

The boundary between science and non-science is a delicate line, around which there are too many important political and social issues for the boundary to be misunderstood. Its concerns lie sufficiently outside of scientific expertise that the burden of patrolling the boundary cannot rest only on scientists. At the same time, politicians generally don't have the scientific knowledge or understanding needed to responsibly handle issues involving science. Attempts have been made to bridge this boundary by conscientious scientists in the past, but the manner in which these attempts have been made has failed to address all of the difficulties of the science/non-science boundary. Specifically, boundary organizations have not made it clear to the general public that scientific activities are in some ways grounded in political and social values.

In his book "Between Politics and Science" (2000), David Guston gives a history of boundary organizations, which he defines as "institutions that straddle the apparent politics/science boundary and, in doing so, internalize the provisional and ambiguous character of that boundary" (Guston, 30). One specific aspect of that boundary on which Guston focuses is the part that deals with assuring the integrity of science and research.

The scientific community had been left to self-regulation until 1981, when "Congress asked if there were scientists on the federal payroll who were not pursuing truth and, if so, what the agencies were doing about it" (Guston, 88). The hearings that followed resulted in a more formalized system of self-regulation: the Institutional Liaison Office (ILO) at the National Institutes of Health (NIH) shouldered more of the burden of investigating claims of misconduct. By keeping the responsibility for investigation at

NIH, the scientific community maintained much of its independence, and Congress was satisfied.

A paper written in 1987 by scientists Ned Feder and Walter Stewart revealed misconduct in research that had not been corrected through self-regulation. The scientific community's generally hostile reaction to this paper was received by members of Congress as "stonewalling by the scientific community in the face of the empirical scrutiny they saw as necessary to assure the integrity of the public investment in research" (Guston, 91). In response, Congress began a more formal investigation of how misconduct is dealt with by the scientific community. The result was a "deconstruction of scientific exceptionalism" (Guston, 92). Congress lost its trust of the scientific community's abilities "to monitor and investigate the integrity of their own" (Guston, 93), and began to pursue the need for an independent program to assure the integrity of research.

The Office of Scientific Integrity (OSI) and the Office of Scientific Integrity Review (OSIR) were established in 1989 to take over the job of investigating scientific misconduct from the scientific community. Even though these offices were outside of NIH, OSI and OSIR were still intimately tied to the scientific community by the fact that those handling the investigations were scientists, rotated in and out of the offices. As they were formed, the offices were meant to "preserve the privileged participation of scientists" (Guston, 102). In 1992, these two offices were combined with a legal component to form the Office of Research Integrity (ORI). Just like OSI, ORI was to oversee investigations of misconduct, and investigate allegations of misconduct itself anytime such intervention was deemed necessary. ORI was somewhat less self-

regulatory because it had both scientists and non-scientists involved in investigations of research misconduct, whereas OSI had placed “the primary responsibility for investigations of scientific misconduct on people with scientific knowledge” (Guston, 102).

These offices that Guston describes do work at a boundary of science. This boundary, however, is not between science and politics, but rather between good science and bad science. These boundary organizations were a disciplinary action against the scientific community, the result of a loss of trust in the scientific community. They did not question the other boundaries of science, such as how politics or social concerns influence the kinds of science that are well funded, ignored, or celebrated. Focusing their self-reflection on blatant failures of judgment allowed scientists to avert their attention from the subtle ways in which science is steered by non-scientific concerns. The issues addressed by ORI belong in the mind of every scientist. Ethics in research is not an external concern; it is inherent to the profession of science.

Or is it? Is there any universal answer to the question of whether science is fundamentally concerned with ethics? Can there be such thing as good science, absent good ethics, where by ‘good ethics’ I mean good by the ethical standards of society? For instance, can human experimentation be called good science, even if it entails bad ethics? Further, is that question directed towards scientists and their perceptions of good science, or rather towards the non-scientific general public?

