

Shadows of Evidence

A few introductory comments on our seminar, and on the first reading assignment.

B.Mazur

We walk around the world with a bewildering network of opinions, beliefs, and judgments, some ephemeral (*I think that I won't need an umbrella today*) and some vital (*I trust that person*).

Why is the sky blue? Why do you believe you are mortal? Why is four twice two? How do you know that George Washington actually existed?

If we have an opinion about such a question, then when we are challenged, we offer what we think counts for *evidence*. We hope, of course, that our evidence persuades our challenger (i.e., we hope that our *rhetoric* is up to the task) but more importantly, we hope that our evidence really justifies our opinion.

Different disciplines of knowledge (*Literary studies, History, Biology, Physics, Mathematics*) justify their findings differently; they have, one might say, quite incommensurate *rules of evidence*. *Law* has, of course, its own precise formulation of the rules to govern its activities. Often a significant shift of emphasis, or framing, of one of these great disciplines goes along with a change of the format of what is considered to be *evidence* justifying claims and findings in that field.

It might be illuminating to spend time paying close attention to the *varieties of evidence* that are considered appropriate to establish knowledge in different academic areas, as well as in daily life.

Taken in a straightforward way, this could be an epistemological project within the scope of something that is taught by the Philosophy department. Or, taken in a slightly different direction, it could very easily be taught in the Statistics Department, for *Statistics* is the lingua franca of quantitative reasoning related to evidence.

But Professor Feldman and I envision this seminar-course as having a somewhat different goal. We see it as a 'conversation' where experts in different fields will be presenting material in lectures and discussions about the structure of evidence in their field---the type of 'evidence' that is necessary to have---so that a result in their field, supported by that type of evidence, is generally accepted, and without that type of evidence remains questionable. How does the agreed-upon format of evidence shape their field? How does it help the field cohere 'as one field'? How does it delimit it? How it has changed in time, and what repercussions do these changes have? We hope that we can all learn, in some specificity from people in these fields

—but via concrete examples graspable by people outside the field—what **evidence** consists of in the humanities, the sciences, in mathematics, in the Law.¹

One of my personal goals is to get a slightly better sense of the way various ‘faces of evidence’ play a role in my mathematical work. But much more importantly, I hope that this seminar will enable each of us to become aware of the various distinct profiles of evidence in a number of disciplines². I trust that this will enable all of us to appreciate (and view) our own work in a deeper way.

The issue of *evidence* in Law is---of course---major, both in terms of the role it plays in the practice of Law, but also in the precise manner in which its structure is explicitly articulated: the level of explicitness and clarity related to the consensually agreed upon hierarchy of levels of strength of different types of evidence (in Law) is not matched in other disciplines. I am very eager to learn about the nature of evidence in subjects other my own, and especially in the subject that most people in this room are experts in.³

Even the way the word evidence is used can already tell us much about the profile of an intellectual discipline. To take a simple example, consider Charles Darwin’s language in *The Origin of Species*—specifically, his use of the words *fact* and *evidence*—as offering us clues about the types of argumentation that Darwin counts in support, or in critique, of his emerging theory of evolution⁴. Sometimes Darwin provides us with a sotto voce commentary on what shouldn’t count—or should only marginally count—as evidence, such as when he writes:

But we have better evidence on this subject than mere theoretical calculations.

He spends much time offering his assessment of what one can expect—or not expect—to glean from the fossil record. He gives quick characterizations of types of evidence—for example, ‘historical evidence’ he calls ‘indirect’ (as, indeed, it is in comparison with the evidence one gets by having an actual bone in one’s actual hands). These types of judgments

¹ And it would also be good to compare what we learn from experts with what can be said about the informal texture of evidence that we all use for justification of our judgments, in daily life.

² Once we look with a microscope at the structure of evidence in any of these fields, the notion may turn out to be far trickier, far more specific-to-the-field, far more of a moving target than one might have originally guessed. Also the relations between the fields may be revealing.

³ That there might have been slightly more of a kinship than one might think, between the discursive structure of mathematics and the practice of law in early Greek thought, is a topic being currently explored by a friend of mine, Apostolos Doxiadis.

⁴ As is perfectly reasonable, Darwin reserves the word *fact* for those pieces of data or opinion that have been, in some sense, vetted, and are not currently in dispute; The word *evidence* in “The Origin of Species” can refer to something more preliminary than *fact*, yet to be subject to tests to be deemed admissible or not. Sometimes, if evidence is firmer than that, Darwin will supply it with an adjective such as *clear evidence* or *plainest evidence*; it may come as a negative, such as “there isn’t a shadow of evidence.”

frame the project of evolution.

