The Science Wars and the Future of the American Academic Profession

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It is all too easy to be perplexed about the state of health of academia in the United States. On the one hand, observers proclaim this "the golden age of the American university,"[1] and it would be hard to disagree based on any sort of objective measure, such as the competition for admission to selective insitutions, or the net influx of foreign students. Subjectively, the positive public image of the American university also seems to be holding.[2] At the same time, a steady stream of jeremiads fills the shelves at bookstores and libraries, lamenting the catastrophic failure of American higher education to carry out its intended functions. These portray American colleges and universities as places where students go to have their minds closed and their spirits killed by tenured radicals engaged in a giant professorial scam.[3] It's difficult to read such books without feeling we're doing *something* wrong.

The status of the natural sciences is similarly confusing. Measures based on student demand are no less positive than in other disciplines. Predictions that by now we would not be producing enough scientists to replace the increasing numbers of retirees from academic positions show no signs of coming true. American scientific research continues to lead the world in most fields, by any objective or subjective measure. While a good deal of scientific research goes on outside universities (in contrast to the majority of scholarly work in other disciplines), surely this leadership is due in very large part to the academic component.[4] Nonetheless, academic scientists sense that all is not well. The most obvious sign is pressure on research funding. It is telling that the latest

federal R&D budget, which barely (if even) keeps up with inflation, is being celebrated as a "significant achievement" compared to what *might* have happened.[5] Issues on which scientists may think they have the most authority slip completely out of their jurisdiction, and become topics of debate in Congress and the media. What is the proper balance between fundamental and applied research? How widespread is the problem of scientific fraud, and what can/should be done about it? What are the consequences of the increasing proportion of industrial sponsorship of academic research, and of the burgeoning entrepreneurial behavior of academic scientists — is the potential for conflict-of-interest significantly dangerous? And many more.

These lurking problems are mostly specific to the natural sciences. Do the more general problems of the university apply to science as well? The critics tend to draw fairly heavy lines between science and the rest of the university, and exclude scientists from the most virulent attacks (aside from the universal complaint of slighting teaching at the expense of research). But if *as scientists* we take any comfort from this partial exculpation, it must be balanced against the implicit criticism of our roles as members of the academic profession. Science is portrayed as a completely separate enterprise in academia, with little interaction or even mutual awareness between it and the other disciplines. The implications of the departmental structure of American universities, and the conflicting demands of disciplinary vs. institutional loyalty, have been discussed before;[6] but here the consequences are presented in a particularly dire light. As described by Bloom, "the scientists have had less and less to say to, and to do with, their colleagues in the social studies and humanities. The university has lost whatever polis-like character it had and has become like the ship on which the passengers

are just accidental fellow travelers soon to disembark and go their separate ways."[7]

In this context, recent developments in the relationship between science and the other disciplines must strike one as supremely ironic. Scholars in the social sciences and humanities are increasingly looking to the sciences for subjects to study, and scientists are increasingly becoming aware of this work — but does this mean that we are finally beginning the work of lowering barriers? Apparently not: according to the reactions of (some) scientists, we are dealing with a trend that looks much more like a cross-border invasion than a cross-boundary collaboration. And this trend has been characterized as a potentially serious threat, both to science and to the academy. In the balance of this essay, I will briefly summarize the history and substance of what have come to be known as the Science Wars, offer a recommendation for a more charitable view of science studies by scientists, and try to assess their potential for affecting, both for good and ill, the future of the scientific enterprise and the academic profession.

A BRIEF CHRONICLE OF THE SCIENCE WARS

Arguably, the person who has had the greatest influence on scholarly titles in recent years (since the invention of the colon, perhaps?) is George Lucas. A search of the computerized catalogs of two modest university collections (Caltech and the Claremont Colleges) yielded well over 50 books, all published since the appearance of *Star Wars* in 1977, with the phrase "X Wars" in their titles — Aspirin Wars, Car Wars, Erotic Wars, Gene Wars, Memory Wars, Mind Wars, Sperm Wars, Time Wars, and so on — not even counting individual articles.

And now we have Science Wars. The phrase (probably derived from "Culture Wars") has become popularized, primarily by a special issue of the journal *Social Text* (more on that shortly); but what are they about, and who are the forces on each side? Basically these are turf wars. Can those who are not professional, trained, practicing scientists speak on what science is about and how it works, or do scientists remain the sole authorities on these issues? In antebellum times (say before the 60's) scientists were largely unthreatened by nonscientists studying science. History of science tended to be primarily of a celebratory nature, while philosophy of science (as viewed by scientists) is, well, philosophy — it's not about anything *real*.

But things have changed, and the publication of Thomas Kuhn's *The Structure of Scientific Revolutions* in 1962 is often identified as a key factor in that change. Of course, there is a long tradition of inquiry into the nature of knowledge. But Kuhn's work, perhaps granted an extra measure of authority by his credentials as a physicist, served for many to legitimate the notion that scientific knowledge is not a simple and rational consequence of "the way the world really is," and led to a number of alternative approaches to the study of science over the next decades. Perhaps the first systematic one was the "Strong Programme" initiated at Edinburgh in the early '70s, which constituted a sociological treatment of scientific knowledge. Such studies of science are centered on the concept of social constructivism — that scientific facts are constructed by the activities of scientists, rather than sitting out there in Nature, waiting to be picked up.

