to be crafted that required that techniques and principles be established to a certainty. Such a standard is as undesirable as it is unworkable and epistemologically ingenuous.

A. Science Meets Law

The expectations, goals, demands and general culture of the legal system and those of scientific research in general are purportedly incongruous.143 The adversarial system is based on the premise that each litigant will have an equally competent and learned advocate who will assert his respective best arguments, and from this clash, the fact finder will discern "the" just conclusion.144 The system discourages the presentation of all evidence by each side as the lawyer must present its case in the best available light.145 The gaps left by each side are presumably to be filled in by the jurors.146

Counsel justify their distortions, exaggerations, word games, omissions and other manipulations on the ground that such advocacy is a necessary part of the process. Congress relied on this system in enacting the Rules, with their more lenient standard for the admission of expert testimony.147 The drafters believed that competent cross-examination and refutation would discredit any questionable expert testimony.

The adversarial approach to conflict resolution with its heavy reliance on zealous advocacy, still purports to seek a "truth;" one that is fair and just; not necessarily an objective or descriptive truth. Perhaps more accurately, the legal system is concerned with more than truth.148 If it were otherwise, the jury might not be our chosen

decision maker. Instead, we would seek the "best" and the "brightest" academics. The jury system provides community involvement of ordinary citizens in a democratic fashion, allowing the values of the community to be incorporated into the system.149 The need for quick and final answers also influence these choices.150

The more explicitly value-driven and judgmental legal system contrasts sharply with the purported intellectual openness of the scientific process and its quest for more reflective understandings, under little to no time constraints.151 Scientists insist they rely heavily on empiricism as its way of knowing and purport to discard the subjective biases that inflict the common layperson.152 The Court in *Daubert* did attempt to temper this belief in acknowledging that "there are no certainties in science."153

B. The Players and their Roles

Who should evaluate evidence beyond the knowledge and experience of the average layperson; the expert, the judge or the jury? Standards of admissibility dictate the varying roles for these individuals in the judicial drama.

Much scholarly work has focused on the ability of the jury to intelligently distinguish between the valid and dubious testimony they hear and to understand the content of the testimony. *Daubert* addresses the concerns of those who worry that jurors are more influenced or overwhelmed by impressive credentials, by instructing the judge to shield them from these tendencies. The general acceptance standard in Frye presumed that experts in the particular community should have the paramount role in assessing the validity of expert testimony. The current approach under *Daubert,* however, implicitly reflects a determination that the judge is inherently more able to assess the reliability of expert testimony by providing the judge with that gatekeeping role.154

However, if the juror is incapable of distinguishing among experts and evaluating the reliability and validity of their testimony for purposes of admission, they may likewise be incapable of understanding and evaluating the testimony that ultimately reaches them.155 Perhaps the criticism of juror incompetence argues loudly for an extension of the role of the expert and the judge. Those who share this doubt about the juror's ability to adequately grasp the concepts presented to them might be more comforted by the judge's carefully straining the information before allowing it to reach the jury.

Many scholars have made suggestions to mitigate any problems of competency, such as providing special education for the triers of fact,156 and presenting the information in a more comprehensible format.157 Even if a juror is less capable of understanding and evaluating expert testimony than a judge, the consensus developed by a twelve-member panel may be equally acceptable.158

Those arguing that jurors are not capable of effectively distinguishing among experts, argue that the judge has had significant experience with this process, while the juror will presumably make these distinctions only once in a lifetime. Furthermore, a judge can enlist outside help if necessary.159 While commentators have more faith in the judge's ability to assess expert testimony, the judges themselves may not feel so equipped either from a competency perspective or from the perspective of time constraints.160

Assessments of the role of the expert are the flipside of views about the jury's and judge's role. Restrictions on the admission of expert testimony can be placed on a continuum in which a desire to give the juror complete independence is at one end and a desire to accord the expert's conclusions complete deference is at the other. In between these two extremes lies the educatory role. Most rules on the admission of expert testimony reflect a combination of these values along this continuum.161 The education metaphor has however predominated.162 The expert is to educate the jurors as to information that is not considered to be in their possession.163 Often

this education will consist of dispelling certain stereotypes, or biases or providing alternatives with which the jury can explain particular assertions.[164]

What standard is actually applied depends on how significant a role one believes the expert should play and concomitantly, what role the jury and judge should play in the entire drama. Numerous factors guide this determination. For example, more stringent standards for admitting expert testimony might contribute to the popular goal of reducing litigation. By the same token, the more stringent the standard, the more likely deserving plaintiffs will go uncompensated or undeserving defendants will be wrongly held accountable.

Thus legislatures and the courts may have to decide whether they prefer toleration of highly uncertain expert testimony to leaving victims uncompensated.[165] Conceivably, we may find the so-called "charlatan" to be a useful and integral part of the legal system.

The direction that the *Daubert* doctrine will take is neither predetermined nor presently evident. At least two ambiguities contribute to this indeterminacy. First, by virtue of the Supreme Court's decision in *Daubert*, judges have been given a much larger role to play in the use of scientific expert witness testimony in the courtroom.

This augmented role for judges places a considerable burden on them; no longer can the application of the simple rule of general acceptance be used, as under the Frye test, nor is the liberality of the Federal Rules of Evidence embraced by *Daubert*. Granting judges such a substantial role in the determination of scientific expert witness admissibility means that no single doctrine will determine what expert testimony will and will not be admitted into courts of law**.**

Second, and as a consequence of empowering judges in admissibility determinations, the role that scientific experts will play is up in the air. Under the *Frye* test, the "general acceptance" standard meant that the scientific community played a major role in what would be admitted into a court of law, with judges and juries playing relatively minor roles; in this way, it was the scientific community who was the primary arbiter of truth claims. In contrast, under the Federal Rules of Evidence, much of the onus for evaluating scientific evidence was placed on the jury due to the liberality of the admissibility doctrine.

C. The Confused Response to *Daubert* by the Federal Courts

A mere sampling of federal cases in which the courts have addressed and interpreted the approach to expert testimony suggested by *Daubert* serves to illustrate the extent of the confusion surrounding just what exactly the Supreme Court had in mind when making its recommendations. At both the district and appellate levels, courts differ on a number of fundamental issues.

First, there is the issue of the scope of *Daubert*. Does it apply to expert testimony *in general* or only *scientific* expert testimony or only *novel scientific* expert testimony? The question itself suggests that when the expert represents certain interpretive communities, greater reliability is predictable for reasons of stronger method or more impressive canons of proof.

Other disciplines, however, are more suspect. Their experts may know more than the Court about a probative matter, but the relative flabbiness of their professional discourse reduces their usefulness to the Court. For the latter, the Court would still have to engage mentally with the evidence. The expert is, in such situations, a *mere* facilitator. How disappointingly inadequate such lack of closure must be for those who harbor the view that answers to complex questions are extant **if** we can only encounter the right expert.

So how have post-*Daubert* courts handled what for those seeking definitive nomothetic statements from experts is a perplexing problem? Canvassing federal court opinions citing *Daubert* yields a hodgepodge of responses.166 In *Berry v. Detroit*,167 the court cited *Daubert* in excluding the expert testimony of a law enforcement officer on the grounds of "suspect" methodology.168 At least one other Sixth Circuit court has followed *Berry* in this broad construal of *Daubert's* scope.169

At the same time, the Seventh Circuit Court of Appeals has limited *Daubert* to scientific expertise. In one case, a defendant who had been convicted of financial improprieties such as accepting kickbacks, argued that certain legal expertise should not have been excluded by the district court, because it met the standards of the *Daubert* test.170 The Seventh Circuit Court of Appeals, however, disagreed, holding that the applicability of the *Daubert* test is limited to scientific expert testimony.171 Both Second172 and Fifth173 Circuit courts have adopted this interpretation as well.

Yet, limiting *Daubert's* applicability to science is not the narrowest interpretation offered thus far. Some district courts have interpreted *Daubert* as applying not to scientific expert testimony in general, but rather only to that which is considered 'novel'.174

Especially pertinent to this article, federal courts have issued conflicting interpretations about the sort of test that should be applied in determining evidentiary admissibility. Some courts have adopted a fairly liberal approach to admissibility, citing *Daubert's* emphasis on the capable role of the adversarial system in exposing faulty testimony.175 And at least one court expressing faith in the adversarial system suggested that there is a "presumption of admissibility."176 At the same time, other courts have been more ambiguous about the liberality of their standard in interpreting *Daubert*.177 While still others have been quite plainly stringent.178

These diverse interpretations reveal a U. S. Court system that knows it needs experts, although it is not sure what specific needs experts should be asked to fulfil. Those courts that see experts as providing a potentially useful view of evidence, *from inside the club of those who study the issue*, presume admissibility. Their perspective depends on the quality of the adversaries and the minds of the judge or jury to discover and evaluate the claims of the experts. But, just as is true for those courts that habitually exclude all but the most credible of expertise, these courts expect a lot from experts. The experts are seen as bringing crystallizations or specialized cognitive gems for the court to view.

III. The Production of Scientific Knowledge

Crafting a role for the scientific expert witness after *Daubert* requires an understanding of the context from which experts emerge, namely, the community of natural and social scientists. Depending upon one's conception of these communities, different expert roles are likely to follow. For example, if a judge believes a given discipline to be both disorganized and lacking in mechanisms whereby scholarly work can be evaluated, then she is unlikely to apply a rule like *Frye*, which puts such great faith in intradisciplinary judgements of potential scientific expert witnesses.179

In this section, we will offer our understanding of the context of scientific inquiry and the processes that yield those persons we count on for expert opinion. Before doing so, we will offer some brief comments on our epistemological perspective as it relates to both Justice Blackmun's perspective as reflected in the *Daubert* decision as well as that of other commentators on expert witnesses.

A. A Note on Epistemology[180]

The apparently poor guidance *Daubert* has provided the federal courts derives from its internally conflicting philosophical underpinnings.[181] On the one hand, Blackmun demonstrates an allegiance to positivism in delineating the loose guidelines that courts are to follow in determining expert witness admissibility.[182] On the other hand, an acceptance of constructivism, or the notion that truth is socially constructed,[183] bears out in the Supreme Court's recommendation that lay persons, namely judges and juries, make assessments of the validity of scientific research and methods before them.[184]

Questions of epistemology are indeed at the heart of decisions about standards of admissibility and, by implication, the role of experts in a court of law. By advocating the 'general acceptance' standard, the *Frye* test placed penultimate faith in the deliberations of the scientific community to determine questions of epistemology, methodology, and, ultimately, truth. In contrast, the Federal Rules of Evidence assign those in the sciences no such role, but rather promote epistemological deliberations by the jury in a court of law. In this way, as has already been noted, the expert is no longer the bearer of truth she was under *Frye*, but rather a dueler in an adversarial system of law where truth is apparently relative.

Just as the expert role implied by *Frye* and the Federal Rules entails certain epistemological beliefs, so, too, does our own recommended role. Recent works dealing with scientific evidence in the courtroom as well as the nature of scientific evidence more generally urge us to outline what these epistemological underpinnings are so as to avoid perpetuating what has become a rather polarized debate on these matters.

Defenders of positivism, rightly criticizing those critics who argue that any flaw in science means that the entire enterprise of science itself is fundamentally flawed, tend to subsume *all* critics of positivism under this extreme category. For example, Huber has suggested that the "only real alternative" to positivism is nihilism.[185] Similarly, in their recent diatribe against leftist critiques of science, Gross and Levitt assign the intended pejorative of "relativist" and "idealist" to all those making these criticisms.[186] Even Thomas Kuhn, himself no child of positivism and realism,[187] has spoken rather vituperatively against the sociology of scientific knowledge for its critical approach to the alleged epistemological purity of scientific inquiry and knowledge.[188]

Perhaps the ferocity of disagreement and the ensuing mischaracterization lies in the unit of analysis chosen by the different camps. While defenders of the faith tend to focus on science itself,[189] we instead emphasize and concentrate attention upon the agents of this enterprise, human beings, and the 'social dimension' they lend to theory building and experimentation.

This social dimension is important in at least two senses. First, with respect to the differing externalist and internalist perspectives on science,[190] we accept the superiority of the former: Science, whether natural or social and including both its practioners and theorists, does not operate in a vacuum with its own internal logic but rather comes under the influence of social forces.[191] Second, not only is 'the social' an external influence on scientific inquiry, it is immanent in the process itself,[192] by which we mean that scientists are not disinterested agents but rather are immersed in a web of relations that play an important role in determining the character of truths that emerge from their interactions.[193]

It is important to note that adopting this perspective of scientific inquiry's social immanence does not entail a wholesale rejection of scientific knowledge and a reversion to epistemological nihilism. Instead, it calls into question the value of individualistic and atomistic frameworks for interpreting this knowledge. When we exclude the social dimension from truth formation and acceptance and consider, along individualistic lines, a claim to be

true only if "its warrants are direct, experiential, and individual", then very little would count as knowledge, scientific or otherwise.194 Thus, from this perspective, the 'social dimension' of scientific inquiry should be construed "not as a pollutant but as a necessary condition for making, holding, extending,and changing knowledge."195

Greater clarification of our perspective might come via a discussion of epistemological sovereignty, a term Rouse borrows from Foucaldian conceptions of political sovereignty.196 From the realist perspective on truth, an epistemological sovereign is necessary to evaluate truth claims and delineate those that are worthy and those that are not. It might be located in any number of places " e.g., in the majority of the scientific community or in a particular methodology such as realism's favorite bedfellow, positivism " but what's important is that this sovereign is both unified and centrally located.197

In the absence of these conditions, the realists argue, we fall down the slippery slope into relativism.198 Following Rouse, we disagree and hold as fundamental to our epistemological perspective the notion that there is no epistemological sovereign. As Rouse points out, this lack of belief in epistemological sovereignty is not tantamount to crude relativism, for that kind of relativism, rather than banishing the epistemological sovereign, embraces its multiplication and diffusion: This sovereign is vested in us all.199

Rejecting the very idea of the epistemological sovereign, however, is more consonant with our perspective. Such a rejection moves away from the notion of a static locale where knowledge is legitimated or delegitimated and moves us towards a more dynamic conception of epistemology that retains the idea that there can be epistemic legitimacy while at the same time emphasizing its contested nature and the processes whereby conflicts concerning it emerge and are settled through exclusion, appropriation, or some other means. Rouse states this well:

> The crucial point is not that there is no legitimacy . . . In the circulation of contested, heterogeneous knowledges, disputes about legitimacy and the criteria for legitimacy are part and parcel of the dynamics of that circulation. Understanding knowledge as 'a strategical situation' rather than as a definitive outcome places epistemological reflection in the midst of ongoing struggles to legitimate (and delegitimate) various skills, practices, and assertions. Recognizing that the boundaries of science (or of knowledge) are what is being contested, epistemology is within those contested boundaries.200

What are the implications of adopting an epistemological perspective that emphasizes the sociality of truth? As Rouse's comments suggest, recognizing the relations among members of the scientific community, including the various perspectives, motives, and aspirations found there, makes power an important factor in understanding what counts as knowledge.201 Within the scientific community there are rhetorical struggles and scrambles for resources and avid quests for collegial acceptance of one's own claims, all of which often play an important part in the determination of facts and plausible theories.