A branch of inquiry known as the sociology of scientific knowledge (SSK) focuses on this question, and in doing so

has eroded the traditional idea that science is a unique and exceptional branch of human activity...An important accomplishment of this new

tradition has been to reveal the many ways in which science is neither exceptional nor immune from the forces that affect other human activities. (Bimber and Guston, 1995)

These forces include ethics. SSK is not, however, performed by scientists, and as such is an observer's view of the issue. The scientific community's answer to the question of where ethics fall with respect to science is primarily important; how scientists answer that question will reveal the extent to which scientific inquiry must be supplemented by ethical inquiry. To gauge the scientific communities understanding of their responsibilities with regard to ethics, I looked at two reports: one prepared by the Committee on Scientific Freedom and Responsibility of the American Association for the Advancement of Science (AAAS, 1975), the other prepared by the National Academy of Sciences (NAS called "On Being a Scientist" (NAS, 1995).

The Committee on Scientific Freedom and Responsibility was formed "in response to [AAAS's] concern for independent scientific inquiry and responsible conduct" (AAAS, v). Its conclusions in this report are that "the issues of scientific freedom and responsibility are basically inseparable" (Edsall, 5). In a discussion of science and values, the report states that:

it is often said that science is ethically neutral and value-free. Such statements, in our opinion, are seriously misleading and in some respects quite false...The *activities* of scientists and technologists...are conditioned and directed at every turn by considerations of human values. This is true over the whole range of activity, from the most basic research to the applications of science in technology. (Edsall, 6)

This statement about how science is intrinsically tied to values begins to get at the fact that science is not an isolated exploration of the physical world. This is explicitly put forth in the report's introductory summary: "Science is now inextricably intertwined with major political, social, and economic problems" (Edsall, ix) and again later on in a

discussion of technology from an article written in 1973 by Steven and Hilary Rose:

“‘Can Science Be Neutral?’ Their answer is an emphatic ‘no,’ and in the domain that we are here considering they are certainly right” (Edsall, 27). (There is of course the question of whether this report is representative of the scientific community as a whole, or rather a statement by concerned members to the effect that scientists should be concerned. If it were the latter, some of the report’s prescriptive power would be lost, since the fundamental assumption of the report would be the same as its conclusion. Judging from the sustained prominence of AAAS, however, I would have to assume that this report is not solely indicative of a concerned minority.)

Echoing AAAS’s idea that science and values are inseparable is a report published by the NAS in 1989 and again in 1995. “Written for beginning researchers, [the original ‘On Being a Scientist’ written in 1989] sought to describe the ethical foundations of scientific practices and some of the personal and professional issues that researchers encounter in their work.” (NAS, 5) The fundamental assumption that there is something called “research ethics” is not questioned, it is explained. The basis for the belief in research ethics comes from the exchange of influence between science and society: society depends on science, and science cannot isolate itself from the society in which it is performed.

Scientific knowledge obviously emerges from a process that is intensely human, a process indelibly shaped by human virtues, values, and limitations and by societal contexts...With science becoming an increasingly important social institution, scientists have become more accountable to the broader society that expects to benefit from their work. (NAS, 10-11)

Just like the AAAS report, NAS discusses values in science and the extent to which they influence scientific products:

students of science have shown that social and personal beliefs...can shape scientific judgment in fundamental ways. For example, Einstein's rejection of quantum mechanics as an irreducible description of nature – summarized by his insistence that “God does not play dice” – seems to have been based largely on an aesthetic conviction. (NAS, 16)

These statements echo the AAAS report, where it is written “the initial decision to start on one trail rather than another is likely to be greatly affected by current social values that tend to establish what is worth doing” (Edsall, 8).

There are “many responsibilities incumbent upon researchers because of science’s function in modern society (NAS, 33). That incumbency speaks directly to the question of whether ethics are an inherent concern of science instead of being something about which humanists and conscientious scientists talk about outside of the lab. Both factors add to the need for science to include ethics: the fact that science is value-laden as well as the responsibility science bears with respect to the society it serves. The agreement between these two documents is indicative of a general understanding among scientists about the work they do and the responsibilities that follow.