The subsequent changes in Darwin's initial repertoire, such as evidence obtained by formulating various mathematical models, or the formidable technology of gene sequencing, etc., mark changes in the types of argument evolutionary biologists regard as the constituting a genuine result in the field—in effect, changes of what they regard evolutionary biology to be.

My subject, mathematics, has an extremely intimate relationship with its own foundations, and the explicit formulation of proof. Nevertheless, its actual practice is laced with a much broader range of issues related to evidence, than simply proof. (And “proof” itself is vastly complex.) These are issues that connect, not only to *correctness* but also to value, to explanatory power, to appropriateness, to promise. I'll get into all of these in my presentation later this semester.

Here are three moods in which one can talk about evidence.

1. One can consider generic issues and formats for acceptable evidence that cross fields, such as the broad structure of experiment and hypothesis, as dwelt on in the brief excerpts listed in the **background reading list**. We will review some of this in a moment.
2. One can focus on the structure of evidence in specific fields and how these structures connect, or not, with the different structures of other fields. As described above, this is the primary mission of the various presentations-and-discussions that we will be participating in throughout the semester.
3. One can study essays that deal with very particular *cases* where peculiar types of ‘evidence’ is at play —such as “The Crimean War Essay” of Errol Morris⁵, or particular *issues* such as the writings of Marcia Angell on the placebo effect. This type of engagement with evidence may yield material for individual papers.

Our seminar begins with readings related to (1) above. It may be good for us to review early arguments meant to establish *experiment* as a firm element in the protocol of scientific thinking.

Our first reading, from Aristotle (Book VI of The Nichomachean Ethics) sets a frame for a type of discursive argument. In other parts of Book VI he makes clear that the tightness of the frame should depend upon, and be suitable to, the subject of discourse. Different fields need different formats for what constitutes evidence. For example, for subjects like political science, Aristotle feels that we must be content

...in speaking of such subjects ... to indicate the truth roughly and in outline, and in speaking about things which are only for the most part true ... to reach conclusions that are no better. In the same spirit, therefore, should each type of statement be received; for it is the mark of an educated man to look for precision in each class of things just so far as the nature of the subject admits; it is evidently equally

⁵ This is in his book *Believing is Seeing (Observations on the mysteries of photography)* Penguin Press (2011)

foolish to accept probable reasoning from a mathematician⁶ and to demand from a rhetorician scientific proofs.

The formulation of experiment is implicitly or explicitly in the writings of Bacon; and of Galileo (who takes exception to the views of Aristotle---who, for his part, is hardly against experiment!).

The requirement that for an empirical statement to be taken seriously in the sciences it must *be capable of being falsified by an experiment*⁷ is proclaimed, and defended, in the excerpt of the writing of Popper. A dictum of his is: *Every “good” scientific theory is a prohibition: it forbids certain things to happen. The more a theory forbids, the better it is.*

That hypothesis-fishing, and correlation-fishing expeditions should be clearly labeled as such is an issue can be found discussed many places in the literature. For example, the procedure that requires the hypothesis one is testing to be explicitly framed and fixed *before* either accumulating or viewing the data meant to determine whether it holds is labeled “predesignation” in one of our readings; we specifically chose an excerpt of an essay commenting on the writing of Peirce on this matter. (Peirce works here, as usual, on a meta-level where he is pointing out the difficulties you encounter when you try to *justify* predesignation as something desirable.)

The various statistical issues of experiments (e.g., the problems---both open and hidden---of reasoning from a sample population to the whole population, or from whole to a sample) is also discussed in our background reading list.

The thorny question of causality and correlation is also treated in our background reading. When you perceive a correlation in the data related to two phenomena A and B, you might be tempted to say that A and B are ---somehow---causally linked. The problems involved with this are treated in much of the literature. The question of whether—a certain such A is the cause of, or is caused by, a certain B is taken up in a curious way in the William James excerpt.

What does a “general physical law” mean, and what authority does it have, when derived from a host of experiments, or---worse---when that derivation is aided by pure thought? This is raised by Mach in his “Science of Mechanics.” Mach takes quite an extreme position about the matter. In effect, scientific laws, for Mach, are just economical formulations describing events that constantly recur, and have no authority beyond this.

On *economy* Mach writes:

⁶ Well...Aristotle might be surprised to read the following (in a recent mathematical article):

Probabilistically checkable proofs are proofs that can be checked probabilistically by reading very few bits of the proof. In the early 1990s, it was shown that proofs could be transformed into probabilistically checkable ones with only a modest increase in their length.

⁷ This requirement is called, succinctly, *falsification*.

“Economy of communication and of apprehension is of the very essence of science.”

On *describing recurring events* he writes:

“...for description presupposes the employment of names by which to designate elements; and names can acquire meaning only when applied to elements that constantly reappear.