Since then an extensive body of science studies, from a variety of viewpoints — social, cultural, linguistic, feminist, etc. — has burgeoned. These vary widely in many aspects — commitment to realism or relativism, respect for or hostility towards the scientific enterprise, etc. — and it would be both misleading and unfair to try to capture them all in a simple description. They do all call into question the traditional view of what science is about and how it works, though, and it would not be at all surprising for them to provoke at least some sense of disturbance among scientists. Nonetheless, for a long time (until around 1990) there was little evidence that scientists paid much attention to these movements. If we represent the Science Wars as a Lucasian film trilogy, the appropriate title for the first reel would be *The Mouse that Roared*.[8]

Scientists did begin taking notice in the early '90s, and for this second phase we can use Lucas' title: *The Empire Strikes Back* is a very apt description of the responses that started showing up in print. The first significant attacks, focusing on the social constructivist school, were incorporated in books published in 1992 by physicist Steven Weinberg and biologist Lewis Wolpert.[9] In 1994 the battle lines were drawn for all to see. An account of a heated debate between Wolpert and sociologist of science Harry Collins at a meeting of the British Association for the Advancement of Science appeared in the (London) Times Higher Education Supplement, while an anti-constructivist meeting of the National Academy of Scholars was featured in US papers such as the Boston Globe. But the main event so far — the grand declaration of war — was the book *Higher Superstition* by biologist Paul Gross and mathematician Norman Levitt,[10] which examined a number of areas of study, and concluded that they constitute a general movement that is hostile to science, arrogant in its assumption of competence, and aimed at overthrowing scientific authority. As a sequel, the

authors organized a meeting of the New York Academy of Sciences in 1995, entitled "The Flight from Science and Reason."[11]

The targets of these attacks began regrouping, and put forth an organized defense of their positions in the afore-mentioned special issue of *Social Text*, which appeared in 1996.[12] However, the defenders unknowingly harbored a fifth columnist! An article by physicist Alan Sokal, entitled "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity,"[13] was accepted for this special issue. Simultaneously with its publication, Sokal revealed that his article was a parody, deliberately crammed with as much nonsense as possible and submitted to test whether the hoax would be detected.[14] Inevitably, it was this aspect of the issue — what has come to be known as The Sokal Affair — that got all the attention. Letters and Op-Ed pieces, both praising and condemnatory, filled the New York Times for weeks, and continue to echo in a wide range of scholarly and popular media, most visibly in a recent issue of *Newsweek*.[15]

A FEW NOTES FROM A WAR CORRESPONDENT

I first became interested in science studies about 5 years ago. The suggestion that high barriers between science and the other academic disciplines are detrimental to the health of the university seemed right to me, and I was also dissatisfied with the demarcations between my own professional pursuits — then strictly scientific — and my extracurricular interests. Some of my initial reading forays into social studies of science proved quite intriguing, but also disappointing, because the authors exhibited little apparent interest in attracting scientists to their work, and often indulged in rhetoric that couldn't help but

provoke some scientists to antagonism, even if unintentionally. I expressed some of these thoughts in an article, which was published in *Social Studies of Science*, along with a set of responses.[16] By and large the latter were quite positive, recognizing the need for developing dialogs between the two camps.

I was dismayed, therefore, by the outbreak of war signaled by the appearance of the Gross and Levitt book, and its call for scientists to change their attitude towards science studies from benign neglect to active combat. While perhaps few have yet rallied to that banner, some in prominent positions have done so. For example, in a guest editorial in *Chemical & Engineering News* (the weekly organ received by all members of the American Chemical Society), Allen Bard, editor of the prestigious *Journal of the American Chemical Society*, opined: "Scientists should also confront the sociologists and philosophers at their institutions who are attacking the foundations of science. Presumably, tenure decisions and promotions at universities are based on scholarship, and academic scientists must take an interest in the academic decisions in other departments on campus. This is not a question of academic freedom, but rather one of competency."[17] I did say that I hoped to see more interactions between different disciplines, but that's not quite the sort of thing I meant!

Is this really about an attack on the foundations of science? And can scientists simply dismiss such work as incompetent? Obviously I can't address the full range of topics; *Higher Superstition* alone criticizes 4 major groups (so defined on the basis of getting an entire chapter to themselves) — social constructivism, postmodern literary and cultural criticism, feminist criticism, and radical environmentalism — along with several smaller movements, and other writers have still longer hit lists. But I would like to comment briefly on one

aspect — social constructivism — and to argue for a much more positive interpretation of what (some of) these science studies are trying to do.