And outside the scientific community forces exist and exert influence on the creation of knowledge as well. Brown gives the hypothetical example of scientists determining the 'best' theory among existing alternatives about the psychology of an enslaved people in a societal context where those who embrace slavery as an institution create all existing theories: In this situation, even if the scientific community chooses the 'best' theory, it will still construe the enslaved race to be primitive and feeble minded, as will all other theories.202

B. The Context from which Experts Emerge

One of science's central categories of inquiry is the fact. In 1935, the German Ludwick Fleck published a classic in the philosophy and sociology of science, *Genesis and Development of a Scientific Fact*.[203] Stressing the fundamentally social character of science,[204] Fleck distinguishes between two kinds of science, journal and vandemecum. As the name would suggest, the former consists of all the articles that fill science's many journals. These articles often contradict one another, and any effort to organize them into a unified whole would be fruitless.[205]

Characterized by all this conflict, journal science, says Fleck, "bears the imprint of the provisional and the personal."[206] Vandemecum science, on the other hand, or what Fleck also calls 'handbook science', represents science's institutionalized knowledge. In the transition from journal to vandemecum science, there is a parallel shift in the author's rhetorical approach: what was once "It appears possible that . . ." becomes "It has been firmly established that . . . ";[207] in making his move to vandemecum science, the hedger gains certitude.

This distinction is relevant to courts that deal with expert scientific evidence in at least two ways. First, courts more often than not get the certitude or hardened facts of vandemecum science. Contemporary sociologists of science liken these to 'black boxes'[208] or ships in a bottle.[209] Whatever the choice of metaphor, the point is that, in the absence of closer scrutiny, judges and juries have no way of knowing how the facts before them got there.

Enter the second relevant aspect of Fleck's distinction, namely the implication that courts *should* know. This point comes through in Fleck's description of how vandemecum science emerges: " . . . only through a directed selection of individual investigations and a directed compilation [does a scientific claim become vandemecum science]. But once part of the vandemecum, it is taught and generally used. It forms the keystone of the system and thus exerts a constraint on thinking."[210]

Because vandemecum science acts as a constraint on thinking and because it emerges as a homogeneous entity from a heterogeneity of perspectives, it is important for courts to understand how the "directed selections of individual investigations" is conducted.[211] It is our intention in the rest of this section to provide insight into this process. As we will argue later, such a process has important implications for fashioning a role for the scientific expert witness.

C. Network-building, Fact construction

If scientists adhered loyally to Merton's four norms of science " universalism, communism, disinterestedness, and organized skepticism[212]"then understanding how theories, methodologies, and general facts emerge from scientific disciplines would be an easily grasped and acceptable matter. The norm of universalism would guarantee that any truth claims are treated as just that, and not in a framework that discriminates on the basis of arbitrary categories like race, gender, status, and charisma.[213] This universalism, along with the norms of disinterestedness and organized skepticism would guarantee that the criteria of discrimination would be a claim's logic and empirical validity, and that all such claims would be as avidly scrutinized as the next.[214] Finally, adherence to the norm of communism would guarantee not only equal accessibility to evaluative resources for all persons working in the scientific community, but also that every scientist would have the positive liberty to gain community acceptance for his or her claims.[215] Were all these norms to be strictly adhered to, courts could feel equally good about the validity of all claims emerging from the scientific community with general acceptance, or at least about the process whereby they gained this acceptance.

But as the Court in *Daubert* apparently recognized in holding that the criterion of general acceptance should not

be a sufficient condition for accepting or rejecting expert testimony, things do not work quite this smoothly in science when we descend from the level of Merton's ideal norms. Scientific claims do not get inserted into a perfect evaluative machine called the 'scientific community' but rather are subjected to a substantial amount of arbitrary treatment by other scientists.[216] As LaTour writes:

> . . . the fate of a statement depends on others' behaviour. You may have written the definitive paper proving that the earth is hollow or that the moon is made of green cheese but this paper will not become definitive if others do not take it up and use it as a matter of fact later on. You need *them* to make *your* paper a decisive one. If they laugh at you, if they are indifferent, if they shrug it off, that is the end of your paper.[217]

To capture better this aleatory dimension of the scientific determination of which truth claims are superior and, by implication, which scholars making these claims will become their field's experts, LaTour offers the metaphor of a rugby game where a scientist's proposed fact is the ball. The trajectory of this ball, its speed, its direction " all are dependent upon the persons through which it passes. In this context, the person who initially got the ball moving has little control over its ultimate fate.

Likewise, a scientist who proposes a theory or a methodological modification or any other claim, and who wants to turn this proposal into a black box, to make it vandemecum science, is dependent upon the receptivity of those she is attempting to persuade.[218] It is in this sense that "[t]he construction of facts, like a game of rugby, is . . . a collective process."[219] Those who proffer claims are not *completely* dependent upon the group who does the evaluating. The actor-network theory of scientific practice provides insight on this point. According to this perspective, scientists take proactive steps to turn their own claims into that which is later unquestioningly accepted as fact.[220] To do so, they make use of voluminous reference lists intended to demonstrate agreement with their own argument even in the most indirect sense, informal conversations with others in their area of research, appeals to both historical and contemporary authority, and various interest groups.[221] All this network-building is done with an eye toward creating order out of disorder.[222] On this account, shifting from disorder to order is not tantamount to moving from confusion to truth but rather is a process laden with multiple contingencies, each of which could yield a somewhat different order.[223]

To understand how this process of fact construction through network building plays out, an example is probably in order. The case of the struggle between neoclassical and institutionalist economists over the soul of their discipline's methodology in the period between the two world wars[224] is especially attractive for our purposes here, given *Daubert's* emphasis on examining the methodology of an expert.[225] While neoclassicals and institutionalists professed to have similar goals and values, they disagreed about what constituted the proper method of economic science: while the former held out predictive model building based on abstract reasoning and a set of assumptions as the proper tact, the latter called for a more empirically grounded approach.[226]

Yonay applies actor-network theory to analyze this struggle eventually won by the neoclassicals.[227] On his account, the victory was not strictly a consequence of rational deliberation and evaluation of the competing claims in the context of reigning Mertonian norms of science.[228] Instead, both sides employed philosophical views, theories and methods from prestigious disciplines, claims about relevancy to practical problems, and the history of thought within their own discipline to win this struggle,[229] making 'allies' out of facts, people, money, theories, and organizations in the process.[230]

The perspective of actor-network theory provides initial insight into the imperfection of the scientific community in evaluating research by its members, at least in relation to its alleged ethos of objectivity and universalism.

However, while this theory introduces the variables of arbitrariness and social adeptness into the determination of 'good' research, it leaves its analysis at the level of rhetorical struggles among undifferentiated individuals seeking prestige and recognition. A discussion of elites prompts us to consider how status inequalities affect the ability of scientists to engage in these struggles, both in terms of the resources at their disposal and their ability as perceived by evaluators.

D The Role of Elites

Like the societies in which they are embedded, scientific communities are stratified.231 As Cole argues, the cognitive worth of a scientific claim no doubt plays a role in evaluation of that claim. So too, however, does the social characteristics of the scientists who make these claims as well as the operation of social processes such as the rhetorical force of intellectual authority.232

Even some who acknowledge the existence of a scientific elite acknowledge that the credit this select group accrues throughout their career exceeds the amount that the worth of their research might suggest they deserve.233 Because of the intellectual class structure of elites and non-elites in science, Merton argued that what he calls a 'Matthew Effect' has an important influence.234 Merton intends this biblical reference to capture the tendency in science for 'famous' scientists to be '*over*recognized' and for others to be '*under*recognized' in cases of collaboration between these two status groups as well as of independent multiple discoveries by scientists of substantially different rank.235

Despite this deviation from the norms of universalism and disinterestedness, Merton does not consider these nonmerit based inequalities to be detrimental to science. In fact, consistent with his general sociological perspective, Merton conceives of the Matthew Effect as quite functional for the social system of science: Elites presumably help ensure that worthy research does not go unrecognized by attaching their famous name to it, while their status also helps to create the conditions necessary for risk taking in scientific investigations and quality research more generally by effecting the concentration of resources; big institutions with big names get big money, thereby enabling high quality research to be carried out.236

Merton's functionalist rationale for the disproportionate amount of credit going to elites in science is, at best, incoherent. He vests elites with the wisdom to decide which research is and is not worthy and to attach their name accordingly, while at the same time acknowledging that the elites' own fame derives from more than the worth of their research to the scientific enterprise. Moreover, Merton does not address a basic problem arising from the fact that scientific elites are not omniscient, namely, that even when such elites make great efforts to advance what they consider to be worthy research, they have no way of evaluating the universe of possibilities.

As a consequence, elite efforts alone cannot make up for the marginalization of significant and valid research in a community stratified on the basis of criteria other than merit. Merton seems to have a penchant for ignoring anything that might vitiate the purity of the scientific project, such as the operation of power, authority, and multiple standards of evaluation that are both reasonable and in conflict.

Illustrative of the role of aleatory factors in creating knowledge claims is the treatment of women in science. On the basis of an examination of the history of women in science, Rossiter offers an alternative to Merton's 'Matthew Effect' that calls into question the functionality of science's non-merit based hierarchy.237 She coins the term 'Matilda Effect'238 to represent the fact that there has been and still is a systematic undervaluing of women's contribution to science.239 There have been several prominent examples of important discoveries by women that have gone unrecognized.240 Today, women constitute just 18 percent of all employed doctoral level

scientists and engineers.241 Compared to men, women with similar credentials are less likely to gain employment in elite institutions.242 And, regardless of where they gain university employment, women move more slowly up the academic ranks.243

Although it is important to be cautious when inferring a causal process from an outcome,244 such a dramatic disparity certainly suggests that, *contra* the norms of universalism and disinterestedness, the scientific community is not exempt from the problems of sex discrimination, even if these problems do not monocausally effect women's inferior status in the scientific hierarchy. Indeed, in a survey of 699 former National Science Foundation and National Research Council postdoctoral fellows,245 women frequently claimed "marginalization in the network of collegial interaction."246 While claims of mistreatment are cheap by themselves, that women feel marginalized suggests in and of itself that expertise is a human phenomenon, rife with all the struggles and mistrust we learn to expect in a social enterprise.

Differential treatment of women's work would constitute a serious blemish to science's presumed universalist norms. However, unless we assume the existence of a 'women's perspective' as distinct from that of men, gender discrimination has no *necessary* implications for the consideration of what role is desirable for the scientific expert witness. One could assume, although we do not, that improving women's position within science would have no qualitative impact on its perspectives, methodologies, and stock of important facts any more than would improving the position of marginalized men and, thus, the case of gender discrimination would be a socioeconomic, not intellectual, one. As a consequence, our consideration of the proper role for expert witnesses would not require a contemplation of women's peripheral position.

Intellectual suppression and hegemony,247 on the other hand, are a different matter. First, this phenomenon is far more difficult to grasp because it lies outside the parameters of everyday experience: one would not expect to turn on the television and learn of an intellectual suppression complaint in the way that she or he might hear about a sexual harassment suit. Second, intellectual suppression and hegemony, while both being more subtle forces, have a much greater degree of direct relevance to any consideration of the role of expert witnesses. If reasonably valid perspectives from a discipline are silenced, then what are the implications for a court seeking 'the biologist's' perspective on a matter? Application of *Frye*'s general acceptance standard, for example, would mean that these marginalized perspectives would not make it into court.

Critical studies of the rigidity of disciplinary boundaries recognize this kind of suppression as a reality and explore the reasons why as well as the means by which this occurs. The seminal work in this emerging field of interest did not actually treat a discipline as the unit of analysis, but rather the entirety of the scientific field.248 In Gieryn's analysis, "characteristics of science are examined neither as inherent nor possibly unique, but as part of ideological efforts *by scientists* to distinguish their work and its products from non-scientific intellectual activities."249 Through historical analysis, Gieryn identifies three turning points in the development of science when its status was in doubt and prominent members of the scientific community made use of the ideology of boundary work to expand, monopolize, and preserve science's authority.250

The basic premise for Gieryn's work was that "scientists too struggle for authority, power, and resources,"251 and subsequent scholars have extended this analysis to the level of the academic discipline. Klein argues that the promotion of a discipline's 'unity' serves to obscure the tremendous diversity of theoretical positions, methodologies, and assumptions that can be found in any single discipline, especially due to the proliferation of specialties.252 She points to the use of disciplinary histories as a means of "indoctrinating new entrants into a field, legitimating the field to outsiders, and controlling, promoting, or opposing change."253

In a similar vein, some economists have examined their own field, arguing that boundary drawing in relation to what does and does not constitute the discipline has served as a hegemonic device.254 They argue that, in economics, positivism has been the object around which these boundaries have been drawn, as advocates of this methodology distinguish their work from that of others within the field along the lines of truth versus falsity, rigor versus error, and modification versus deviation.255

These claims about the commonality of intradisciplinary struggles and the obscurantist homogenization of perspectives that they yield cast at least a partial shadow over the presumed brilliance of rational inquiry in scientific academic inquiry. However, the skeptic might be wondering about just how important these struggles really are. Do members of disciplines in pursuit of scientific knowledge generally adhere to the Mertonian norms, with the kind of struggles outlined above taking at most an anomalous position? Or do these struggles play a more central role in determining which theories and methodologies are deemed as worthy?

To answer these questions, a good place to start is the theoretical perspective developed by Fuchs.256 According to his organizational theory of science, the degree to which a subject or discipline is considered scientific and objective is not a product of the intrinsic nature of the subject matter, but instead is dependent upon its organizational structure. On this account, the more centralized a discipline's resources, and the greater the degree of control exerted over how these resources are used " i.e., the more centralized is its elite and the greater is the agreement about theories, methods, assumptions, and appropriate objects and questions of study " the more likely it is to gain these much coveted twin descriptors and be considered 'successful'.257

In a decidedly revealing paper about how scientific disciplines 'work', Pfeffer corroborates not only Fuchs' theoretical perspective but also claims discussed earlier about the way in which the drive for unity and consensus within a discipline marginalizes potentially valid perspectives.258 What makes this essay such compelling evidence for the empirical validity of the latter point is that Pfeffer recognizes these marginalizing and homogenizing forces within successful disciplines but, nevertheless, partially embraces them as a positive direction for his own discipline, organizational science, for the very reason that they do engender success.259

Pfeffer focuses his attention on the level of a discipline's paradigm development " i.e., the extent of existing agreement about the proper methods, questions, and objects of study " and argues that the more advanced such development is, the more successful will be a discipline in terms of acquiring resources, faculty pay, and general power and prestige in the academy.260 Getting to higher levels of paradigm development depends upon the emergence of consensus.

