Before science and technology studies can play more important roles in the research agendas for science communication, science and engineering education, and science and technology policy, the field must first restore its credibility among scientists, address its internal fragmentation, and reestablish its relevance to public affairs. Accomplishing these goals will require the reassessment of tools and approaches that the field has already developed, as well as an open appraisal of where the field has fallen short in the past.

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**Coming of Age in Science and Technology Studies**

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*Universities*—secular inheritors of monastic traditions of scholarship—are by history and ethos conservative institutions. Research and teaching are organized according to disciplinary divisions that are proverbially entrenched and hard to cross. Established areas of study do not lightly welcome new disciplines, or their practitioners, into the fold. When intruders do appear on the horizon, the attempt to fit them within existing demarcation lines and resource allocations often gives rise to bitter turf battles and prolonged states of siege.

As the head since 1991 of Cornell University’s successful, but still youthful, Department of Science and Technology Studies (S&TS), I have frequently participated in the skirmishes—local, national, and even international—that have accompanied the efforts to institutionalize my particular field of study in contemporary higher education. Despite occasional setbacks

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and disappointments, these struggles have only confirmed my judgment that
S&TS has critically important roles to play in science communication, science and engineering education, and science and technology policy. To
claim our legitimate place in academic and public life, however, we cannot
simply unfurl the disciplinary banner of S&TS and expect to quell all
opposition. Three important challenges stand in the way: to repair the field’s
uncertain credibility among scientists, to overcome its tendencies toward
internal fragmentation, and to reestablish its relevance to public affairs. All
three goals can be achieved in principle, but they will all require sustained
intellectual commitment and thoughtful ambassadorship.

For those unfamiliar with science and technology studies as an academic
field, a brief review of its U.S. origins may be in order. History of science,
later joined by the history of technology, gained a foothold in American
universities in the aftermath of World War II, but outside a small school of
sociological research, relatively little attention was paid to contemporary
social studies of science and technology (S&T) until the 1960s. That era’s
heady mix of student protest, race and gender politics, and emerging envi-
ronmental consciousness provided the impetus for a critical exploration of
the societal impacts of science and technology. Leading U.S. universities—
including Harvard, MIT, Stanford, and Cornell—formed programs to study
such controversial issues as airport and highway construction, pesticide use,
chemical weapons, genetic engineering, and nuclear power. Successful at
their inception, many of these “science, technology, and society” (STS)
programs ran out of steam by the late 1980s, having failed to meet the tests
of rigor, appeal, relevance, and coherence required for long-term academic
survival. But the ideas and problems that gave rise to STS remained in
circulation, and the systematic analysis of S&T proved much too important
to be relegated to the trash heap of forgotten academic experiments. The
notion that S&T could systematically be studied as social institutions gained
ground again in the 1990s, helped along by imaginative funding policies at
the U.S. National Science Foundation (NSF) and by infusions of new theo-
retical ideas, both imported and homegrown.

From my vantage point at Cornell, I am persuaded that “science and
technology studies” is indeed going through a kind of renaissance as an
academic discipline, but its integration into higher education is far from
complete. S&TS is regaining some of the visibility and vitality that older STS
programs enjoyed in the 1960s. At the same time, the field has risen enor-
mously in intellectual power and prestige (Jasanoff et al. 1995). At Cornell,
student interest in S&TS offerings is higher now than it has been in twenty
years. Undergraduates are flocking to courses in such subjects as science
policy, bioethics, gender and science, social construction of technology, and
tenth-century S&T. Increasing numbers are looking toward careers that will demand both technical skills and the ability to participate intelligently in social, political, or legal decisionmaking. S&TS is seen by many as a happy realization of the modern liberal arts ideal: a field that enables one to become conversant with multiple analytic frameworks, professional discourses, and approaches to dealing with complexity. There is also a developing market in the policy world for the insights generated by S&TS work. Among knowledgeable science advisers, risk analysts, international agencies, and industrial managers, there is a great deal of sympathy for a field that seeks to embrace rather than ignore the heterogeneity of human experiences with science and technology.

These successes, however, have entailed some substantial costs that we cannot afford to sweep under the carpet. Chief among these is a loss of connection with the scientific and engineering communities whose activities, both contemporary and historical, have provided the central subject matter for members of our field. Gone are the days when distinguished scientists with an interest in social policy could settle, almost for the asking, into a second career in STS. Gone, too, is the sense of easy communion between academic S&TS research and the practicalities of public policymaking. With growing professionalism, S&TS scholars have understandably raised the entry barriers against amateurish or superficial commentary on science and technology. Conversation between scholars and practitioners has grown correspondingly more difficult. As S&TS has matured, scientists and other professionals have begun to feel excluded, even patronized, by a disciplinary discourse that strikes them as unnecessarily opaque and distant from their lived experience. Some view the emergence of a newly empowered social study of science with deep misgiving—as part of a wider cultural struggle against reason, progress, and modernity (Gross and Levitt 1994; Gross, Levitt, and Lewis 1996; Holton 1993).