The bare idea that scientific knowledge is socially constructed may be fleshed out in a number of ways, ranging from the mild position that social factors *affect* scientific practice — even Gross and Levitt find that perfectly acceptable[18] — to the extreme view that the laws of nature *themselves* are socially determined, caricatured by Sokal's invitation that those who so believe try transgressing those laws from his 23rd floor apartment. A philosopher (*not* a social constructivist) has offered a more moderate statement:

> The deep point of the sociological critique is that the social forces that operate in this modification of practice — the rules for consensus shaping, the conversations with peers, the training process and broader socialization within a larger community — may be sufficiently powerful that the effects of nature are negligible.[19]

which has been given much more vivid voice, as for example the oft-quoted (but incorrectly; see below): "The natural world in no way constrains what is believed to be." Most scientists would, I believe, reject this version, as indeed do many in the science studies world as well. Philosopher Susan Haack, for example: "Bad sociology of science is thus *purely* sociological, whereas good sociology of science, acknowledging the relevance of evidential considerations, is not."[20] Noting the possibility of "bad good sociology of knowledge" — sociology done poorly though taking the right approach — she charitably (and symmetrically) recognizes the possibility of "good bad sociology" — that studies based on a purely sociological perspective could nonetheless yield valuable results. But she

insists that any such accomplishment would be mostly by chance (like the blind squirrel that occasionally finds an acorn?).

I propose a different perspective, that starts from the *correct* version of the above quote: "The appropriate attitude for conducting this kind of enquiry is to assume that 'the natural world in no way constrains what is believed to be'."[21] That's quite different: it represents the "social is all" view as a methodological starting point, not an ideology or a conclusion. In this sense, what Haack calls bad sociology is not denying the relevance of Nature, but simply bracketing it out of consideration, in order to focus on the social. And certainly such a research strategy should not seem foreign to any scientist, as Haack herself points out: "What is distinctive about inquiry in the sciences is, rather: systematic commitment to criticism and testing, and to *isolating one variable at a time*...." (my italics).[22] Granting that there is a social dimension to the scientific endeavor — without necessarily specifying its magnitude — and that it is worthy of scholarly examination, then a social constructivist approach can be viewed as just one possible experimental design strategy, and one that may not be so unreasonable according to traditional scientific standards.

Certainly a constructivist approach is not the *only* strategy, and I have argued for its shortcomings in my earlier article.[16] Furthermore, it must be acknowledged that many (most?) of those engaged in science studies would refuse to concede either the non-uniqueness or the incompleteness of their approaches; also that they are prone to making flamboyant rhetorical claims that offend those who are committed to any sort of realist position. So it is not surprising that this particular battleground is one of the main sites where the Science Wars are fought. But perhaps a small shift of perspective can allow us to

fit it within our traditional understanding of scholarly — even experimental — work, and to recognize the possibility of obtaining useful insights even though we may not like the starting premise.

I believe a number of projects in cultural and literary criticism of science (usually attacked under the blanket term of postmodernism, which may make up in convenience some of what it lacks in definition) may be similarly reconstituted, although a detailed discussion would be out of place here. We all find ourselves living in a world that is completely permeated by science and its products; and it seems to me perfectly understandable that many of those who are not practicing scientists nonetheless feel the urge to bring their own professional expertise to bear in the attempt to make sense of this scientific world.

Now, nothing in this section should be taken to deny that *some* science studies are incompetently done, or are motivated by a clearly hostile stance, or exhibit tones that might be reasonably characterized as arrogant. Bad work (whether "bad good" or "bad bad" by Haack's criteria) is always with us.[23] It also must be admitted that rigorous criteria for deciding whether a piece of work is good or bad are hard to come by. For this reason, Sokal's "prank," which has been lauded by some and condemned by others, seems to me quite appropriate. We need some kind of assay, and Sokal has provided an *experimental* one (note the title of his *Lingua Franca* article). Complaints about betrayal of trust and the like are beside the point; we would like assurance that the system is capable of distinguishing between sound work and garbage, and the results of this particular experiment were less than encouraging.

Nevertheless, I hope that scientists would recognize that much of the work that has been characterized as attacking the foundations of science may actually be part of the same project, viewed on the largest scale, that they themselves are engaged in. Compare Herschbach's mountain-climbing metaphor for science:

> [I]t is vital to have some scientists willing to explore unorthodox paths, perhaps straying far from the route favored by consensus. By going off in what is deemed the wrong way, such a maverick may discern the right path. Hence in science, it is not even desirable, much less necessary or possible, to be right at each step.[24]

THE (PRESENT AND) FUTURE OF THE SCIENCE WARS

We need a title for the third reel of the Science Wars epic — what shall it be? From the point of view of science, *Much Ado About Nothing* may well be the most appropriate. There is little or no evidence that the "assault" on science and reason has had any measurable effect on science itself, dire proclamations like the following (from a philosopher, not a scientist) notwithstanding:

> In Feyerabend's view, science is a religion, for it rests on certain dogmas which cannot be rationally justified....Because most scientists can't justify their methodology, Feyerabend's claims have gone largely unanswered. As a result, Feyerabend's position has become prominent in both academia and the public at large. This has arguably led not only to the rise of pseudoscience and religious fundamentalism, but also to a shrinking pool of scientific jobs and research funds.[25]