According to Pfeffer, consensus is not the product of rational deliberation yielding a patently correct position for all to take; it is imposed by elites in whom the discipline vests its authority261 as well as by members who make conformity to disciplinary conventions a *sine qua non* for success.262 He points to the natural sciences as well as economics and political science in the social sciences as models of successful paradigm development, and stresses that this success did not come because their objects of study are any less complex than his own, where there is a comparatively undeveloped paradigm.263 Significantly, Pfeffer is not a maverick crying that he's been marginalized, which, if true, might prompt valid concern that he's overstating his case. Quite to the contrary, Pfeffer argues that organizational studies should move in the direction of more paradigmatically developed fields.264

E. Conservatism and Deviance in Successful Disciplines

Peter Huber, the consummate advocate for evidentiary standards deferential to the academic disciplines that produce our experts, reassures judges that, with the onset of modern science, the Galileo problem265 is a problem no more.266 He bases his comments on the advances science has made in the areas of common standards and social structure.267 However, as the analyses of Fuchs and Pfeffer highlight, it is these very processes of consensus formation and resource consolidation, the double lane to success for a discipline, that, rather than providing a bulwark against the recurrence of a Galileo-like situation, actually creates the condition necessary for it, namely disciplinary conservatism.

Fuchs and Pfeffer are not the first to notice this characteristic of successful disciplines. Kuhn's theory of paradigm change and normal science's role in militating against it says as much. Travis and Collins' concept of 'cognitive cronyism', as does Zupan's discussion of 'paradigm stickiness',268 elucidates why general consensus generated by rational debate and coercion, tends to perpetuate itself.269 Dolby contributes supplemental explanation for how power consolidation in an elite creates a bias against change.270 Myers presents a complementary empirical account of how this conservatism plays out in the peer review process.271

IV. Courts and Contrary Expertise

If as we claim, the norms of particularism, solitariness, interestedness, and organized dogmatism (Prelli, 1989) offset Merton's norms in scientific practice, expertise is inescapably human, with all that such a designation applies. Investigators are sometimes as noble as one of Aristotle's "essential" friends. At other times, self-aggrandizement and groupthink lead them to squelch new ideas. Courts are hardly in a position to determine the extent to which a body of expertise has emerged from a Habermasian ideal speech situation.

The rhetorical burden that experts can fulfil in such a climate is that of the self-conscious rhetor. Just as judges would be hesitant to certify the fairness of any proceedings where one party was represented by counsel and the other had no representation, they should be wary of any legal setting where expertise is univocal. To expect judge or jury to sort through the jargon and biases of any particular expert is to make light of all the hard work the expert has undertaken to distinguish herself from everyone else in the courtroom. Only extreme hubris would cause a court to see itself as equal to that task.

Yet courts can make use of expertise to meet their needs. In doing so, they should be guided by the poet, William Blake: without contraries is no progression (Posner, 1990). If experts are fallible and the court's ability to discern the limits of credibility of a particular expertise is constrained by background deficits, the courts have a method of insuring that they will, at least, hear two contrary voices of expertise. Rule 706 would permit courts to obtain the multiple experts that they require to have a decent opportunity to sort out the usefulness of expertise.

While listening to a second expert is hardly an adequate substitute for access to a full panoply of pertinent expert testimony, the widespread use of Rule 706 would be more beneficial than might be apparent (Gergen, 1994; Brown, 1987). The judge and jury would no longer be able to hold out the realistic hope that the right expert would stroll into the courtroom and fulfil their decision making responsibility. The resulting clash of expert opinion would force courts to face up to their responsibilities as critical thinkers.

The expert is a tool serving on behalf of the court's admission of incomplete understanding. From that perspective, the courts should be open to multiple experts representing multiple perspectives. While the issue of which perspectives deserve a hearing would need to be addressed, just recognizing that expertise, even that

correctly labelled a "consensus viewpoint" is a negotiated process, reflecting power relationships as well as logic and data, would signify enormous judicial progress.

Notes

1. *See* Learned Hand, *Historical and Practical Considerations Regarding Expert Testimony*, 15 Harv. L. Rev. 40 (1901) (discussing the use of expert knowledge in the courtroom from as far back as the fourteenth century).

2. Judge Learned Hand's article on expert testimony illustrates that the regulation of expert testimony has varied throughout history. For example, Judge Hand relates that the rules during the eighteenth century were far more liberal than those applied by the common law in the twentieth century. *See* Hand, *supra* note 1, at 47.

3. Leslie A. Lunney, *Protecting Juries from Themselves: Restricting the Admission of Expert Testimony in Toxic Tort Cases*, 48 SMU L. Rev. 103, 104-05 (1994); *see also* United States v. Williams, 583 F.2d 1194, 1199 (2d Cir. 1978), *cert. denied*, 439 U.S. 1117 (1979) ("mythic infallibility"); United States v. Downing, 753 F.2d 1224, 1236 (3d Cir. 1985) (jurors may be swayed into believing that scientific testimony is especially reliable and trustworthy). *But see* Jack B. Weinstein, *Scientific Evidence in Complex Litigation*, C607 ALI-ABA 709, 711 (1991) (noting the dearth of evidence supporting this fear that jurors will give undue weight to testimony because it comes from one labelled an "expert"). Some commentators have suggested that this aura may be particularly acute when experts are proffering certain types of testimony. For example, Jack B. Weinstein suggested that statistical evidence is especially likely to create an "appearance of infallibility." Weinstein, *supra*, at 714.

4. This aura makes for an interesting dynamic when the trier of fact is faced with two or more conflicting views coming from equally "infallible" experts. In this situation, the trier may "split the difference." *See* Richard A. Epstein, *A New Regime for Expert Witnesses*, 26 Val. U. L. Rev. 757, *4 (1992). On the other hand, the trier of fact may decide for the defendant believing that if all of these experts disagree then the plaintiff can not have met its burden of proof, especially when that burden is beyond a reasonable doubt.

5. John W. Osborne, *Judicial/Technical Assessment of Novel Scientific Evidence*, 1990 U.Ill. L. Rev. 497, 501 (1990).

6. *See, e.g.*, Margaret A. Berger, *Reference Manual on Sci. Evid.* 37, *36 (1994); Weinstein, *supra* note 3, at 712 (noting the potential impact of the "imprimatur of the judge's decision that the person testifying is an "expert"").

7. *See, e.g.*, Stanley D. Davis, *A Fresh Look at Hypothetical Questions and Ultimate Issues: The Kansas Experience*, 36 U.Kan. L. Rev. 311 (1988). This expropriation may result from the structure of the legal system and its resulting jury instructions or from the jurors themselves. Faced with the specter of these unerring mental giants, the jurors may no longer rely on their own experience, even when they are otherwise instructed. *See* Clifton T. Hutchinson & Danny S. Ashby, Daubert v. Merrell Dow Pharmaceuticals, Inc.: *Redefining the Bases for Admissibility of Expert Scientific Testimony*, 15 Cardozo L. Rev. 1875, 1878-79 (1994).

8. *See, e.g.*, Lunney, *supra* note 3, at 110; Weinstein, *supra* note 3, at 712 (citing In re Air Crash Disaster at

New Orleans, Louisiana, 795 F.2d 1230, 1234 (5th Cir. 1986)); L. Timothy Perrin, *Expert Testimony: Back to the Future*, 29 U. Rich. L. Rev. 1389 (1995) (experts not impartial professionals, but prostitutes, mercenaries or advocates for the litigant who hired them). The formation of a regulatory entity to enforce standards of ethics for expert witnesses would help address this problem. *See* Weinstein, *supra* note 3, at 729 (noting that this proposal has been considered by the National Academy of Sciences Panel on Statistical Assessments).

9. See Peter Huber, *Galileo's Revenge: Junk Science in the Courtroom*. (1991) (lamenting the abundance of "junk science" let into the courtroom).

10. For example, at common law, a layperson could not testify to opinions. *See* Hand, *supra* note 1, at 44. Judge Hand notes that the requirement that witnesses may not testify to opinion was based on the desire to avoid redundant evidence, contrary to other rules of exclusion addressed to evidence relevant, but problematic on some other ground. *Id.* The opinion of the witness is irrelevant in that it should not make the existence of a material fact more or less probable. *S*ee Fed. R. Evid. 401. Experts, however, have not been subject to this proscription. Thomas E. Baker, *The Impropriety of Expert Witness Testimony on the Law*, 40 UMKC L. Rev. 325, *1 (1992).

Under the present Federal Rules of Evidence, a lay witness can testify to opinion or inferences only if the opinions or inferences are rationally based on the perception of the witness and helpful to a clear understanding of the witness' testimony or the determination of a fact in issue. Fed. R. Evid. 701. An expert, however, is not subject to this restraint on opinion with some exceptions. Under the Rules, an expert may testify to opinions so long as it will assist the trier of fact or determine a fact in issue. Fed. R. Evid. 702.

Admittedly, the standard to qualify as an expert is far from insurmountable. *See, e.g.*, *Holbrook*, 1996 WL 127849, *2 (3d Cir.) (noting that a broad range of knowledge, skills and training can qualify an expert). The court in *Holbrook* also cited to Hammond v. International Harvester Co., 691 F.2d 646, 653 (3d Cir. 1982), where an engineer with sales experience in automotive and agricultural equipment, who had taught high school auto repair, testified as an expert in products liability suit involving tractors.

One definition of expert is a person who is "qualified, either by actual experience or by careful study, as to enable [the expert] to form definite opinions with respect to a division of science, branch of art, or department of trade about which persons having no particular training or special study are incapable of forming accurate opinions or of drawing correct conclusions." 31A Am. Jur. 2d Evidence § 1 (1989).

11. See, e.g., Ronald J. Allen & Joseph S. Miller, 87 Nw. U. L. Rev. 1131 (1993) (noting the "increasingly controversial" nature of expert testimony). This decision to admit expert evidence has been described as often outcome-determinative or one as to the ultimate issue. *See, e.g.*, Wendy Fleishman & Russel Jackson, 723 PLI/Comm 121 (1995); Alaini Golanski, *Judicial Scrutiny of Expert Testimony in Environmental Tort Litigatio*n, 9 Pace Envtl. L. Rev. 399 (1992); *see also* Rosen v. CIBA-GEIGY Corp., 78 F.3d 316, 318 (7th Cir. 1996) (noting that the exclusion of expert's testimony regarding role of nicotine patch would "doom" plaintiff's case). The question of admissibility of this type of evidence may directly alter the odds of winning or losing a dispute significantly. The standard by which this decision is made is thus important. To the extent that scientific evidence has increased in the courtroom, the treatment of expert scientific testimony is that much more significant.

12. *See* Baker, *supra* note 10.

13. *See* Allen, *supra* note 11, at 1132 (describing the common law desire for witnesses to testify only to their "thinly varnished sensory impressions"). The distinction between "fact" and "opinion" is not easily discernable or even tenable. Courts have, however, continued to use the distinction, believing it to be useful. *See, e.g.*, Allen, *supra* note 11, at 1132. In 1622, Lord Coke apparently declared that it "'is not satisfactory for a witness to say that he thinks or persuadeth himself.'"

14. Allen, *supra* note 11, at 1132. Black's law dictionary defines witness as "one who, being present, personally sees or perceives a thing." *Black's Law Dictionary* 1603 (6th ed. 1990).

15. *See* Allen, *supra* note 11, at 1132.

16. *See* Allen, *supra* note 11, at 1132.

17. This deviation from the personal knowledge requirement was reconciled in the 1782 case of Folkes v. Chadd, in which Lord Mansfield equated an expert's knowledge in his field as personal knowledge.

18. Allen, *supra* note 11, at 1132-33.

19. Lee Waldman Miller, *Cross-Examination of Expert Witnesses: Dispelling the Aura of* Reliability, 42 U. Miami L. Rev. 1073, 1074 (1988) (citing Bridger v. Union Ry, 355 F.2d 382, 387 (6th Cir. 1966)); Baker, *supra* note 10. The Sixth Circuit decision in United States v. Thomas provides an example of an area that was not considered beyond the ability of the jurors to understand. 74 F.3d at 684-85 (jurors fully capable of understanding the incentive to lie created by a plea agreement).

Prior to the establishment of the adversary system, the jury was not composed of the average layperson. Instead, one mode to select the jury was to collect "experts' or individuals especially familiar with the case. *See* Baker, *supra* note 10; Hand, *supra* note 1, at 40. Prior to the advent of the witness in the fifteenth century, the jury took it upon themselves to discern the necessary facts. Hand, *supra* note 1, at 44.

The adoption of the Federal Rules of Evidence eliminated this requirement that expert testimony was limited to matters outside the ken of laypersons. *See* Fed. R. Evid. 702, which requires that the testimony aid the trier of fact.

20. Miller, *supra* note 19, at 1041 (citing Rossi, Modern Evidence and the Expert Witness, Litigation, fall 1985, at 18).

21. Miller, *supra* note 19, at 1074.

22. Miller, *supra* note 19, at 1076. An opinion can be broken down into the parts that form it and thus the jury can make that final leap on its own. This common law restriction against testifying to the ultimate issue was also abolished by the Rules. *See* Fed. R. Evid. 704 & advisor committee's note.

23. This personal knowledge requirement was designed to guard against the unreliability of hearsay. The more

mediums through which the knowledge passed, the more likely the message was tainted. Further, the originator was not available to be cross-examined.

24. Miller, *supra* note 19, at 1074.

25. For example, in a product liability case, the expert's role is to instruct the jury as to the relationship between the defendant's conduct and the complained of condition. These restrictions necessarily presume that the judge will know of what the jury is capable. Further, the restrictions are based on some notion of the average juror, not those less capable or more capable. *See infra* notes 144 to 150 and accompanying discussion about the adversarial system.

26. *See* Clayton C. Skaggs, *Evidence: Say Good-Bye to the Frye "General Acceptance: Test* [Daubert v. Merrell bow Pharmaceutical, 113 S. Ct. 2786 (1993)], 33 Washburn L.J. 450 n.59 (1994); Miller, *supra* note 19, at 1075. Some courts used the Frye principle outside of the context of scientific testimony. Additionally, it is difficult in some cases to distinguish between that which is scientific and that which is nonscientific or that which is soft science and that which is hard.