A backlash was perhaps inevitable. In the recent controversy labeled “science wars,” some scientists have challenged the proposition that S&TS research is capable of making authoritative representations of science and technology. A few have dedicated themselves, with mixed success, to trying to recapture scientists’ monopoly on speaking for science. It should be sobering for people in the field of S&TS that Alan Sokal, the physicist who planted a debunking article about critical theory in the journal Social Text, won by that single act greater (if more fleeting) name recognition than most leaders of our field have achieved in lifetimes of active scholarship (Hilgartner 1997; Sokal 1996). A recent quick check of Web sites on the Internet revealed no fewer than 1,073 “hits” on the name “Alan Sokal” as compared with 100-300 for many central figures in S&TS.
One could dismiss Sokal himself as just a passing phenomenon, but his prank has been accompanied by other events, great and small, that should persuade S&TS scholars to take the communications gap between science and S&TS more seriously. Laudatory references to Sokal’s hoax still crop up in the elite and popular press. These are not the only warning signs. In the past year or two, there have been numerous attacks on S&TS as a dangerously relativist social movement. More worrying from the standpoint of free inquiry, journalists have been dismissed for supposed hostility to science, and academic positions have been denied to S&TS scholars for their alleged postmodernist or constructivist leanings. “Antiscience” and “constructivist” have become exclusionary labels within academia, operating altogether too much like the hateful designations “communist” and “socialist” of an earlier era. S&TS in Europe has thus far been spared some of America’s worst excesses, but if the backlash persists here, then that calm may prove illusory.

To rebuild the connections between S&TS and its potential audiences and allies, we will first have to rediscover how to talk to practitioners of science, engineering, and medicine in ways that are seen as enlightening and fruitful rather than dismissive or demeaning. We will have to learn, as well, how to communicate better among ourselves, so as to consolidate and make explicit the advances made by S&TS across its varied subdisciplines. In a globalizing world, we must find the right languages for knitting together divergent national traditions of scholarship in S&TS. Last but not least, we must try to reconnect S&TS research with the broader intellectual and social currents of our time. There are major tasks of intellectual diplomacy ahead. Where should we begin?

S&TS scholarship needs, first and foremost, to shed the reductionist label of “deconstruction” that has been pinned on it by some of the field’s most vocal critics. Deconstruction—the analytic process by which scientific claims and technological systems are pulled apart into their material, social, and rhetorical components—has proved to be an enormously useful and powerful methodological approach within S&TS. But the concept has also acquired negative connotations that are proving detrimental to communication about our field. People who casually come upon S&TS from other disciplines are often troubled, or even turned off, by the idea of deconstruction. For many, the word carries the stamp of nihilism, a denial of the many liberating and humanistic achievements of science and technology. Others associate deconstruction with an abstruse literary theory that has little or no bearing on the concrete manifestations of S&TS.

To be sure, deconstruction as practiced by S&TS researchers is anything but a denial of reality. On the contrary, it represents one of the most serious attempts to comprehend the nature of reality currently under way in any
academic field. By refusing to take reality for granted, S&TS work helps to unmask the diversity of elements that together make up our sense of what is objective, real, and reliable. Skeptical questions about how something comes to be seen as "real" lead in the end to more complete ways of accounting for the constituents of reality. Far from being nihilistic, the bulk of S&TS scholarship is preoccupied with the durability of ideas and things. The word deconstruction only imperfectly captures this basic commitment. Construction, not deconstruction, is at the heart of the S&TS enterprise. Making sense of the way technological societies construct their ways of life is the primary objective of our field.

Put in this positive light, constructivism becomes quite simply the study of how complex systems or entities are put together out of the most heterogeneous construction materials available to human societies. Some of the most compelling work in contemporary S&TS has centered on the ways in which scientific knowledge, technological artifacts, and social order are held together through complex interconnections and negotiated settlements. Our field has developed a variety of ways of speaking about these connections, using terms such as heterogeneous engineering, actor-network theory (Bijker, Hughes, and Pinch 1987), cyborgs and hybrids (Haraway 1991), mutual shaping, and co-production. Fortunately for the health of the field, no single theory or school of thought dominates the others. Yet, there are some strong commonalities among the different subfields of S&TS, and stressing these should become a matter of the highest priority.

Social theorists have long noted the tendency of marginal groups to splinter into yet smaller ideological enclaves, and so to disappear from the fields of effective thought and action. S&TS now stands at the crossroads in this respect. We can choose the route of factionalism, under charismatic but fractured leadership. Alternatively—and this is my preference—we can undertake the hard work of theoretical integration and capitalize on the salient insights that have emerged from all the diverse corners of our field.