There may well be a shrinking pool of scientific jobs and research funds, but is it because the public at large (or Congress at small) has taken Feyerabendism to heart? I think not. The countersuggestion that scientists blame science studies for their plight rather than confronting the true culprits — the end of the Cold War and consequent reductions in defense-related research, and the deficit-induced pressure on budgets for science[26] — is also off the mark. Science is undergoing change because it is entering a no-growth regime, simply because it can't grow anymore. Price was one of the first to note that the scientific endeavor has been growing exponentially and continuously for several centuries. Using the number of scientific journals as a quantitative measure, he found fairly smooth exponential growth, with a doubling period of about 15 years, applies over the entire period of 1750-1950. Clearly such growth couldn't continue indefinitely — without making everyone in the world a scientist, it can't continue much at all past the present — and this enforced demographic transition is more than enough to account for the strains on the scientific community.[27]

(If I might digress for a moment, the growth of academia shows very similar behavior. Figure 1 plots number of faculty in US academic institutions from 1880-1980.[28] The exponential growth is, again, remarkably smooth, persisting through all the changes in emphasis and historical events during that century. If these data are representative, they do not reflect common wisdom, such as: "It is obvious...that the intrusion of the federal government into higher education since the end of World War II...[made] for an expansion of the professoriate to a size almost inconceivable when the United States dropped its atom bombs over Japan."[29] There is no corresponding deviation in the graph. Furthermore, the growth rate — a doubling period of about 16 years — is almost

identical to that determined for science by Price! Is there some innate institutional growth rate operating here? In any case, clearly academia has reached or is about to reach an impenetrable ceiling just as science has, and doubtless some of the current upheaval should be ascribed to that same cause.)

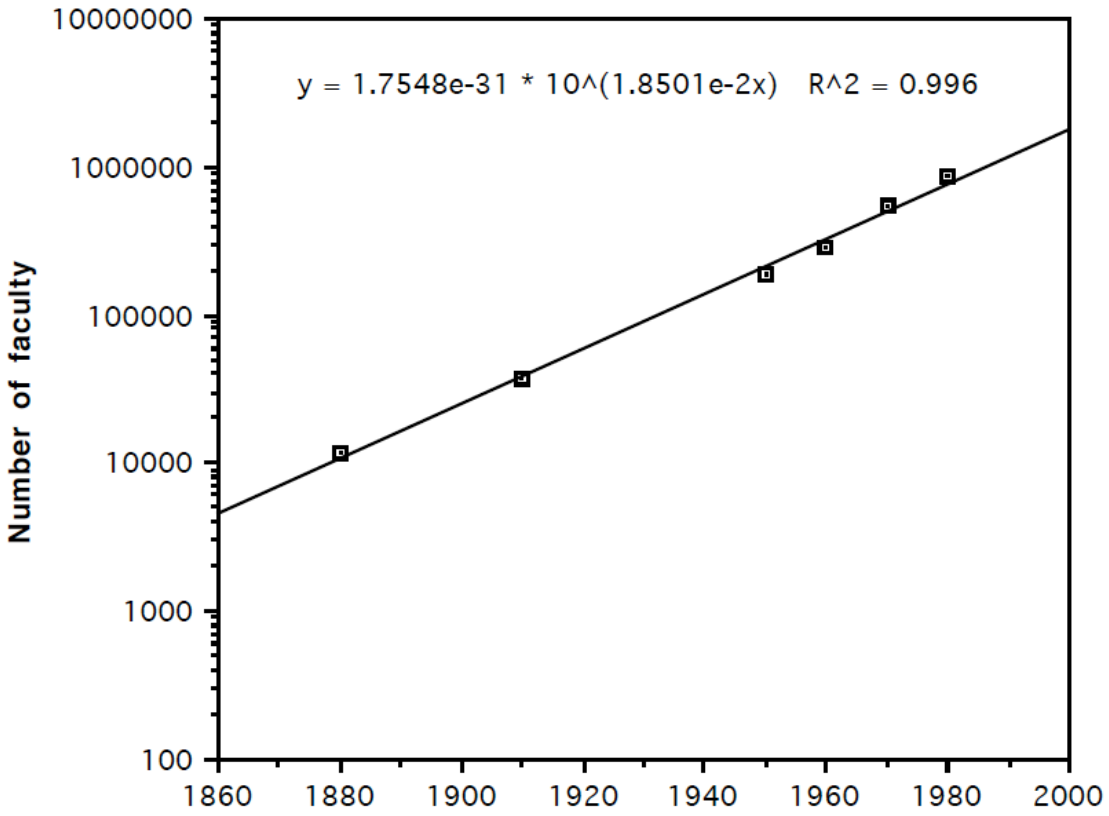

Figure 1. Number of Faculty in US Academic Institutions, 1880-1980 (data from ref. 28)

So if science isn't really threatened, why is there so much agitation? Sokal has proposed that these are primarily *civil* wars within the other disciplines:

> Finally, *within* academia and the left, this affair tapped into a pre-existing pool of consternation and resentment among non-postmodernist academics in the humanities and social sciences (of which I, as a scientist, was largely unaware). It's this latter factor

> that has kept the affair going — in the form of innumerable forums, colloquia and debates — in academia.[30]

I think that's probably pretty accurate. At the "Flight from Science and Reason" conference, the majority of participants were non-scientists, as Gross points out,[31] and some of the most virulent attacks came from that group (see below). My own (mostly anecdotal) experience is also consistent with this interpretation. Very few practicing scientists have yet become aware that anything is happening at all. If I mention to a colleague that I'm writing on the "Science Wars," the inevitable response is "what's that?"; and when I gave a talk on the topic to a group of inorganic chemists last summer (when the Sokal affair was still going strong in the newspapers), exactly one hand went up (in an audience of nearly 100) when I asked who had read or even just heard of the Gross & Levitt book. (A "science wars briefing" in a recent issue of *Nature*[32] may help to raise scientific awareness.)

Furthermore, I've seen no documentation for the claim that anti-science attitudes have diffused into the general public. A 1995 NSF-funded poll showed not only that the popular attitude towards science is strongly positive but, more importantly, that the level of support has remained essentially constant since the surveys began in 1979.[33] If the "postmodern attacks" on science were having any significant impact outside academia, surely one would expect *some* downward trend during this period.

What about the impact within academia itself, then? Beyond the sound and fury, is anything tangible happening? This is the question of greatest relevance to our concern about the academic profession. I have little data, but

there are a couple of intriguing cases, most notably in the form of two non-hirings at the Princeton Institute for Advanced Studies.

About six years ago an offer of a position to prominent science studier Bruno Latour was in the works, but scientists at the institute objected. Particle physicist Frank Wilczek commented:

> Roughly speaking, this school [of science studies] takes the techniques anthropologists have used to study preliterate cultures — going in without preconceptions and observing — and applies [these methods] to science. That is clearly inappropriate in the study of modern science. You can't make sense of the endeavor without reference to what it is about. It is a human endeavor and scientists have all the human motivations, but ultimately the test is a confrontation with reality.[34]

As I've commented earlier, it is not at all clear to me that observing without preconceptions is an inappropriate method. Even if one agrees (as I do) with the last phrase of Wilczek's quote, the key word there is "ultimately." Nonetheless, the offer was withdrawn. At the time, the event did not attract much general attention. Now history has repeated itself, with the overturning of an appointment to historian of science Norton Wise; and this time the controversy has spilled over into the academic world at large, as a new battle in the Science Wars.[35]

How might the evolution of the Science Wars play out in academia? I can imagine two distinct (but by no means mutually exclusive) scenarios. Continuing with our movie title schema, I'll call the first of these the *I'm Gonna Git You Sucka!* scenario. Recall the suggestion, cited earlier, that scientists should

monitor tenure decisions in other departments. That has been amplified and expanded, as in the following two quotes (both from philosophers) at the NYAS meeting:

> Walk a few steps away from the faculties of science, engineering, medicine, or law, towards the faculty of arts. Here you will meet another world, one where falsities and lies are tolerated, nay manufactured and taught, in industrial quantities....This fraud has got to be stopped, in the name of intellectual honesty....Let them do that anywhere else they please, but not in schools; for these are supposed to be places of learning. We should expel the charlatans from the university....[36]

> The sole remedy at our disposal is to quarantine the antiscience brigades and inoculate the rest of the population against them. This requires that those who know something about science — I mean scientists — will have to devote some of their energy to systematic confrontation with the enemies of science....[37]

A disturbing aspect of these diatribes, beyond the apocalyptic tone, is the implication that a number of movements, each comprised of many scholars with widely ranging goals and methods, can nonetheless be linked together as the "antiscience brigades." This is a strategy of "unite and conquer" that avoids the need to treat an individual case on its own merits, when guilt by association can be imposed instead. In the Wise case several commentators (including Wise himself) suggested that this was the main factor in his rejection, as he is not generally considered to be as controversial and "far out" within the field of science studies as Latour.

A quote from Gross and Levitt, if stated less stridently than the above, offers an even more threatening proposition:

> The humanities, as traditionally understood, are indispensable to our civilization and to the prospects of living a fulfilling life within it. The indispensability of professional academic humanists, on the other hand, is a less certain proposition....If, taking a fanciful hypothesis, the humanities department at MIT (a bastion, by the way, of left-wing rectitude) were to walk out in a huff, the scientific faculty could...patch together a humanities curriculum, to be taught by the scientists themselves....[that] would be, we imagine, no worse than operative....The notion that scientists and engineers will always accept as axiomatic the competence and indispensability for higher education of humanists and social scientists is altogether too smug.[38]

There are many possible comments, such as what should we make of Gross and Levitt's accusation of arrogance on the part of humanists and social scientists in light of the last quote;[39] but let the obvious one suffice: if these polemics are translated from the realm of rhetoric to that of action, the potential for destroying the quality of life in the academic profession seems virtually limitless.