27. Allen, *supra* note 11, at 1133.

28. *See, e.g.*, Michael S. Jacobs, *Testing the Assumptions Underlying the Debate About Scientific Evidence: A Closure Look at Juror "Incompetence" and Scientific "Objectivity," 25 Conn. L. Rev. 1083, 1090 (1993) (*noting the concern that jurors may split the "intellectual difference" between the "'charlatans and Nobel prize winners'"); Allen, *supra* note 11.

29. Frye v. United States, 293 F. 1013 (D.C. Cir. 1923).

30. *Id.* at 1014.

31. Miller, *supra* note 19, at 1093.

32. *See* Jon P. Thames, *It's Not Bad Law"It's Bad Science: Problems with Expert Testimony in Trial* Proceedings, 18 Am. J. Trial Advoc. 545, 549 (1995).

33. A predecessor to the current polygraph machine.

34. *Frye*, 293 F. at 1013.

35. *Id.*

36. *Id.* In the words of Justice Van Orsdel:

> Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction

is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.

37. *Introduction, Confronting the New Challenges of Scientific Evidence*, 108 Harv. L. Rev. 1481, 1486 (1995) ("Harvard1"). It would not be enough under this standard if ten experts believed it to be reliable. Professor McCormick has suggested just such a standard in which any relevant evidence supported by a qualified expert would be admissible. *See* Osborne, *supra* note 5, at 512 (citing C. McCormick, Evidence 363-64 (1954)). It is not clear whether Professor McCormick's standard would utilize the same permissive standard to qualify as an expert that presently is used.

38. *See, e.g.*, United States v. Brown, 557 F.2d 541 (1977) (applying Frye subsequent to enactment of the Rules); United States v. Shorter, 809 F.2d 54, 60 (D.C. Cir.), *cert. denied*, 484 U.S. 817 (1987) (application of Frye standard subsequent to Rules enactment).

39. Thames, *supra* note 32, at 549; *see also* Reed v. State, 391 A.2d 364, 368 (Md. 1978). Arguably, the two page opinion was not intended to reach the areas in which it has been applied. For example, *Frye* excluded testimony addressing the credibility of a particular witness and not a question of fact. Credibility should be decided by the jury.

In another context, courts have prohibited experts from testifying that an accused child molester deviates from the profile of a child abuser as that testimony is infringing on the jurors' role of assessing the credibility of the abuser. *See, e.g.*, People v. Berrios, 568 N.Y.S.2d 512 (1991) (refusing to admit profile testimony of a child abuser).

Other examples of types of scientific evidence to which the Frye standard has been applied include the following: United States v. Addison, 498 F.2d 741, 743 (D.C. Cir. 1974) (voice prints); State v. Smith, 50 Ohio App.2d 183, 362 N.E.2d 1239, 1246 (1976) (gunshot residue tests); People v. Slone, 76 Cal.App.3d 611, 143 Cal. Rptr. 61, 68 (1978) (bite-mark comparisons); United States v. Tranowski, 702 F.2d 668 (1983) (astronomer's testimony dating photographs by measuring lengths of shadows); Hughes v. Mathews, 576 F.2d 1250, 1258 (7th Cir.), cert. denied, 439 U.S. 801 (1978) (psychiatric testimony); United States v. Kilgus, 571 F.2d 508, 510 (9th Cir. 1978) (forward looking infrared imaging systems); Lindsey v. United States, 237 F.2d 893, 896 (9th Cir. 1956) (sodium pentothal); People v. Alston, 79 Misc.2d 1077, 1085, 362 N.Y.S.2d 356, 362 (N.Y.Sup.Ct. 1974) (blood testing); People v. Alston, 79 Misc.2d 1077, 1085, 362 N.Y.S.2d 356, 362 (N.Y.Sup.Ct. 1974); People v. Palmer, 80 Cal. App. 3d 239, 252, 145 Cal. Rptr. 466, 472 (1978) (scanning electron microscope).

40. Alan W. Tamarelli, Jr., Daubert v. Merrell Dow Pharmaceuticals: *Pushing the Limits of Scientific Reliability"The Questionable Wisdom of Abandoning the Peer Review Standard for Admitting Expert Testimony*, 47 Vand. L. Rev. 1175, 1176 (1994) (other experts should make decisions about the reliability of scientific evidence); Osborne, *supra* note 5, at 501; *Confronting the New Challenges of Scientific Evidence*, 108 Harv. L. Rev. 1509, 1510 (1995) ("Harvard3") ("[T]he community of experts within a particular field is most qualified to assess the validity of an expert's theory or technique on that subject"); *see also* United States v. Addison, 498 F.2d 741, 743-44 (D.C. Cir. 1974). *Contra* David F. Horrobin, *The Philosophical Basis of Peer Review and the Suppression of Innovation*, 263 JAMA 1438, 1439 (1990) ("The frequency of error is low among peer-reviewed articles. But unfortunately, ... the numbers of truly important innovative articles presented to an editor are small.... Peer review must therefore be judged by how it handles those rare articles

that genuinely offer the possibility of new approaches ....").

Peter Huber, in advocating the Frye standard, draws the analogy to one's own decision regarding one's own health and medical care. One is not likely to go with the esoteric treatment that is not supported generally by the medical community. Huber, *supra* note 9, at 11 ("What he trusts is the institution, the process, the collegiality, the experience, and the track record."). The extent to which we rely on such a heuristic may depend on inability or unwillingness to expend the time to evaluate our various selections.

A fear exists, however, that experts who have a vested interest in the development of a particular procedure will inaccurately present the status of the procedure in their respective community. *See, e.g.*, Horne, *supra*, at 5; Majmudar, at 197. One court addressed this criticism by requiring that the procedure in issue be established by "disinterested and impartial . . . scientists whose livelihood was not intimately connected with" the procedure. People v. Kelly, 17 Cal.3d 24, 549 P.2d 1240, 130 Cal. Rptr. 144 (1976). The involvement that makes an expert especially appropriate for the task may likewise render that same expert disinterested and thus inherently suspect. *But cf* People v. Young, 425 Mich. 470, 391 N.W.2d 270 (1986) (expert witnesses who are intimately connected with a technique should not be discounted unless the court determines some basis for unreliability).

41. Michael S. Jacobs, *Testing the Assumptions Underlying the Debate about Scientific Evidence: A Closer Look at Juror "Incompetence" and Scientific "Objectivity,"* 25 Conn. L. Rev. 1083, 1088 (1993) (citing Edward J. Imwinkelried, *Judge Versus Jury: Who Should Decide Questions of Preliminary Facts Conditioning the Admissibility of Scientific Evidence?*, 25 Wm. & Mary L. Rev. 577, 580 (1984)). Given this inability to distinguish between "charlatans" and "Nobel prize winners," presented with two extremes, jurors are likely to presume the truth lies somewhere in between. Jacobs, *supra* note 28, at 115 n.8.

This denunciation of juror competence and reliance on outside help to assess the reliability of the evidence should apply likewise to the jury's ability to evaluate the testimony that is admitted.

One recent proposal was to extend Frye and have the judge present the proffered scientific evidence to a committee of scientists who would testify at trial as to its validity. Weinstein, *supra* note 3, at 728.

42. *See, e.g.*, Tamarelli, *supra* note 40, at 1179. The standard has also been referred to as "all-or-nothing." Hutchinson, *supra* note 7, at 1905.

43. Peter Huber, *Junk Science in the Courtroom*, 26 Val. U. L. Rev. 723, 11 (1992) ("Huber1") (noting that the judge need not know anything about the substantive science because he can simply access scientific journals to determine where scientific consensus lies).

44. Thames, *supra* note 32, at 549-50. Peter Huber has suggested that this publication and peer review needs to occur only in "good journals." Huber1, *supra* note 43, at *12.

45. John William Strong, *Language and Logic in Expert Testimony: Limiting Expert Testimony by Restrictions of Function, Reliability, and Form*, 71 Or. L. Rev. 349, *6 (1992); Tamarelli, *supra* note 40, at 1179.

46. Tamarelli, *supra* note 11, at 1179. At some point, protecting the jurors from such "banter" borders on usurpation of their role as finder of fact. If the court gets rid of all the so-called badinage, it runs the risk of

determining the juror's conclusion by implicitly presenting the testimony as gospel.

47. Huber1, *supra* note 43, at 26-28.

48. Osborne, *supra* note 5, at 501. This asserted advantage illustrates vividly the interplay between the norms of the legal system and science. The legal system wants the best it can get in a short period of time. The norms of science presumably do not demand such speed. *But see Confronting the New Challenges of Scientific Evidence*, 108 Harv. L. Rev. 1532 (1995) ("Harvard4") (Arguing that the distinction between the rigor required by law and science is a false dichotomy and that the task for courts is to determine how scientists can reach the certainty required by legal system in a particular case).

49. Miller, *supra* note 19, at 1093; Tamarelli, *supra* note 40, at 1176 ("[the general acceptance standard] arguably excludes potentially useful cutting-edge theories"). Melissa M. Horne refers to this delay as a "'cultural lag,'" suggesting that it is more than the pure passage of time that may be necessary to get an idea accepted. Note, Melissa M. Horne, *Novel Scientific Evidence: Does Frye Require that General Acceptance within the Scientific Community Be Established by Disinterested Scientist?,* 65 U. Det. L. Rev. 147 (1987).

50. Tamarelli, *supra* note 40, at 1178-79; *see also Daubert*, 113 S. Ct. at 2798-99 (recognizing that, even under the new standard in *Daubert*, some authentic insights will not get to the jury). In addition, Frye could let in so-called charlatans as well. *S*ee Harvard3, *supra* note 40, 1511; Horne, *supra* note 49, at *3; Osborne, *supra* note 5, at 509-20 (unreliable evidence could satisfy the Frye standard, and the scientific community will not always extensively test a novel scientific technique).

An example of a test considered generally accepted that later turned out to be flawed is a paraffin test that purported to detect nitrate residues from gunpowder on hands. For a quarter of a century defendants would be convicted based on these results until it was determined that the test creates a high number of false positives from substances such as tobacco or nail polish. *See* Thames, *supra* note 32, at 547.

51. *See, e.g.*, Tamarelli, *supra* note 40, at 1176 (referring to this dilemma as a "double-edge sword" that many courts preferred to the alternative liberal admission approach); Osborne, *supra* note 5, at 508. *But see* United States v. Baller, 519 F.2d 463, 466 (4th Cir.), *cert. denied*, 423 U.S. 1019 (1975) (taking a more liberal approach, believing it is better to let the jury hear the testimony and assess the credibility in light of cross-examination and refutation). In making an analogy between the scientist as researcher and the judge as "researcher," David L. Faigman characterizes the admission of evidence when it is invalid as a "type I error" and excluding valid evidence as a "type II error." In statistics, the type I error refers to the acceptance of an hypothesis when it should have been rejected. The type II error refers to the rejection of an hypothesis when it should have been accepted. As in science, a decision must be made as to the relative desirability of each type of error in a particular instance. David L. Faigman, *Mapping the Labyrinth of Scientific Evidence*, 46 Hastings L.J. 555, 568 (1995).

52. Perhaps the results of this balancing come out differently when in the criminal context. *See infra* notes 66 to 69 discussing special considerations with criminal defendants.

53. *See* Hutchinson, *supra* note 7, at 1927 (citing Bert Black, *A Unified theory of Scientific Evidence*, 56 Fordham L. Rev. 595, 629 (1988) ("Few decisions have dominated an area of the law or caused as much

confusion as Frye v. United States")); Horne, *supra* note 49, at *4 (noting that Frye criticized as " 'remarkably vague' " and " 'undefinable' ") (citing e.g., 22 C. Wright & Graham, Federal Practice and Procedure: Evidence 5168 at 87)) . *But see* Frank R. Emmerich, *The Supreme Court Strengthens the Discretionary Powers of the District Courts in Admitting Expert Scientific Testimony: Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 3 Widener J. Pub. L. 1051 (1994) ([T]he application of this new rule [the *Daubert* standard] will only lead to greater confusion and frustration than that associated with Frye").

Bert Black has suggested that part of the confusion created by Frye stems from an emphasis on "the thing from which the deduction is made," leading courts to look for devices and techniques, ignoring theories and reasoning. Hutchinson, *supra* note 7, at 1927 n.167 (citing Black, *supra* note 53, at 629-30); Strong, *supra* note 45, at *17 n.54; *see also* Campbell v. People, 814 P.2d 1, 8 (Colo. 1991) (refusing to apply Frye to expert psychological testimony on eyewitness reliability because it was not a scientific device).

54. The Third Circuit in *Downing*, addressed Frye's vagueness and the concern that the court could manipulate the relevant scientific community depending upon whether it wanted to admit the evidence. If the court wanted to admit the evidence, it would make the community broader and to insure exclusion, it would make the relevant community more narrow. *Downing*, 753 F.2d at 1236 (citing People v. Williams, 164 Cal. App.2d Supp. 858, 331 P.2d 251, 254 (1958)); *see also* Skaggs, *supra* note 26, at 403 (citing Edward Becker & Aviva Orenstein, *The Federal Rules of Evidence After Sixteen years"The Effect of "Plain Meaning" Jurisprudence, the Need for an Advisory Committee on the Rules of Evidence, and Suggestions for Selective Revision of the Rules*, 60 Geo. Wash. L.Rev. 857, 878 (1992)). In the *Williams* case, cited by the *Downing* court, the court looked for general acceptance by those who were expected to be familiar with the technique, instead of looking at whether the technique had achieved acceptance within the medical profession as a whole).

"Scientific knowledge," according to *Daubert*, is evidence derived by the scientific method and supported by appropriate validation. Evidence will assist the trier of fact if it is relevant. This relevancy requirement however is not sufficient to meet the assistance criterion. Instead, the evidence also must contain a "valid scientific connection to the pertinent inquiry." *Daubert*, 113 S. Ct. at 2795-96.

55. Osborne, supra note 5, at 502 (citing Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, A Half-Century Later*, 80 Colum. L. Rev. 1197, 1208 (1980)); Harvard1, *supra* note 37, at 1486 (citing Bert Black, *A Unified Theory of Scientific Evidence*, 56 Fordham L. Rev. 595 (1988)). Alan W. Tamarelli has noted the range of judicial definitions of "general acceptance," including "widespread, prevalent, extensive though not universal." *See* Tamarelli, *supra* note 40, at 1186-87. For a further discussion on the application of the standard see discussion *infra* on Judicial Application of Frye.

A related difficulty arises when the court must choose between two competing schools of accepted theory. Jacobs, *supra* note 28, at 1115 n.27.

Peter Huber vigorously disagrees with the notion that determining the relevant community and the extent of acceptance is a difficult process. According to Professor Huber, a court need only look at the "top-notch" scientific journals to determine whether a particular technique or method is "generally accepted." Huber1, *supra* note 43, at *11.

56. *See* Weinstein, *supra* note 3, at 712. Further, if there is a three-way tie among the experts regarding a particular principle or technique, under the Frye standard, there is no general acceptance.