Across topics as diverse as scientific change, controversies, laboratory practices, testing and safety, science and gender, public understanding of science, and the social regulation of new technologies, S&TS research has illuminated how social and cultural assumptions get incorporated into images of the way the world works, as well as the technologies that build upon these images. Matters of fact about the physical world are thus shown to be significant social achievements, which may vary from one historical or cultural setting to another. Even supposedly inanimate artifacts—such as a space telescope, guided missile, or genetic testing kit—incorporate social beliefs and commitments, such as judgments about what is fair, objective, natural, or credible. Both facts and artifacts, then, can usefully be seen as
stable conglomerates of heterogeneous components, ranging from tools, implements, and hardware to cultural norms of legal and political accountability.

S&TS scholarship at its best offers not only new ways of grasping how features of S&T are constructed but also new insights into culture and society. Comparative research over the past two decades has shown that many of our ways of dealing with nature and technology are culturally embedded and place-specific. Repeatedly, when we might have expected uniformity in people’s responses to S&T, we have found difference. So, for example, national regulatory systems have come to different results when trying to estimate the risk of cancer from dioxin, the contribution of greenhouse gases to global warming, the risks of releasing genetically engineered organisms into the environment, or the sustainability of fishing and harvesting practices. People trained in rational modes of thought seem nonetheless to perceive the “same” technological risks (and benefits) differently from different cultural standpoints. Biotechnology, for example, has drawn divergent public and policy responses in Germany, France, Denmark, and the United States. New medical technologies, such as prenatal testing, are not equally accepted in every society. Their reception varies with gender, ethnicity, race, class, and economic status. Alternative medicine, similarly, enjoys a greater vogue in some technologically advanced societies than others. These systematic variations cannot be heedlessly shoehorned into the convenient explanatory frameworks of “irrationality,” “scientific illiteracy,” or “public misunderstanding of science.” Rather, by exploring deep-seated differences in public responses to science and technology, we can hope to gain more fruitful ways of understanding how culture permeates the construction of technological societies.

The metaphor of construction allows us to see, as well, how S&TS scholarship can productively reengage with the concerns of public policy. By shedding light on the constructed character of science and technology, S&TS offers more creative ways for people to change those things that they find most constraining, hazardous, or ineffectual. Policy analysis has been hampered in the past by taking the boundaries between the scientific, the social, and the technological worlds as given and unbridgeable. This has led to unacceptable narrowing in both the framing and solution of perceived problems. For example, mismatches occur when technology-based solutions are applied unthinkingly to complex sociotechnical problems: contraceptive technologies for fighting overpopulation; genetically engineered crops for dealing with hunger; computers in the classroom to compensate for poor teacher-student ratios; and “safer” chemicals to replace those shown to harm
birds, fish, or stratospheric ozone. "Technological fixes" like these fail if they are dropped into incompletely understood social contexts. Constructivist research can improve policy analysis by presenting more nuanced accounts of the connections between science, technology, and society. The complementarity of technology and society can then be factored into policy design.

In a time of growing interaction among cultures of all kinds—economic, social, and political—this aspect of S&TS research promises to be especially valuable. We have learned through cross-cultural studies of scientific and technological change that there are substantial differences in the methods by which people distinguish between acceptable and unacceptable technological developments. For example, some decisionmaking cultures insist on a rigid separation of science from politics, whereas others believe that good decisions require a blending of values and expert knowledge. Quantitative analysis is more favored as a decisionmaking technique in some countries than in others. In some policy systems, decisions are required to be transparent, and policymakers must provide explicit explanations for their decisions; in others, decisionmakers have to meet tacit standards of virtue and reasonableness, but they need not publicly explain their reasons for arriving at particular decisions. In some cultures, technological controversies are resolved by preference through litigation, whereas in others lawsuits are seen as a sign of social breakdown that should be avoided at all costs. In identifying these broad normative patterns, constructivist S&TS research extends and deepens our understanding of basic human preferences concerning technological development.

To recapitulate, then, as we look toward the prospects for S&TS in the next century, we should strive to reject the negative labels that others have tried to fix on our distinctive approaches to understanding science, technology, and society. S&TS research is not at all interested, as some have suggested, in the denial of truth and reality. Quite the contrary, our field is dedicated to the construction of more comprehensive and socially grounded accounts of scientific truth and material reality than are currently afforded by most other academic disciplines. This is the strong and positive sense in which S&TS scholarship may quite accurately be called "constructivist." We should emphasize as well, both within S&TS and in our wider intellectual relations, the common themes that help to unite our field. Work in S&TS questions and is skeptical of prior assumptions, but it also pieces things together constructively, combining heterogeneous elements into more informative pictures of complex systems and activities. Policymakers who wish to make wise decisions about science and technology should learn to take our pictures seriously, just as we S&TS scholars should learn how to represent
our work more effectively to audiences outside the field. If this effort succeeds, then S&TS will indeed have much to offer to scientists, academics, governments—and, not least, our fellow citizens—in the coming century.

References


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