But there is, I would like to believe, an upside potential as well. If it is true that the rigid and near-universal separation between science and other disciplines has been and is undesirable, is it possible that the Science Wars could be converted, from a wedge to separate them further, into a bridge (forgive the overused metaphor) to rejoin them? This might be the *Terms of Endearment* scenario. Collaboration, or at least more mutual awareness, between scientists and those engaged in science studies may provide a mechanism whereby each side can get a better idea of what their opposite numbers are up to.

I do not want to pretend that this is going to be easy to achieve. To start off, as has often been observed, the practice of science readily consumes all the time that is granted to it. It is quite understandable that the majority of academic scientists, especially young ones struggling for tenure, would feel that devoting any fraction of that time to matters outside their mainstream research — even if they were interested in doing so — could not be justified.[40] And of course the structure of academia only reinforces that conclusion: it rarely offers much in the way of rewards for such interdisciplinary pursuits, or even for critical examination of one's own discipline.

At the same time, a scientist making exploratory moves in the direction of science studies can encounter indications that the welcome mat may not be out. These include some of the examples of rhetorical excess alluded to earlier, which can make it difficult to focus on possible joint agendas, as well as what seem to be explicit rejections of the desirability of cross-boundary interactions, such as:

> [T]he social epistemologist should engage in what ethnomethodologists call "participant observation" of scientific practices. In other words, she should learn to ply her trade in the presence of those whose company she is most likely to loathe.[41]

> [T]he opinions of scientists about science studies are not of much importance....The vision we develop of science does not have to resemble what scientists think about science, any more than the understanding a physician has about the inner workings of my body must resemble what I feel of it.[42]

But we should not make too much out of rhetoric — especially out of individual soundbites. People say different things at different times and places, as chemist Dudley Herschbach noted at the NYAS meeting,[43] and many of those engaged in science studies, including the last two quoted above, have elsewhere expressed interest in reconciliation. Indeed, there are examples of productive interactions between scientists and science studiers, even though hostilities get all the press. So perhaps the barriers are not insurmountable.[44]

What is to be gained by striving to surmount them? First and foremost, as already indicated, is to begin reversing the fragmentation of the university. If we agree that sharp disciplinary separation is not beneficial to the health of the academic profession, such moves are essential. Beyond that, I believe there are potential advantages for science studies and science alike. I discussed these in my earlier paper[16] and will not repeat them here in detail; generally I argued that science studies would benefit from collaborations with practicing scientists, while the latter might well find that some of the ideas introduced and elaborated by science studies give them new and stimulating insights into the way they do their work. The intersection of science and public policy is an obvious locus for productive interactions as well.

One topic of particular relevance to the academic profession is science education. Science studies can claim to have debunked the idealized model of science that Kitcher has termed Legend,[45] but I expect that any practicing scientist has already learned that lesson from his experience. (That may in part explain why some scientists are little impressed by science studies.) The *teaching* of science, on the other hand, is usually thoroughly imbued with Legend, from beginning surveys for non-science majors all the way up through graduate

courses. This was brought home to me a few years ago, reading the student evaluations of an advanced course I taught on catalysis. For such a course, which covers primarily recent and still ongoing work, I like to present a good deal of the material in case-study mode. That is, I might describe some of the first experiments on a given topic, explain how they led to a certain conclusion, then show how later work changed the interpretation, and so on. A number of students didn't care for this at all. "It's too confusing," one evaluation read, "why can't you just give us the facts?" I found this response rather surprising, especially from graduate students who would shortly be going out into the real world and engaging in that sort of process themselves. On reconsideration, perhaps it isn't so surprising, if the majority of their education has led them to view science as the unproblematic generation of facts — a view which isn't significantly changed until they enter into the actual practice of science. Herschbach has experienced this as well:

> Many students [in introductory science courses] have told me about a disheartening syndrome: the questions and problems seem to have only one right answer, to be found by some canonical procedure. The student who does not quickly grasp the "right" way, or finds it uncongenial, is soon likely to become alienated from science....Nothing could be further from what actual frontier science is like.[46]

I would make a similar argument concerning the science we teach to those who are *not* going to become scientists: is it desirable that they be taught according to a model that we don't take seriously? As noted earlier, many scientific critics are worried about the negative impact of science studies on the public image of science.[47] If the more extreme versions of relativism/constructivism were to be accepted as common wisdom, that

certainly *would* be disastrous; but I see little or no evidence that there is any significant danger of that happening. On the other hand, an overly idealized public understanding of how science works is also dangerous: when science (inevitably) fails to live up to the ideal, there will always be the possibility of disenchantment and backlash. Two of my Caltech colleagues have argued convincingly that such misunderstanding is a major factor in much of the recent agitation over scientific "misconduct."[48] Perhaps, in teaching science, the addition of a dose of science studies might be beneficial.[49]

To close, I would support the above-cited call for scientists to pay some attention to their colleagues outside of science — but not as a confrontation of enemies. No doubt there *are* some enemies out there; but if, as argued here, they pose little real threat to science, the time and energy required would be much more profitably expended in a positive engagement — to the possible benefit of science and science studies, as well as the highly probable benefit of the academic profession — than in escalating the Science Wars to the next level of bellicosity.