57. *See, e.g.*, Harvard1, *supra* note 37, at 1486. Dean McCormick has suggested that the general acceptance test is an appropriate standard to determine of what a court can take judicial notice, but is not suitable to determine whether the evidence can be admitted. *See* Kaushal B. Majmudar, *Daubert v. Merrell Dow: A flexible Approach to the Admissibility of Novel Scientific Evidence*, 7 Harv. J.L. & Tech. 187, 198 (1993) (citing Charles T. McCormick, Handbook of the Law of Evidence 170 (1954)).

Interestingly, the new standard articulated by the Supreme Court in *Daubert*, renouncing Frye, has been described by commentators as "a more conservative and nebulous test." *See, e.g.*, Emmerich, *supra* note 53.

58. *See, e.g., Daubert*, 113 S. Ct. at 2794.

59. *See* Fed. R. Evid. 401 (defining relevant as that which has "any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence").

60. U.S. Const. amend. VII.

61. This concern is especially apt given the often outcome-determinative nature of a decision to admit expert testimony.

62. *See, e.g.*, Horne, *supra* note 49, at *3.

63. *See* Giannelli, *supra* note 55, at 1230. Not only might there be a heightened concern for infringing on the defendant's right to present exculpatory evidence, but there may also be a heightened concern for prejudicial evidence and the impact on the jury.

64. *Id*., at 1234.

65. *See* Horne, *supra* note 49, at *3.

66. *See Downing*, 753 F.2d at 1236 (citing Giannelli, *supra* note 55, at 1208-21 n.9). The Ninth Circuit in *Daubert* found other decisions as to the reliability of reanalysis studies persuasive. *See* discussion *infra*, section II, discussing the application of the Frye standard.

67. *See* Harvard3, *supra* note 40, at 1529 (citing Paul C. Giannelli, *'Junk Science': The Criminal Cases*, 84 J. Crim. L. & Criminology 105, 111 (1993)); *see also* Huber1, *supra* note 43 .

68. *See* Giannelli, *supra* note 55, at 111.

69. Many courts and commentators have noted the difficulty in distinguishing between that evidence which is "scientific" and that which is "unscientific." *See, e.g.,* State v. Hall, 297 N.W.2d 80, 85 (Iowa 1980); Horne, *supra* note 49, at *3.

70. Lisa M. Agrimonti, 35 Washburn L.J. 134 (1993) (noting that Frye was limited to scientific evidence and

Daubert should be as well).

71. *See* Horne, *supra* note 49, at 152.

72. Horne, *supra* note 49, at 154.

73. Horne, *supra* note 49, at 155 (citing Giannelli, *supra* note 55, at 1211).

74. Horne, *supra* note 49, at 160 (citing Commonwealth v. Lykus, 327 N.E.2d 671, 678 n.6 (1975) ('a degree of scientific divergence of view is inevitable').

75. *See, e.g.*, United States v. Zeiger, 350 F. Supp. 685 (D.D.C.) (describing general acceptance as widespread or prevalent; *see also* Giannelli, *supra* note 55, at 1211.) .

76. Eileen Scallen, *Classical Rhetoric, Practical Reasonings, and the Law of Evidence*, 44 AM. U.L. REV 1717 (Summer, 1995).

77. Horne, *supra* note 49, at 157. For an example of a court looking to expert testimony in a prior judicial opinion see People v. Kelly, 549 P.2d 1240, 1247 (1976). *But see* United States v. Downing, 753 F.2d 1224, 1236-37 (criticizing Courts for looking to prior judicial acceptance as a basis for establishing general acceptance).

78. *See* Osborne, *supra* note 5, at 510. One commentator argues for a more individualistic approach on the part of the judge, seeing each situation anew. Harvard3, *supra* note 40, at 1519 (noting for example, that expert testimony on the reliability eyewitness identification is typically excluded, but in some cases should be admitted).

79. *See Daubert*, 113 S. Ct. at 2795 (describing science as an evolving process subject to continuing revision); Horne, *supra* note 49, (noting the concern that a judge's reliance on prior cases may result in the judge missing subsequent developments that may have invalidated or validated the procedure).

80. See Horne, *supra* note 49, at 161 (citing Giannelli, *supra* note 55, at 1215).

81. *See* Horne, *supra* note 49, at 160 (arguing that disinterested scientists should not be required to demonstrate general acceptance).

82. Horne, *supra* note 49, at 157; Huber1, *supra* note 43, at 26.

83. Giannelli, *supra* note 55.

84. According to Peter Huber, such a task merely requires a look at the "best" scientific journals. Huber1, *supra* note 43, at 34.

85. Horne, *supra* note 49, at 164.

86. The process of enacting the rules took over thirteen years. S. Rep. No. 1277, 93d Cong., 2d Sess. (1974), reprinted in 1974 U.S.C.C.A.N. 7051-52.

87. *See, e.g.*, Holbrook v. Lykes Bros. Steamship Co., 1996 WL 127849, *1 (3d Cir.) (noting Rule 702's liberal policy of admission).

88. See Lunney, *supra* note 3, at 105.

89. *See* Fed. R. Evid. 702, permitting an expert to be qualified in any identifiable field of specialized knowledge that may assist the trier of fact.

90. Fed. R. Evid. 705.

91. *See* Harvard1, *supra* note 37, at 1486-87. At common law, an expert could testify that something could have caused a particular result, for example, but not that the expert believed it did cause that outcome in the case at hand. Miller, *supra* note 19, at 1076.

The removal of the bar to testimony as to the ultimate issue in the case has purportedly had little impact, as judges still desire to keep the expert's opinion from treading on the jury's territory and thus prefer to let the jurors take that final step. *See* Weinstein, *supra* note 3, at 717.

Congress retained one exception to the lifting of the ultimate issue ban in Rule 704(b), which forbids an expert from testifying as to the mental state or condition of a criminal defendant, specifically as to whether the defendant had the mental state or condition constituting an element of the crime charged.

92. Fed. R. Evid. 401.

93. See Daubert v. Merrell Dow Pharmaceuticals, Inc., 113 S. Ct. 2786 (1993) ("The Rule's [401] basic standard of relevance thus is a liberal one").

94. Fed. R. Evid. 402. "All relevant evidence is admissible, except as otherwise provided by the Constitution of the United States, by Act of Congress, by these rules, or by other rules prescribed by the Supreme Court pursuant to statutory authority. Evidence which is not relevant is not admissible."

95. Fed. R. Evid. 403. "Unfair prejudice does not mean the damage to a defendant's case that results from the legitimate probative force of the evidence; rather it refers to evidence which tends to suggest decision on an improper basis." United States v. Bonds, 12 F.3d 540, 567 (6th Cir. 1993) (citation omitted). This improper basis could be the perceived likelihood that the jurors will attribute an "aura of infallibility" to the testimony.

Some commentators have suggested that Congress intended that Rule 403 would largely govern the various admissibility issues. Lunney, *supra* note 3, at 108.

96. Fed. R. Evid. 104. Rule 104(a) provides:

Preliminary questions concerning the qualification of a person to be a witness, the existence of a privilege, or the admissibility of evidence shall be determined by the court, subject to the provisions of subdivision (b). In making

its determination it is not bound by the rules of evidence except those with respect to privileges.

This requirement meant that the judge must consider whether the expert is proposing to testify to scientific knowledge and whether that knowledge will assist the trier of fact. Fed. R. Evid. 702.

97. Fed. R. Evid. 702. "If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise." To assist the trier of fact, there must be a valid connection to the pertinent inquiry. *See Daubert*, 113 S. Ct. at 2796.

Professor Frederick I. Lederer suggested a more liberal Rule 702 in which the word "reliable" would come before "scientific." Professor Lederer's justification was that reliability is the universal underlying concern. The debate is over only what standard will be most effective at reaching this goal. *See* William A. Thomas, *Rules for Admissibility of Scientific Evidence*, 115 F.R.D. 79 (1987).

98. While the Rules contain provisions that remove barriers to the admission of testimony, the language could also be construed to provide the judge with significant discretion over the admission of evidence. *See* Harvard1, *supra* note 37, at 1487; *see also infra* notes 125 to 130 noting that commentators have suggested the *Daubert* standard, which largely tracks the Rules, may be less liberal than Frye.

99. Some scholars have suggested that this provision incorporates the Frye standard into the Rules by focusing on the "status quo" or mainstream view in the expert community. *See, e.g.*, Laurel Beeler & William R. Wiebe, *DNA Identification Tests and the Courts*, 63 Wash. L. Rev. 903, 955 n.176 (1988); Gordon J. Beggs, *Novel Expert Evidence in Federal Civil Rights Litigation*, 45 Am. U. L. Rev. 1, 75 n.246 (1995). "Reasonably relied upon" may be defined as that which is "generally" relied upon. The "reasonable" aspect of this exception suggests a liberal interpretation, but the requirement of reliance suggests something akin to the "head counting" of Frye.

100. Rule 706(a) provides:

Appointment. The court may on its own motion or on the motion of any party enter an order to show cause why an expert witness should not be appointed, and may request the parties to submit nominations. The court may appoint any expert witnesses agreed upon by the parties, and may appoint expert witnesses of its own selection. An expert witness shall not be appointed by the court unless the witness consents to act. A witness so appointed shall be informed of the witness' duties by the court in writing, a copy of which shall be filed with the clerk, or at a conference in which the parties shall have an opportunity to participate. A witness so appointed shall advise the parties of the witness' findings, if any; the witness' deposition may be taken by any party; and the witness may be called to testify by the court or any party. The witness shall be subject to cross-examination by each party, including a party calling the witness.

For a detailed discussion on the use of these special masters, see Margaret G. Farrell, *Coping with Scientific Evidence: The Use of Special Masters*, 43 Emory L.J. 927 (1994).

101. *Compare* Paul C. Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, A Half Century Later*, 80 Colum.L.Rev. 1197, 1229 (1980), *with* Jack B. Weinstein & Margaret A. Berger, 3 WEINSTEIN'S EVIDENCE 702[03] at 702-36 (Bender, 1988).

102. *See Downing*, 753 F.2d at 1234; *Daubert*, 113 S. Ct. at 2794; Lunney, *supra* note 3, at 108. While the Frye standard evolved during a time of suspicion of science, the Rules were enacted during a time of consumer advocacy. *S*ee Huber1, *sup*ra note 43, at 40.

103. Horne, *supra* note 49, at *3. Those maintaining that Frye was superseded by the Rules also argue that if Frye were to have survived the drafters of the Rules would have mentioned the standard somewhere. *See Downing*, 753 F.2d at 1234 (citing Weinstein & Berger, 3 WEINSTEIN'S EVIDENCE 702[03] at 702-16). Two Circuit courts explicitly announced the end of the Frye test. U.S. v. Williams, 583 F.2d 1194, 1198 (2d Cir. 1978); *Downing*, 753 F.2d 1224, 1232 (3d Cir. 1985). The Second Circuit, for example, criticized the simplistic head counting, instead of the more difficult task of having the judge determine the scientific reliability. *Williams*, 583 F.2d at 1198. The Second Circuit instead maintained that the focus should be on characteristics such as the potential rate of error of the scientific technique used by the expert, the standards controlling these techniques, or lack thereof, how the technique was employed, and whether the technique lent itself to abuse. *Id.*

104. The Advisory Committee Notes, floor debates and hearings, and committee reports regarding Rule 702 do not indicate whether Congress's intent was to eliminate Frye. Tamarelli, *supra* note 40, at 1182.

105. Horne, *supra* note 49, at *3; *see also* Tamarelli, *supra* note 40, at 1185 (noting that Rule 702 did not contain "a completely integrated standard of admissibility").

106. *See, e.g.*, Christophersen v. Allied-Signal Corp., 939 F.2d 1106, 1110 (5th Cir. 1991) (assuming the Frye standard survived the Rules); United States v. Smith, 869 F.2d 348, 350-51 (7th Cir. 1989) (same).

107. 113 S. Ct. 2786 (1993).

108. Both of the children suffered limb reduction defects. *Daubert*, 727 F.Supp. 570, 571 (S.D.Cal. 1989). The medical records did not evidence any other potential causes for the defects. *See* Skaggs, *supra* note 26 (citing Brief for Petitioner at 4, Daubert (No. 90-102)).

109. *Daubert*, 113 S. Ct. at 2791. There were more than 30 published studies involving at least 130,000 patients. *Id*.

110. The credentials of the experts were: Chief of the California Department of Health and Services Division, Senior Science Advisor to the Environmental Protection Agency and consultant to the Food and Drug Administration on causation issues, professor of epidemiology at the University of Texas, associate professor of pediatrics, pharmacology and toxicology at the University of Texas Medical Branch, Professor of Pediatrics and Pharmacology at Wayne State University College of Medicine, Specialist in pathology and pharmacology, and director of the multi-discipline teaching labs and an assistant professor of pharmacology at the University of Arizona College of Medicine. *See* Skaggs, *supra* note 26, at 462 n.16 (citing Brief for Petitioner at A11-A13, Daubert (No. 90-102)).

111. Specifically, the scientists believed that the properties of the drug, known to be teratogens, were such that ingestion while the fetus' limbs were forming could interfere with development. *See* Skaggs, *supra* note 26, at 471 n.12 (citing Brief for Petitioner at 6-7, Daubert (No. 90-102)).

112. *Daubert*, 113 S. Ct. at 2792.

113. *Daubert*, 951 F.2d at 1130 (citing Brock v. Merrell Dow Pharmaceutical, Inc., 874 F.2d 307, 313-15 (5th Cir. 1989), *modified*, 884 F.2d 166 (1989), *cert. denied*, 494 U.S. 1046 (1990); Richardson v. Richardson-Merrell, 857 F.2d 823, 830 (D.C.Cir. 1988); Lynch v. Merrell-National Labs, 830 F.2d 1190, 1194 (1st Cir. 1987)).

114. *Daubert*, 727 F.Supp. at 575.

115. *Id.* The Ninth Circuit also noted that other circuit courts had refused to admit re-analysis studies in the context of Bendectin risks when those studies had not been subjected to peer review. *Id.* at 1130-31.

116. *Daubert*, 951 F.2d 1128, 1130 (9th Cir. 1991).

117. Certiorari was granted at 113 S. Ct. 320 (1992). As examples of the conflict among the courts, *Daubert* cited United States v. Shorter, 809 F.2d 54 (D.C.Cir. 1987) and DeLuca v. Merrell Dow Pharmaceutical, 911 F.2d 941 (3d Cir. 1990). In *Shorter*, the United States Court of Appeals for the District of Columbia applied the Frye test to an expert's testimony regarding an asserted compulsive gambling disorder as a defense to income tax evasion.