Scientific innovations have shown that there is give-and-take between science and societal ethical standards. History gives examples: a technique such as experimentation on human subjects, which is seen as scientifically useful, is considered too unethical to use. Here it is important not to confuse the words “good” and “useful.” Good science is ethically and scientifically sound. Useful science is productive of results, be it ethically good or not. Those techniques deemed unethical have been left behind in favor of good science, even at the risk of diminished productivity, as in the case of requiring free and

informed consent. That requirement impedes productivity, but its existence is necessary for the maintenance of good, ethical scientific practice.

Conversely, society sometimes adjusts its ethical standards because of science. New techniques and technologies are not always readily accepted by the non-scientific (or even the scientific) community. Galileo's revolutionary idea about the earth's place in the universe is perhaps the most well known example of (what turned out to be) good science being looked down upon because of its relation to the period's non-scientific sensibilities. Modern day examples include much of the history of reproductive science: sperm donation, birth control, abortion, in vitro fertilization, cloning, and fetal research. All of these were initially met with societal barriers. Some of those barriers have been broken down entirely; others are still in the process of eroding. In these cases, productive science had to wait for society to catch up in order to be considered good science.

This kind of iterated compromise between science and ethical standards shows that the idea of 'good science' adjusts to current ethical standards. Galileo was not seen as a good scientist in his time. Similarly, while the advent of cloning is recognized as technologically impressive, praise for the scientists as performers of 'good science' is withheld while society figures out its feelings.

This exchange of approval between science and society highlights the fact that science is subject to an ethical context; science needs an approving society in order to prosper. At the same time, society needs to be informed by scientists as to how to use science. That need is filled by another kind of boundary organization, namely the kind that works to assure good use of the products of science.

In a paper titled “Organizing Integrity: American Science and the Creation of Public Interest Organizations, 1955-1975,” Kelly Moore discusses the attempts of activist scientists to make more noticeable the ethical, social, and political aspects of the professional lives of scientists, by creating organizations whose purpose was to inform the nonscientific world of science in a more politically responsible way. Moore’s paper ends up shedding light on the inadequacies of boundary organizations as forums for addressing the difficulties of our societal and political dependence on science.

The organizations (the Scientists’ Institute for Public Information (SIPI), the Union of Concerned Scientists (UCS), and Science for the People (SftP)) performed boundary work in the sense that they stretched the boundary around science, expanding the areas over which science prevails as the authority on the subject. This description of boundary work echoes Thomas Gieryn’s definition of boundary work as “an ideological style found in scientists’ attempts to create a public image for science by contrasting it favorably to non-scientific or technical activities” (Gieryn, 781). The focus of these boundary organizations, however, does not quite include both sides of the boundary; they only looked at the flow of information and influence from science to non-science. The author suggests that those who formed the organizations were trying “to maintain credibility simultaneously as objective scientists and as political actors serving the public good,” (Moore, 1593) and that the only way to do so was to avoid “suggesting that the *content* of scientific knowledge might be tainted by nonscientific values” (Moore, 1594). Their focus, therefore, was on preventing the misuse of science by nonscientists. They did this by trying to develop better communication between scientists and journalists (SIPI), between scientists and those involved in politics (UCS), and between scientists

and the public (SftP). All of the concern rested in the idea that when science leaves the protection of scientists, it is not cared for in the way that respects its potential. Science without scientists is something easily exploited for political or social ends, and that is a fact that scientists must address.

As the author notes, these boundary organizations avoided self-criticism, a move that “helped to prevent the disastrous disintegration of science and to contribute to the ongoing moral authority of scientists” (Moore, 1594). There were some scientists interested in science as a *source* of political problems as opposed to being the solution, as well as questions of how and why science is performed and funded. But these questions were stifled by lack of universal concern among scientists, and, more importantly, by the desire to maintain the apparent objectivity of science. By maintaining objectivity, the scientific community could at least still have the authority to comment on the ethical usage of their product. All of these boundary organizations avoided the non-scientific influences on science.

The public funding of science involves decisions about what kinds of research are worthy, and how worthy each is. Scientists do not make these decisions, which means that non-scientific concerns influence the direction of science. That is the first boundary between science and non-science. (This boundary also includes the manner in which science is performed by scientists who feel the pressure of the non-scientific concerns of the first boundary.) A second boundary is the one across which information flows from the territory of science to the domain of non-science, for use as evidence or justification by policy-makers. Boundary organizations seem to specialize in this second boundary:

when science enters the nonscientific world, they ask whether the science is trustworthy, and whether it is being used to good ends.