ENDNOTES

[1]. See Thomas Bender, "Politics, Intellect, and the American University, 1945-1995," *Daedalus* 126 (Winter 1997): 1-38; and references cited therein.

[2].. See Kenneth Prewitt, "America's Research Universities under Public Scrutiny," in Jonathan R. Cole, Elinor G. Barber, and Stephen R. Graubard, Eds., *The Research University in a Time of Discontent* (Baltimore, MD: The Johns Hopkins University Press, 1994), 203-217.

[3]. Allan Bloom, *The Closing of the American Mind* (New York: Simon and Schuster, 1987; Page Smith, *Killing the Spirit: Higher Education in America* (New York: Viking, 1990); Roger Kimball, *Tenured Radicals: How Politics has Corrupted Our Higher Education* (New York: Harper & Row, 1990); Charles J. Sykes, *ProfScam: Professors and the Demise of Higher Education* (Washington, D.C.: Regnery Gateway, 1988).

[4]. In a recent assessment of scientific research output, based on citation analysis, the US, UK and Canada came out with unexpectedly high ratings compared to France and Germany, both countries with strong science traditions and reputations. The author suggested this might be due to the preponderance of research in universities in the former group vs. dedicated research institutes in the latter: the university may be a better environment to foster high-quality research. (Robert M. May, "The Scientific Wealth of Nations," *Science* 275 (1997): 793-796.) Alternatively, of course, it may just be that citation analysis doesn't really tell us very much about quality.

[5]. Andrew Lawlor, "Smoother Road for R&D Spending?" *Science* 275 (1997): 916-919.

[6]. See Walter P. Metzger, "The Academic Profession in the United States," Tony Becher, "The Disciplinary Shaping of the Profession," and Kenneth P. Ruscio, "Many Sectors, Many Professions," all in Burton R. Clark, Ed., *The Academic Profession: National, Disciplinary, and Institutional Settings* (Berkeley, CA: University of California Press, 1987). Of interest in this regard is a recent survey reporting that 77% of US academics considered affiliation with their academic discipline to be very important, while only 36% felt the same about institutional affiliation: Ernest L. Boyer, Philip G. Altbach, and Mary Jean Whitelaw, *The*

Academic Profession: An International Perspective (Princeton, NJ: The Carnegie Foundation, 1994), 80.

[7]. Bloom, *The Closing of the American Mind*, 350.

[8]. Recalling the 1959 movie in which a the leaders of a small, impoverished nation devise a plan to declare war on the US and lose, thus ensuring future prosperity; but unfortunately they schedule their invasion for a holiday, and it goes completely unnoticed.

[9]. Steven Weinberg, *Dreams of a Final Theory: The Search for the Fundamental Laws of Nature* (New York: Pantheon, 1992); Lewis Wolpert, *The Unnatural Nature of Science: Why Science Does Not Make (Common) Sense* (London: Faber & Faber, 1992).

[10]. Paul R. Gross and Norman Levitt, *Higher Superstition: The Academic Left and Its Quarrels with Science* (Baltimore, MD: The Johns Hopkins University Press, 1994).

[11]. The proceedings were subsequently published: Paul R. Gross, Norman Levitt, and Martin W. Lewis, Eds., *The Flight from Science and Reason* (New York: New York Academy of Sciences, 1996).

[12]. *Social Text* 14 (Spring/Summer 1996), reprinted with the addition of a number of articles (and the deletion of one — Sokal's) as Andrew Ross, Ed., *Science Wars* (Durham, NC: Duke University Press, 1996).

[13]. The text of this article, as well as a number of commentaries and many links to related work, may be found at the following Website:
http://weber.u.washington.edu/~jwalsh/sokal/

[14]. Alan D. Sokal, "A Physicist Experiments with Cultural Studies," *Lingua Franca* (May/June 1996): 62-64.

[15]. Sharon Begley, "The Science Wars," *Newsweek* (April 21, 1997): 54-57.

[16]. Jay A. Labinger, "Science as Culture: A View from the Petri Dish," *Social Studies of Science* 25 (1995): 285-306; and following articles.

[17]. Allen J. Bard, "The Antiscience Cancer," *Chemical & Engineering News* (April 22, 1996): 5.

[18]. Gross and Levitt, *Higher Superstition*, 43-44.

[19]. Philip Kitcher, *The Advancement of Science: Science Without Legend, Objectivity Without Illusions* (Oxford: Oxford University Press, 1993), 162.

[20]. Susan Haack, "Towards a Sober Sociology of Science," in Gross *et al.*, *The Flight from Science and Reason*, 259-265.

[21]. H. M. Collins, "'Son of Seven Sexes: The Social Destruction of a Physical Phenomenon," *Social Studies of Science*, 11 (1981): 33-62.

[22]. Haack, "Towards a Sober Sociology of Science," 261.