In contrast, the Third Circuit in *DeLuca* applied a standard derived from the Rules. The Court looked at the following factors: (1) the soundness and reliability of the process or technique used in generating the evidence, (2) the possibility that admitting the evidence would overwhelm, confuse, or mislead the jury, and (3) the proffered connection between the scientific research or test result to be presented and particular disputed factual issues in the case. *DeLuca*, 911 F.2d at 947.

The status of Frye after *Daubert* in the state courts is less-resolved. States have taken various approaches to the issue of whether Frye is still a viable standard in light of *Daubert*. Some have retained Frye on the ground that the state's rules of evidence were not patterned after the federal rules. Another approach has been to find Frye superseded by the state's rules of evidence as they were patterned after the federal rules. Third, courts have deferred the issue until it reaches the state supreme court. *See* Skaggs, *supra* note 26, at 458 n.103.

118. *Daubert*, 113 S. Ct. at 2793.

119. *Id.*

120. *See* Emmerich, *supra* note 53, at *4 (citing Brief for Respondent at 9, Daubert (no. 92-102)).

121. The judges however were unanimous in finding that the Frye test was superseded by the Rules. *Daubert*, 113 S. Ct. at 2793.

122. The *Daubert* decision is viewed as being quite significant as it overruled a test that was widely accepted and employed for over seventy years. *See* Skaggs, *supra* note 26. Faigman describes this standard as one that requires the judge to be a "sophisticated consumer of science." Faigman, *supra* note 51, at 556. Mr. Faigman does not advocate that judges must become familiar with the specifics of the particular scientific discipline as

much as they must understand the basic principles scientists use to study these questions, such as statistics and research methodology. Faigman, *supra* note 51, at 558-59.

123. *Daubert*, 113 S. Ct. at 2794. For a case admitting testimony not "generally accepted" in the community under *Daubert* see Federal Deposit Ins. Corp. v. Suna Assocs., Inc., 1996 WL 138506 (2d Cir.).

124. *Id.*; *Christophersen*, 939 F.2d at 1111 (quoting Osburn v. Anchor Laboratories, Inc., 825 F.2d 908 (5th Cir. 1987); *see also* Faigman, *supra* note 51, at 563 (*Daubert*'s replacement of Frye anticipates that there will be many cases in which the research lacks general consensus in its field but it is accurate enough to assist the trial process).

125. While overruling Frye for its lack of liberality, some have suggested that the new standard under *Daubert* may actually result in the exclusion of as much or more relevant scientific evidence. The judge must exclude the evidence unless she makes a determination that the testimony is both scientifically valid and has a valid scientific connection. *See, e.g.*, Lunney, *supra* note 3, at 141.

126. *Daubert*, 113 S. Ct. at 2794. The Court distinguished its decision in United States v. Abel, 469 U.S. 45 (1984), in which it stated that the common law could still serve as an aid to the application of the Rules, by noting that Rule 702 clearly addressed the issue, making the common law unnecessary. *Id.*

127. *Daubert*, 113 S. Ct. at 2795.

128. Buckner v. Sam's Club, Inc., 75 F.3d 290, 293 (1996) (refusing to admit an affidavit describing the likelihood that a particular object had fallen off a table and caused injury to the plaintiff on the ground that the affidavit contained "simple common sense").

129. Hutchinson, *supra* note 7, at 1875-76.

130. *Daubert*, 113 S. Ct. at 2796.

131. The Court defined the "scientific method" as the formation and testing of a hypothesis. *Id.* at 2795.

132. *Daubert*, 113 S. Ct. at 2796-99. The dissent by Chief Justice Rehnquist and Justice Stevens criticized the majority for these "general observations." The dissenting Justices found the standards especially unhelpful given that the Court did not apply them, but remanded to the lower court. *Id.* at 2799-8000.

One other factor that may influence the determination as to the admissibility of the expert testimony is whether the expert conducted its research with the litigation in mind. *See* Harvard3, *supra* note 40, at 1515.

According to the Court in *Daubert*, other rules must bear on this inquiry as well where applicable. *Id.* at 2797-98 (also citing to Rules 706 allowing for court experts and 403's balancing test). Additionally, Rule 703's allowance for hearsay if the opinion is "of a type reasonably relied upon by experts in forming opinions or inferences upon the subject." Fed. R. Evid. 703.

133. *Id.* at 2797; *see also* Joiner v. General Elec. Co., 78 F.3d 514 (11th Cir. 1996) (validity of expert's

conclusions is question for jury).

134. *Id.* at 2800 (Rehnquist, dissenting).

135. The Daubert standard, as stated by the Court, was not necessarily more liberal in practice than the Frye standard. *See, e.g.*, Emmerich, *supra* note 53, at 1060 (describing the Daubert standard as more conservative than Frye in the discretion given to the judge). In fact, the standard could conceivably be applied more conservatively.

136. Approaches other than the Frye and Daubert standards have been set forth. For example, Mark McCormick has suggested the following factors to consider as a variation to Daubert's reliability approach: (1) the potential error rate in using the technique, (2) the existence and maintenance of standards governing its use, (3) presence of safeguards in the characteristics of the technique, (4) analogy to other scientific techniques whose results are admissible, (5) the extent to which the technique has been accepted by scientists in the field involved, (6) the nature and breadth of the inference adduced, (7) the clarity and simplicity with which the technique can be described and its results explained, (8) the extent to which the basic data are verifiable by the court and jury, (9) the availability of other experts to test and evaluate the technique, (10) the probative significance of the evidence in the circumstances of the case, and (11) the care with which the technique was employed in the case. Mark McCormick, *Scientific Evidence: Defining A New Approach to Admissibility*, 67 Iowa L.Rev. 879, 912 (1982).

137. This change in focus will prevent a court from admitting a generally accepted technique when it was accepted for a purpose different than the expert is relying. *See* Hutchinson, *supra* note 7, at 1908-09.

138. *See infra* notes 143 to 151 (discussing the assumptions underlying the adoption of a particular approach to evidentiary admissibility).

139. Lisa M. Agrimonti proposed that the Daubert analysis should apply only to scientific testimony and a standard akin to Frye should govern other experts. *See* Agrimonti *supra* note 70. *But see* Faigman, *supra* note 51, at 559 (finding the interpretation that Daubert applied only to "science" was a misconstruction).

140. *See, e.g.*, United States v. Thomas, 74 F.3d 676, 680-81 (6th Cir. 1995) (applying the Daubert standard to testimony by an expert witness on the behavior of drug dealers). *But see* Tamarin v. Adam Centers, Inc., 13 F.3d 51 (2d Cir. 1993) (Daubert limited to scientific evidence).

141. *See* Harvard3, *supra* note 40, at 1523-24; *see also* Imwinkelried, *supra* note 41, at 2283 noting the inherent inapplicability of the Daubert standard to nonscientific knowledge because of its different epistemology.

142. *Daubert*, 113 S. Ct. at 2795.

143. *See, e.g.*, Harvard1, *supra* note 37, at 1484. For example, in tort litigation, expert testimony of causation is required. In those cases, the court often demands evidence of causation to a degree of certainty not felt by that relevant scientific community. This discrepancy works both ways. The legal system may require more from science than it can honestly give and that same judiciary system may settle for far less because of external

constraints of time and money, for example.

Dan Burk, in reflecting on this "inherent inconsistency," stated:

> Lawyers, who dwell ... in an adversarial realm, are governed by written rules of professional conduct that require them to ... act as zealous advocates on their client's behalf... Scientists, on the other hand ... have developed strong unwritten professional rules " based on norms of intellectual objectivity " that are different than those governing lawyers.

The Court in *Daubert* also acknowledged this distinction between science and the law, emphasizing the legal system's need to settle disputes quickly and finally. *Daubert*, 113 S. Ct. at 2798. Benjamin Cardozo compared science to the legal system, saying "The work of a judge is in one sense enduring and in another ephemeral. In the endless process of testing and retesting, there is a constant rejection of the dross and a constant retention of whatever is pure and sound and fine." Benjamin Cardozo, *The Nature Of The Judicial Process* 178-79 (1921), quoted in *Daubert*, 113 S. Ct. at 2799 n.13.

As evidence of the time constraints on the legal system, restrictions exist that make courts restrict the number of experts that may testify and the amount of time in which they may testify. *See, e.g.*, Weinstein, *supra* note 3, at 726 (citing Flannigan v. GAF Corp, No. 89-3650 (6th Cir. June 4, 1990)).

The standards enunciated by the Court and the structure of the adversary generally have thus discouraged honest skepticism and reflection. *See, e.g.*, Huber, *supra* note 9, at 347 ("Any half competent lawyer will prefer committed support from the fringe to even the slightest ambivalence from the middle.").

144. "Best" arguments from a legal perspective, not an intellectual one. Related to these adversarial principles is the metaphor of the "market place of ideas." If everybody is allowed to "ply her wares" in the market, we will have the best opportunity to arrive at the "truth." *See* Hutchinson, *supra* note 7, at 1879-80; Huber1, *supra* note 43, at *9 ("[S]cientific journals err on the side of permitting questionable theses to be published, so they may be discussed and checked in the hope of finding something of value."); *see also* Kaushal B. Majmudar, Daubert v. Merrell Dow: *A Flexible Approach to the Admissibility of Novel Scientific Evidence*, 7 Harv. J.L. & Tech. 187, 195-96 (1993).

145. Harvard4, *supra* note 48, at 1587.

146. Harvard4, *supra* note 48, at 1587 (citing a case in which the jury mistakenly believed that all victims of asbestosis would experience the disease in an identical manner because the lawyers failed to complete the picture).

147. *See* Lunney, *supra* note 3, at 105.

148. *See, e.g.,* Jacobs, *supra* note 28, at 1086

149. *See, e.g.,* Jacobs, *supra* note 28, at 1086 (citing e.g. Richard O. Lempert, *Civil Juries and Complex Cases: Let's Not Rush to Judgment*, 80 Mich. L. Rev. 68, 80-84 (1981)

150. *Id.*, at 86.

151. *Id.* Most importantly for this discussion, the jury may make this assumption of objectivity. *See* Hutchinson, *supra* note 7, at 1878-79. Many would advocate that science is not so objective and more like the legal system that might be thought. One very prominent critique of claims of unbiased objectivity of the scientist is Stephen J. Gould. *See, e.g.*, Stephen J. Gould, *The MisMeasure of Man* 20 (1981). In fact, it may be that the more objective the scientist, the less inclined to testify in the courtroom.

152. *See*, Allan Megill, *Rethinking Objectivity*, 1994, at 5-8.

153. Lunney, supra note 3 at 110.

154. *See Daubert*, 113 S. Ct. at 2796; *see also* Harvard3, *supr*a note 40, at 1513. *But see Daubert*, 113 S. Ct. at 2799-2800 (Rehnquist, C.J., dissenting) (expressing doubts whether judges can understand areas of expertise in which they lack formal training and citing to amicus briefs illustrating that the admissibility questions would involve interpretation of scientific knowledge, method and validity, not interpretation of cases and statutory provisions of which the judge is accustomed and trained).

One scholar has noted the tension between the role of reliance upon evidence and the evaluation of that same evidence. See Harvard3, *supra* note 40, at 1510.

The British have a practice in which they try complex matters to "lay judges" who possess particular technical expertise. *See* Warren E. Burger, Agenda for Change, 54 Judicature 232, 235 (1971).

155. Augustine Brannigan, *On Bearing False Witness*, 11 J. CONTEMP. ETHNOGRAPHY 115.

156. For example, in one case, counsel furnished the jurors with definitions of all the exotic terms to be used in some patent litigation. *see also* In re Richardson Merrell Inc. "Bendectin" Products Liability Litigation, MDL 486 (S.D. Ohio 1984) (glossary of terms provided for the jurors).

157. For example, Jack B. Weinstein has suggested the use of pedagogical aids to better allow the jury to organize the information. Weinstein, *supra* note 3, at 712.

158. *See* Allen, *supra* note 11, at 1131 (noting the greater likelihood that twelve jurors will understand the testimony than one).

159. See, *supra* note 100.

160. *See, e.g.*, Harvard3, *supra* note 40, at 1513. Some commentators have suggested that a judge, when feeling ill-equipped because of the complexity of the matter, may give the expert more latitude. In other words, depending on the judge's trust in its ability to act as gatekeeper, the judge may be more or less stringent with his admissions. *See, e.g.*, Zuchowicz v. United States, 870 F.Supp. 15 (D. Conn. 1994) (applying the general acceptance standard of Frye because complexity of issue justified substantial latitude to expert). On remand in *Daubert*, Judge Kozinsky noted the daunting task judges had to grapple with scientific testimony. 43 F.3d 1311, 1315-16 (9th Cir. 1995).

In response to this perceived need to aid the judge in this evaluation role, institutions are coming out with texts

providing such support. *See* Harvard3, *supra* note 40, at 1517.

161. *See* Ronald J. Allen & Joseph S. Miller, *The Common Law Theory of Experts: Deference or Education?*, 87 Nw. U. L. Rev. 1131 (1993).

162. *See, e.g.*, Allen, *supra* note 11, at 1141 (noting that the Rules encourage the educatory role of the expert).

163. *Id.*, at 1143.

164. *See, e.g.*, 434 Mich. 691, 726 (date) (expert allowed to dispel misconception that delay in reporting sexual abuse means abuse did not occur); Roger B. Handberg, *Expert Testimony on Eyewitness Identification: A New Pair of Glasses for the Jury*, 32 Am. Crim. L. Rev. 1013, 1015 (1995) (noting the need for experts to dispel misperceptions about reliability of eyewitness identification).

165. *See* Weinstein, *supra* note 3, at 730.

166. The Supreme Court itself said that its judgement was "limited to the scientific context," as opposed to "technical, or other specialized knowledge" to which Rule 702 also applies. *Daubert v. Merrel Dow Pharmaceuticals, Inc.*, 113 S.Ct. 2795n.8 (S.Ct. 1993). The Court also gave the following advice: "Faced with a proffer of expert testimony, then, the trial judge must determine at the outset, pursuant to Rule 104(a), whether the expert is proposing to testify to . . . scientific knowledge . . ." *Id.* at 2795.

167. 25 F.3d 1342 (U.S. Ct. of Appeals, 6th Cir. 1994). .

168. *Id.* at 1352.

169. *See U.S. v. Thomas*, 74 F.3d 676, 681 (U.S. Ct. of Appeals, 6th Cir. 1996) (citing *Berry* in stating that " [while] *Daubert* dealt with scientific experts, its language relative to the 'gatekeeper' function of federal judges is applicable to all expert testimony offered under Rule 702").

170. *See United States v. Sinclair*, 74 F.3d 753, 757 (U.S. Ct. of Appeals, 7th Cir. 1996).