These types of boundary organizations are extremely important, as they catch the more complex ethical issues presented by science and draw more people into their consideration. It is just as important for these boundary organizations to be supplemented by another kind. Boundary organizations have been set up by scientists to maintain ownership of their product and to protect the reputation of their profession, and by non-scientists to maintain their trust in science by watching over it. In his AAAS report, John Edsall also examined SIPI as a boundary organization (though not using that language).

His understanding of it was that

SIPI endeavors to be informative, without taking sides on controversial issues. Such a dispassionate attitude, of course, is difficult to maintain consistently; a writer may believe that he is being objective, while his critics are equally convinced that he is selecting data to prove a thesis. Certainly, however, SIPI has performed, and continues to perform, valuable service in setting forth essential and reliable information that is necessary for making sound decisions on many public issues that involve science and technology.” (Edsall, 33)

His analysis seems consistent with the idea that there is something missing from boundary organizations. He goes on to say that “private *ad hoc* organizations [i.e., non-governmental boundary organizations], formed to deal with particular issues, can play an important role [“in obtaining balanced consideration of important controversial issues” (Edsall 33)]. Generally, they are not impartial but are formed to support one side of the dispute” (Edsall 34). I think that this generalization still stands today, with new boundary organizations popping up in response to new technologies and threats to our society’s ethical sensibilities.

There is a need, then, for a boundary organization that does not have an interest in the appearance of objectivity or the preservation of the reliability of science at all costs, but rather exists only to ensure that science and non-science are not merging in irresponsible ways. Science and politics are in a state of constant, mutual, subtle exploitation across the first boundary, and it is that boundary that needs supervision. The more we ignore the problem of subjectivity in science for the sake of peace of mind, the more enmeshed in politics we allow science to become.

AAAS and NAS showed through their reports the willingness to tear down the apparent objectivity of science. NAS states, importantly, that

science offers only one window on human experience. While upholding the honor of their profession, scientists must seek to avoid putting scientific knowledge on a pedestal above knowledge obtained through other means. (NAS, 33)

If that attitude has been around since 1975, then why is it that we still have this problem of science holding power when it comes to issues like global climate change, for which we focus on science as the ultimate informer? One problem is that these reports do not address the general public. It's vitally important that scientists be aware of science's rightful place in our society, but without the public sharing that attitude, science is effectively king again. The NAS report, "though...aimed primarily at graduate students and beginning researchers, [has lessons that] apply to all scientists at all stages of their scientific careers" (NAS 6). I would argue that its lessons are not only for scientists, but for the public who rely on scientists as well.

Here then is the need for yet another kind of boundary organization: related to the kind of impartial boundary organization described above, it's the kind that deals with catching the public up to the understanding scientists have of what they do, as described

by the AAAS and NAS publications. Clearly, scientists understand that science is not the most important type of knowledge there is. Non-scientists, however, do not understand that attitude in the same way. In order to lessen our societal and political dependence on science, scientists must make clear to the public, and not just to themselves, that the authority presently granted to science is not entirely appropriate.

Doing this, of course, threatens the authority of the scientific community. That threat has been largely avoided, either consciously or unconsciously, and scientific exceptionalism has been maintained. Perhaps an important question is, is there a good reason that has happened? Do we as a society not want to lose the effective objectivity of science? Is there some good in holding on to a source of knowledge as ultimately reliable, even at the risk of fooling ourselves? I don't think anyone is conspiring to keep the public from fully understanding the place of science in our society. At the same time, though, no one is suggesting that there be dialogues between scientists and the general public about why the general public should not look to science so readily. Perhaps the answer to that question is best understood by scientists and those who work closely with science. Then, the trust afforded the scientific community can be moderated at the level of scientists, instead of having the general public lose the faith that allows science to be performed to its current degree. It may just be that we're better off with more science coupled with watchdog agencies than we are with a lack of trust in science.

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