[23]. There is a rule to this effect, known as Sturgeon's Law. When challenged that 90% of science fiction is crap, SF author Theodore Sturgeon freely agreed, but countered that 90% of *anything* is crap. I cite this not in support of the magnitude he proposed, but simply as a reminder that judging a whole by a few of its more egregious parts can be highly misleading.

[24]. Dudley R. Herschbach, "Imaginary Gardens with Real Toads," in Gross *et al.*, *The Flight from Science and Reason*, 11-30.

[25]. Theodore Schick, from a paper given at a conference titled "Science in the Age of (Mis)Information" sponsored by the Committee for the Scientific Investigation of Claims of the Paranormal, as reported in the *New York Times*, July 7, 1996.

[26]. See, for example, Dorothy Nelkin, "The Science Wars: Response to a Marriage Failed," in Ross, *Science Wars*, 114-122.

[27]. Derek da Solla Price, *Little Science, Big Science...and Beyond* (New York: Columbia University Press, 1963). See also David L. Goodstein, "Scientific Elites

and Scientific Illiterates," *Engineering & Science*, 56 (Spring 1993): 23-31; John Ziman, *Prometheus Bound: Science in a Dynamic Steady State* (Cambridge: Cambridge University Press, 1994); Rodney W. Nichols, "Federal Science Policy and Universities: Consequences of Success," in Cole *et al.*, *The Research University in a Time of Discontent*, 271-298.

[28]. Data from Metzger, "The Academic Profession in the United States," 124.

[29]. Stephen R. Graubard, "The Research University: Notes toward a New History," in Cole *et al.*, *The Research University in a Time of Discontent*, 361.

[30]. Alan D. Sokal, posted on an e-mail discussion list, Dec. 12, 1996. A similar view is suggested in John R. Searle, "Rationality and Realism, What Is at Stake?" in Cole *et al.*, *The Research University in a Time of Discontent*, 55-83.

[31]. Paul R. Gross, Letter to the Editor, *Chronicle of Higher Education* (October 20, 1995): B3.

[32]. *Nature* 387 (May 22, 1997): 331-335.

[33]. Andrew Lawlor, "Support for Science Stays Strong," *Science* 272 (May 31, 1996): 1256.

[34]. David Berreby, "...that damned elusive Bruno Latour," *Lingua Franca* (September/October 1994): 24

[35]. Liz McMillen, "The Science Wars Flare at the Institute for Advanced Study," *Chronicle of Higher Education* (may 16, 1997), A13.

[36]. Mario Bunge, "In Praise of Intolerance to Charlatanism in Academia," in Gross *et al.*, *The Flight from Science and Reason*, 96-115.

[37]. Barry R. Gross, "Flights of Fancy: Science, Reason, and Common Sense," in Gross *et al.*, *The Flight from Science and Reason*, 79-86.

[38]. Gross and Levitt, *Higher Superstition*, 242-243.

[39]. One might counter with a diploma form suggested by a scientist in 1955: "The Johns Hopkins University certifies that John Wentworth Doe does *not* know anything but Biochemistry. Please pay no attention to any pronouncement he may make on any other subject, particularly when he joins with others of his kind to save the world from something or other. However, he worked hard for this degree and is potentially a most valuable citizen. Please treat him kindly." (Cited in John C. Burnham, *How Superstition Won and Science Lost* (New Brunswick, N.J.: Rutgers University Press, 1987), 251.) Presumably the truth lies somewhere in between?

[40]. On the other hand, it might be noted — admittedly rather cynically — that as scientists find it increasingly difficult to obtain full funding for that mainstream research, the possibility of engaging in some (relatively inexpensive) part-time work at the borders of science may start to look more attractive.

[41]. Steve Fuller, *Philosophy, Rhetoric and the End of Knowledge* (Madison, WI: University of Wisconsin Press, 1993), 311.

[42]. Bruno Latour, Letter to the Editor, *The Sciences* (March/April 1995): 6-7

[43]. Herschbach, "Imaginary Gardens with Real Toads," 15.

[44]. A reviewer wondered whether the increasing numbers of women and minorities who become practicing scientists might make a difference, since their viewpoints play prominent roles in critiques of science. Again there is little hard data, but my impression is that the (lack of) awareness of science studies is essentially the same among these groups as for scientists in general.

[45]. Kitcher, *The Advancement of Science*, 3-10.

[46]. Herschbach, "Imaginary Gardens with Real Toads," 17.

[47]. Concern for the public image of science does not necessarily imply respect for those who try to do something about it, as Gould pointed out in his eulogy for

the late Carl Sagan: Stephen Jay Gould, "Bright Star Among Billions," *Science* 275 (1997): 599.

[48]. James Woodward and David Goodstein, "Conduct, Misconduct and the Structure of Science," *American Scientist* 84 (September-October 1996): 479-490.

[49]. A similar argument was offered in a recent editorial in *Nature*: "Science Wars and the Need for Respect and Rigour," *Nature* 385 (1997): 373. See also Henry H. Bauer, *Scientific Literacy and the Myth of the Scientific Method* (Urbana, IL: University of Illinois Press, 1992).