171. The Court stated: "*Daubert* does not create a special analysis for answering questions about the admissibility of all expert testimony. Instead, it provides a method for evaluating the reliability of witnesses who claim scientific expertise. . . . *Daubert*, therefore, has no direct relevance to questions about the admissibility of testimony who claims legal expertise." *Id.*

172. *See Tamarin v. Adam Caterers, Inc.* 13 F.3d 51 (U.S. Ct. of Appeals 2nd Cir. 1993) ("Adam Caterers' claim that Tamarin did not meet his burden under *Daubert* . . . by establishing the credentials of Peter Levin, the accountant who prepared the payroll review, is not supportable, as that case specifically dealt with the admissibility of scientific evidence"). *See also U.S. v. Starzecpyzel*, 880 F.Supp 1027, 1040 (S.D.N.Y. 1995) ("The Second Circuit has interpreted *Daubert* to apply specifically to scientific testimony"). The District Court itself went on to adopt this interpretation: "The Court therefore finds no support for the proposition that *Daubert* extends past the 'scientific' branch of expert testimony." *Id.* at 1041.

173. *See U.S. v. 14.38 acres of Land, Sit. in LeFlore Cty. MS*, 80 F.3d 1074 (U.S. Ct. of Appeals, 5th Cir. 1996) (explicitly following *U.S. v. Sinclair* in saying that *Daubert* applies only to scientific expert testimony).

174. *See Lappe v. American Honda Motor Co., Inc.*, 857 F.Supp. 222, 228 (N.D.N.Y. 1994) ("Daubert's narrow focus is on the admissibility of 'novel scientific evidence' . . . Daubert only prescribes judicial intervention for expert testimony approaching the outer boundaries of traditional scientific and technological knowledge"); *Officer v. Teledyne Republic/Sprague*, 870 F.Supp. 408 (D.Mass. 1994) ("While *Daubert's* principles have valuable application in determining the admissibility of controversial and novel scientific hypotheses, they have less use in fields like design engineering, where 'general acceptance' is the norm, not the exception"). *But see U.S. v. Starzecpyzel, supra* note 6.

175. *See U.S. v. 14.38 Acres of Land, Sit. in LeFlore City. MS*, 80 F.3d 1074 (U.S. Ct. of Appeals, 5th Cir. 1996). *See also Datskow v. Teledyne Continental Motors* 826 F.Supp. 677, 682-683n.1 (W.D.N.Y. 1993) (citing the *Daubert* Court's holding that the test for admissibility was a 'flexible one' and that concerns about 'pseudoscientific' assertions are unnecessary due to the adequacy of the adversarial system).

176. *See Borawick v. Shay* 68 F.3d 597, 610 (U.S. Ct. of Appeals, 2nd Cir. 1995). This court stated that there are several principles underlying the Supreme Court's holding in *Daubert*. In addition to the Supreme expressed faith in the adversary system to test 'shaky but admissible' evidence, the Second Circuit court also said that "by loosening the strictures on scientific evidence set by *Frye*, *Daubert* reinforces the idea that there should be a presumption of admissibility of evidence." *Id.* A third principle is faith in the judgement of the trial judge: "Rather than using rigid 'safeguards' for determining whether testimony should be admitted, the [Supreme] Court's approach is to permit the trial judge to weigh the various considerations pertinent to the issue in question." *Id.* A fourth and final principle of *Daubert* is the rejection of general acceptance as a determinative criterion and emphasis on evidence's reliability having independent support. *Id.* It should be noted that this case did not deal with scientific evidence or even general expert evidence. Instead, the court in this case said that *Daubert* did not apply to the issues of whether a witness is competent or whether lay testimony is admissible. However, in allowing disputed testimony, the court said that it relied on the indirect guidance of *Daubert* and the underlying principles delineated above. The significance of this case and opinion expressed is the presumption that this interpretation of *Daubert* will be applied should scientific expert evidence come before this court.

177. *See Benedi v. McNeil " P.P.C., Inc.*, 66 F.3d 1378, 1384 (U.S. Ct. of Appeals, 4th Cir. 1995). In this case, the Court of Appeals held that the District Court acted properly in admitting the testimony of an epidemiologist who used methodologies such as history, examination, lab and pathology data, and study of peer reviewed literature, the same methodology, the court noted, used by practicing members of the medical community. This court further stated that studies of scientific experts need prove causation to be admissible: "*Daubert* merely requires that the expert testimony be both relevant and reliable. . . Under the *Daubert* standard, epidemiological studies are not necessarily required to prove causation, as long as the methodology employed by the expert in reaching his or her conclusion is sound." *Id. See also Vadala v. Teledyne Industries, Inc.*, 44 F.3d 36, 39 (U.S. Ct. of Appeals, 1st Cir. 1995) (stating that the trial judge's duty is to ensure that an expert's testimony rests on a reliable foundation and is relevant). It is this standard that testimony be "both relevant and reliable" that is so ambiguous with respect to the stringency of the admissibility test. In the *Benedi* case the court was clearly liberal in its application of this two-pronged consideration; however, it is not difficult to conceive of another court's holding that the requirement of relevance bars the admissibility of evidence not demonstrating causation, or that the requirement of reliability renders inadmissible evidence not based on

controlled laboratory experiments. The complexity enters onto the scene when we start to define what we mean by 'relevance' or 'reliability', not so much when these are offered as appropriate standards for evaluation.

178. *See Iacobelli Const., Inc. v. County of Monroe*, 32 F.3d 19, 25 (U.S. Court of Appeals, 2nd Cir. 1994) (stating that *Daubert* instructed courts to examine the admissibility of an expert's scientific testimony based on (1) its testability, (2) whether it's been subjected to peer review and publication, (3) its potential rate of error, and (4) its 'general' acceptance).

179. Another example comes from the work of Monahan and Walker who believe that social science is a value-free, positivistic enterprise and, therefore, that its 'findings' should in some cases be given the same force as legal precedent in a court of law. *See generally* John Monahan and Lauren Walker, *Judicial Use of Social Science Research after* Daubert, 2 SHEPARD'S EXPERT & SCI. EVIDENCE 327 (1994); *id.*, *Social Frameworks: A New Use of Social Science in Law* 73 VA L. REV. 559 (1987).

180. By epistemology we mean how we come to know what we (think) we know, not how we come to know what is true. The latter entails a realist perspective that we do not embrace, as will soon become quite clear.

181. *See* Margaret G. Farrell, Daubert v. Merrel Dow Pharmaceuticals, Inc.: *Epistemology and the Legal Process* 15 CARDOZO L. REV. 2153 (1994).

182. *Id.* at 2203.

183. *See infra* notes 189 to 201 and accompanying text for a more detailed discussion.

184. *Id.* at 2206.

185. This dichotomy comes through in one of Huber's discussions of the nature of truth and its relationship to standards of admissibility:

> "Some will always insist that all truth is relative and subjective, that anyone should therefore be allowed to testify to anything, that science must be viewed as a chaotic heap of unconnected and contradictory assertions, and that the best we can do is invited the jury to decide scientific truth by majority vote. But anyone who believes in the possibility of neutral law, as many fortunately still do, must at the same time believe in the existence of objective fact, which ultimately means positive science. The only real alternative is nihilism."

Peter Huber, *Junk Science in the Courtroom* FORBES 72 (July 8, 1991).

186. *See* Paul Gross And Norman Levitt, *Higher Superstition: The Academic Left And Its Quarrels With Science* (1994). In reviewing this work, Fuller points out that it is the first of its kind to devote undivided attention to the threats posed by academic critics of science, but that earlier works, namely L. Wolpert, *The Unnatural Nature Of Science* (1992) and S. Weinberg, *Dreams Of A Final Theory* (1988), had addressed this matter in single chapters. *See* Steve Fuller, *A Tale of Two Cultures and Other Higher Superstitions* 8 HIST. OF THE HUMAN SCIENCES 115, 115 (1995).

187. *See generally* Thomas S. Kuhn, *The Structure Of Scientific Revolutions* (1962).

188. *See* Thomas Kuhn, *The Trouble With Historical Philosophy Of Science* 8-9 (1992) (describing the sociology of scientific knowledge as "an example of deconstruction gone made").

It might be useful at this point to distinguish the sociology of scientific knowledge from its more traditional subdisciplinary sibling, the sociology of knowledge, because, although we will draw on insights from both, we find the latter more persuasive. Traditional sociology of knowledge carries with it a certain dualism holding that 'the intellectual' and 'the social' are distinct spheres in academic inquiry, with the latter constituting a contaminant of the former " i.e., in the traditional view, what is social is construed as external to the conception and practice of science. The father of this perspective is Robert K. Merton and it has enjoyed the most support from American sociologists. For the sociology of scientific knowledge, on the other hand, the social dimension is not only not a pollutant of otherwise pure thought, it is "a necessary condition for making, holding, extending, and changing knowledge." Steven Shapin, *Here and Everywhere: Sociology of Scientific Knowledge*, 21 ANNUAL REV. OF SOC. 289, 299-300 (1995).

189. *See, e.g.,* Peter Atkins, *Science as Truth* 8(2) HIST. OF THE HUMAN SCIENCES 97 (1995). In this journal's special issue devoted to the debate over the social aspects of science, Atkins mounts his defense of science by treating it as a monolithic, impersonal force. About the enterprise of science, Atkins claims that "[i]t is honest"; "it is free of *irrational* prejudice . . ."; and it is "the ultimate market economy of knowledge, where only valid observations and plausible theories survive." *Id.* at 97-98. By focusing all of his attention on 'science' and leaving out its human dimension (as indicated by the repeated use of the word 'it'), Atkins assumes away the very point we and others who are thinking along social-constructivist lines are trying to emphasize: the conflicts that reside within science and the central role of humans and their complexity within these. Atkins' analogy to the market economy highlights his non-human oriented conception of science, suggesting that science is a machine whose operation yields the sought after truth, just as 'the market' assigns the undistorted prices and quantities of given commodities. Notably, this analogy does not take into account the very good arguments against our treating the market as an impersonal force. *See, e.g.,* Fred Block, *Postindustrial Possibilities: A Critique Of Economic Discourse* 1-32 (1990).

190. The internalist perspective holds that the scientific community is for the most part isolated from the larger society and decisions made within this community are a consequence of rational deliberation among scientists. Should any external force gain influence, the internalist perspective holds that its distorting effect will quickly be rooted out by the norms of organized skepticism and rigorous evaluation. The externalists, on the other hand, attribute importance to the societal context in which scientists work in shaping not only that work but also the attitudes of the scientists themselves. *See* Margaret C. Jacob, *Science and Politics in the Late Twentieth Century*, 59 SOCIAL RESEARCH 487, 487-488 (1992).

191. *See generally* Jacob, *supra* note *id.* For an excellent illustration of the importance of external social, political, and economic forces in scientific inquiry, see the discussion of academic-corporate linkages, *supra* notes 189 & 190 and accompanying text.

Relating the externalist perspective more directly to the issue of evidentiary admissibility, the implication is that the creation of experts, which we will discuss at much greater length below, is part of the broader social matrix and its power relations. This point is fundamental to the argument of this paper: If the internalist view of science as a pure project of truth seeking were accepted as true, then courts would do well to assign experts the truth-giving

role that the Frye test does, for the gaining of general acceptance presumably would be tantamount to the testifier's having carried out a successful pursuit of truth. *See* Atkins, *supra* for a succinct and lucid explication of the internalist perspective.

192. *See* Shapin, *supra* note 188.

193. *See* Dorothea K. Thompson, *Arguing for Experimental 'Facts' in Science*, 10 WRITTEN COMMUNICATION 106, 111-112 (1993). Thompson provides preliminary insight into the importance of interactions among and between scientists. She offers evidence that the scientific community is a rhetorical one, and not simply a group whose members report in their scholarly journals little nuggets of truth that they have found. Studying the results section of journal articles, Thompson identified on a regular basis rhetorical moves in the authors' methodological justifications and interpretive explanations. *Id.*

194. *See* Shapin, *supra* note 188 at 299.

195.*Id.*

196. Joseph Rouse, *Foucault and the Natural Sciences*, *in* FOUCAULT AND THE CRITIQUE OF INSTITUTIONS 137 (John Caputo and Mark Yount, eds. 1993).

197. *Id.* at 149-157.

198. *Id.* at 157.

199. *Id.*

200. *Id.* at 158.

201. Of course, the locus classicus for this idea is the work of Foucault, and Rouse draws to a considerable extent on this work. *See generally* Michel Foucault, *Power/Knowledge* (1979).

202. *See* James Robert Brown, *Undetermination and the Social Side of Science*, 34 DIALOGUE: CANADIAN PHILOSOPHICAL REVIEW 147, 152 (1995).

203. Ludwick Fleck, *Genesis And Development Of Scientific Fact* (English Language ed. 1979). This book was first published in German by Benno Schwab & Co. in Basil, Switzerland in 1935. *See Id.*

204. *Id.* at 98 (stating that thinking is "a supremely social activity which cannot by any means be completely localized within the confines of the individual").

205. *Id.* at 118-119.

206. *Id.* at 118.

207. *Id.*

208. *See* Bruno Latour, *Science In Action: How To Follow Scientists And Engineers Through Society* 2-3 (1987). Cyberneticians use a 'black box' in place of a piece of machinery or a set of commands that is extremely complex. The box indicates that all one needs to know about these complexities is their input and output. *Id.*

209. H.M. Collins, *Changing Order: Replication And Induction In Scientific Practice* vii (1985).

210. Fleck, *supra* note 203 at 121.

211. *Id.*

212. Robert K. Merton, *The Sociology Of Science* 267-278 (1973). *See* I.I. Mitroff, *The Subjective Side Of Science* (1974) for an extensive empirical study of scientists from several disciplines, on the basis of which Mitroff identifies *counter*norms, including secrecy rather than communism and judgements of scientific claims based on the person making the claim rather than the claim itself.

213. *See* Merton, *id.* at 270-273.

214. *See Id.* at 273-275 and 277-278.

215. *See Id.* at 275-277.

216. *See* Latour, *supra* note 208 at 104.

217. *Id.*

218. One student of science argues that relations among individuals within the scientific community plays an important role in shaping the collective process. *See* Stephen Cole, *Making Science: Between Nature And Society* 176 (1992) (stating that the "most significant basis for particularism" in evaluation is "the positive and negative feelings of individuals toward other individuals and the location of scientists in networks of interpersonal social relations").

219. *See* Latour, *supra* note 208 at 104. If anyone still thinks, following Kuhn, *supra* note 187 at 8-9 that the sociology of scientific knowledge is an example of "deconstruction gone mad", *see* Steven C. Ward, *In the Shadow of Deconstructed Metanarratives: Baudrillard, Latour and the End of Realist Epistemology* 7 HISTORY OF THE HUMAN SCIENCES 73 (1994). This paper does an excellent job of distinguishing Latour's epistemology from the postmodernist Baudrillard's epistemological nihilism. Ward traces Baudrillard's intellectual influences to Nietzsche's equating of knowledge with power and rhetoric. *Id.* at 75-82. Latour's thoughts on epistemology, on the other hand, are mapped back to Durkheim who, instead of proclaiming, like Nietzsche, that "God [i.e., truth] is dead" related truth to social organization and collective embraces, what Ward calls "truth as collective representation." *Id.* at 76. According to Ward, Latour's 'network epistemology' is quite consonant with the Durkheimian perspective insofar as it emphasizes the importance of strong associational networks in the determination of what is and is not a fact. *Id.* at 84. In this view, "[t]he end of realist epistemology is not the end of knowledge generation, nor the true." *Id.* at 89. Instead: "From this position, what

distinguishes irrationality from rationality, belief from science, text from reality, is not the cognitive level or type of the participating actors, but the associationally enhanced power of some individuals and groups to establish resistant coalitions." *Id.* at 87.

220. *See* Yoval P. Yonay, *When Black Boxes Clash: Competing Ideas of What Science is in Economics, 1924-1939* 24 SOC. STUDIES OF SCI. 39, 41 (1994).

221. *See Id.* at 49-64; Latour, *supra* note 208 at 45-60 and 179.

222. *See* Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction Of Scientific Facts* (1986). Based on participant observation in scientific laboratories, LaTour and Woolgar argue that the bulk of purposeful lab activity is directed towards making order out of the disorderliness of both the world and the data collected from it. Thus, on their terms, 'order', or a claim accepted as truth, does not have ontological standing but is constructed through creative processes. *Id.* at 21-23 and 246.

223. *See Id.* at 249-250. LaTour and Woolgar liken this to the biological account: "The relationship between order and disorder, which underpins our account of the construction of facts, is very familiar to biologists. . . . That life is an orderly pattern emerging from disorder through the sorting of *random* mutations, is the stock in trade of the biological representation of life." *Id.* at 249. *But see* James Robert Brown, *Undetermination and the Social Side of Science* 34 DIALOGUE: CANADIAN PHILOSOPHICAL REVIEW 147, 149 (1995). Brown argues that there is definitely a limit, even if it's not clearly defined, on the number of alternative theories that constitute LaTour and Woolgar's idea of disorder. He makes the point that, although infinite alternative theories might exist in some ideal Platonic sense, their actual number is limited by resources and the number of persons interested in a given question. *Id.*

224. *See* Yonay, *supra* note for a full account of this conflict.

225. *Id*. at 46.

226. *Id.*

227. To understand and thoroughly analyze the nature of the conflict and what was at stake, Yonay examined all articles listed under the "Methodology" section of the INDEX OF ECONOMIC ARTICLES between 1924 and 1939. *Id.* at 45.

228. *See* Merton, *supra* note 212 at 267-278.

229. *Id.* at 43-44 and 49-64.

230. *Id.* at 42.

231. *See generally* Jonathan R. Cole & Stephen Cole, *Social Stratification In Science* (1973).

232. *See* Cole, *supra* note 231 at 157.

233. Cole argues that the principle of 'accumulative advantage' helps explain this phenomenon. This principle "refers to the fact that once a scientist has been rewarded, his or her chance of receiving further rewards in the future are greater, *independent* of indicators of role performance." *See* COLE, *supra* note 231 at 165.

234. *See* Robert K. Merton, *The Matthew Effect in Science* 159 SCIENCE 56 (1968). Merton borrows this concept from the Bible's Gospel of Matthew, which states: "For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath." *Id.* at 57. A layperson might describe this process and its outcome as "the rich get richer and the poor get poorer."

235. *Id.* at 57-58.

236. *Id.* at 59-63. Merton does recognize that this is dysfunctional for individuals who go unrecognized as a consequence. *Id.* at 59.

237. *See* Margaret W. Rossiter, *The Matilda Effect in Science* 23 SOC. STUDIES OF SCI. 325 (1993).

238. 'Matilda' comes from Matilda Joslyin Gage, a nineteenth century suffragist and feminist who was relatively underrecognized for her achievements. *See Id.* at 335.

239. *Id.* at 334.

240. Consider two blatant examples. First, Englishwoman Rosalind Franklin produced x-ray spectrographic evidence of DNA's double helix structure, which Nobel winners Crick and Watson subsequently used without recognition of Franklin's assistance. Similarly, it appears that Jocelyn Bell Burnell's discovery of pulsars was falsely attributed to her senior co-workers who walked off with the Nobel Prize. *See* Cynthia Fuchs Epstein, *Constraints on Excellence: Structural and Cultural Barriers to Recognition and Demonstration of Achievement*, *in* THE OUTER CIRCLE: WOMEN IN THE SCIENTIFIC COMMUNITY 239, 241 (Harriet Zuckerman et al., eds. 1991).

241. Jay Scott & Mary Frank Fox, *Scientific Careers: Universalism and Particularism*, 21 ANN. REV. OF SOC. 45, 47 (1995) (citing 1991 data from COMMISSION ON PROFESSIONALS IN SCIENCE AND TECHNOLOGY, PROFESSIONAL WOMEN AND MINORITIES: A TOTAL HUMAN RESOURCE DATA COMPENDIUM (1994)).

242. *See* Gerhard Sonnert & Gerald Holton, *Gender Differences In Science Careers: The Project Access Study* (1995). Sonnert and Holton collected survey data from and conducted interviews with nearly 700 former National Science Foundation (NSF) and National Research Council (NRC) postdoctoral fellows. *Id.* at 32-34. Of the respondents, 25.3 percent of the women were not at universities with a research doctoral program, which are the universities considered the most prestigious by the relevant community; the like figure was just 15.7 percent for men. *Id.* at 48.

243. *Id.* at 43. Although men and women respondents' average age was roughly the same (men's average was just one year more than women's), the largest group of men (41.5%) were full professors, while the largest group of women (29.6%) were associate professors. Moreover, while 67.1 percent of the men had gained tenure, the same was true for just 48 percent of the women. *Id.*

244. *See* Stephen Cole & Robert Fiorentine, *Discrimination Against Women in Science: The Confusion of Outcome with Process*, *in* THE OUTER CIRCLE: WOMEN IN THE SCIENTIFIC COMMUNITY 205, 211-217 (1991) (making the point that evidence of inequalities between men and women does not necessarily mean that these inequalities are the product of sex-discrimination).

245. *See* Sonnert & Holton, *supra* note 242.

246. Sonnert & Holton, *supra* note 242 at 164.

247. Here we mean Gramsci's concept of hegemony: A social relation in which the less powerful accepts both the legitimacy and values of the more powerful, although these are detrimental to the subordinated group. Suppression, on the other hand, constitutes the silencing of discordant voices.

248. *See* Thomas F. Gieryn, *Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists* 48 AM. SOC. REV. 781 (1983).

249. *Id.* at 781-782.

250. The first turning point Gieryn identifies is Victorian England, where science extended its authority at the expense of religion and mechanics. Scientists distinguished their work from that of religion by defining its emphasis on facts through sound empirical examination as distinctly non-religious. At the same time, and at least somewhat contradictorily, scientists asserted the authority of science vis-a-vis the mechanics by calling attention to the latter's lack of pure, abstract theory. *Id.* at 783-787. In Gieryn's second example of a turning point, the struggle between anatomists and phrenologists, scientific authority was monopolized by the anatomists' argument that only specialists could evaluate claims to scientific knowledge. *Id.* at 787-789. Finally, Gieryn illustrates how scientific authority was preserved in the face of federal government claims that more regulation of science was necessary because of the threat of Soviet securement of scientific secrets. Scientists answered this perceived threat to their autonomy by distinguishing the production of scientific knowledge from its consumption/application, and arguing that preserving the scientific community's autonomy with respect to the former was critical to national security. *Id.* at 789-791.

251. *Id.* at 792.

252. *See* Julie Thompson Klein, *Blurring, Cracking, and Crossing: Permeation and the Fracturing of Discipline*, *in* KNOWLEDGES: HISTORICAL AND CRITICAL STUDIES IN DISCIPLINARITY 185, 190 (Ellen Messer-Davidson et al., eds. 1990).

253. *Id.* at 196. *Cf.* STEVE FULLER, SOCIAL EPISTEMOLOGY 197-203 (1988) (arguing that later accounts of disciplinary histories will reflect more clearly demarcated disciplinary boundaries than earlier ones). ARJO KLAMER & DAVID COLANDER, THE MAKING OF AN ECONOMIST, 1990.

254. *See* Jack Amariglio et al., *Division and Difference in the 'Discipline' of Economics*, in KNOWLEDGES: HISTORICAL AND CRITICAL STUDIES IN DISCIPLINARITY 150 (Ellen Messer-Davidson et al., eds. 1990) (" . . . the portrayal of economics as a discipline with distinct boundaries is often a discursive strategy by one school or another to hegemonize the field of economic discourse").

255. *Id.* at 160.

256. Stephan Fuchs, *The Professional Quest For Truth: A Social Theory Of Science And Knowledge* (1992).

257. *Id.* at 191-193.

258. Jeffrey Pfeffer, *Barriers to the Advance of Organizational Science: Paradigm Development as a Dependent Variable* 19 ACADEMY OF MGMT. REV. 599 (1993).

259. In other words, Pfeffer is not a critic of scientific disciplines who might be overstating his case. Rather than a yellow journalist's account of work conditions in a garment factory, Pfeffer takes into the trade journals where managers discuss the various ways in which the workplace environment can be arranged toward the end of cutting costs.

260. *Id.* at 606-608.

261. *Id.* at 613. The importance of elites in consensus formation comes through in the following comments:

" . . . there are forces at work that tend toward stability of whatever system is in place. A field in which control is concentrated in the hands of a comparatively small elite is one in which power is much more institutionalized and control by the dominant paradigm is quite likely to be perpetuated. By contrast, an area of inquiry characterized by diffuse perspectives, none of which has the power to institutionalize its dominance, is one in which consensus is likely to remain elusive and the dispersion in resources, rewards, and activity will be great." *Id.* at 615.

262. Members of high-paradigm fields enforce both theoretical and methodological conformity. They do this by reserving the most desirable places only for those who conform to the disciplinary orthodoxy and criticizing, regardless of their power or the validity of their ideas, those who depart from the established paths." *Id.* at 614.

263. *Id.* at 612-613.

264. *Id.* at 615-618.

265. *See* Peter Huber, *Medical Experts and the Ghost of Galileo*, 54 LAW & CONT. PROB. 119 (1991). The Galileo problem for judges in determining the admissibility of expert witness testimony is that, like Galileo, an expert's view that's considered wrong today will be accepted as common wisdom tomorrow. Judges are haunted by the following thought: "Maybe the maverick scientist's only problem is that he is first. Maybe today's junk science will be tomorrow's orthodoxy." *Id.* at 154.

266. Galileo seems to take on a Comtean model of linear progress in the sciences, the presumption of which is that today is better than yesterday and tomorrow will be even better: "Modern science is a far cry from science centuries ago. The Renaissance scientists lacked any cohesive social structure or professional journals; their relative isolation is irrelevant today. Galileo had limited opportunity to belong to a larger community of scientists,

though one should not forget that Galileo's heresy was to agree with Copernicus. . . . It proves nothing to dredge up ancient examples of correct views that were at first unpopular in the days of scientific prehistory." *Id.* at 168. A few paragraphs later, Huber's assurances become quite direct: " . . . a judge determined to ground decisions on accurate scientific facts may nevertheless proceed quite safely on the assumption that the witness who behaves like a crank most likely *is* a crank." *Id.* at 169.

267. *Id.* at 168.

268. See Mark A. Zupan, *Paradigms and Cultures: Some Economic Reasons for their Stickiness*, 50 AM. J. OF ECON. & SOC. 99 (1991). Zupan provides a succinct account of several reasons why paradigms tend to stick. First, adherents to the reigning paradigm stymie developments in the direction of a new one, because such developments would diminish the worth of their own work. Second, the start-up costs of a new paradigm and the sunk costs in the reigning one pose at least implicit questions of 'is it worth it?'. Third, there's a free rider problem in making a paradigm shift; thus, it's difficult to find scholars willing to stick their neck out in the interests of a new paradigm. Finally, the persuasive force of those advocating a new paradigm is limited by the fact that cross-paradigm communication is often very poor. *Id.* at 99-103.

269. *See* G.D.L. Travis and H.M. Collins, *New Light on Old Boys: Cognitive and Institutional Particularism in the Peer Review System*, 16 SCI., TECH., & HUMAN VALUES 322 (1991). Based on their access to 10 meetings of the United Kingdom Science and Engineering Research Council at which grants are awarded for scientific research, Travis and Collins noted "that committee members sometimes make decisions based on their membership in scientific schools of thought." *Id.* at 323. They call this 'cognitive cronyism', or an evaluator's showing of favoritism based on cognitive similarity with the evaluatee. *Id.* at 327. An inference that could be made is that the fewer the schools of thought there are, the more of an impact this conservative force will have on a discipline or science in general.

270. R.G.A. Dolby, *Reflections on Deviant Science*, *in* ON THE MARGINS OF SCIENCE: THE SOCIAL CONSTRUCTION OF REJECTED KNOWLEDGE 9 (Ron Wallis, ed. 1979). Dolby argues that because elite scientists usually agree with one another, it is especially difficult for 'deviants' at the lower levels of institutionalized science to make a convincing case against a given elite's perspective on an issue. This difficulty, while in itself constituting a conservative bias to the extent that elites agree with one another because they are elites and not because they are overwhelmingly persuaded by one another's work, has an implication that further advances disciplinary conservatism: the difficulty faced by deviants creates a disincentive for them to even try. *Id.* at 16-19. Dolby states this point clearly: "But very often, other scientists remain unimpressed, and the deviant ideas are ignored or rejected after brief criticism. A scientist who doubts whether he can make an impressive case on behalf of his deviant belief may not make the effort, and turn to other scientific matters, or even leave scientific research." *Id.* at 17.

271. Greg Myers, *The Social Construction of Two Biologists' Articles*, *in* KNOWLEDGES: HISTORICAL AND CRITICAL STUDIES IN DISCIPLINARITY 327 (Ellen Messer-Davidson et al., eds. 1990). Myers examines the shaping of two biology articles through the process of submission and resubmission to various journals, with special attention to the way in which the authors adapted their texts to the "larger discourse" of colleagues, journal editors, and referees. *Id.* at 327. With this approach, the discussion highlights a tension that Myers says is inherent in science, namely, the attempts of researchers to do something new while at the same time fitting their work to the existing body of knowledge. *Id.* at 330. Myers' principal conclusion was that "the

authors start by making high-level claims for the importance of the findings, while the reviewers demand that they stick to low-level claims that take their findings as part of the existing structure of knowledge." *Id.*

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