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Introduction

[T]he sciences are confined to certain and prescribed authors…imposed upon the old and instilled into the young so that now...authority is taken for truth, not truth for authority.

--Francis Bacon (1620)

[T]he bitterest clashes [between rival types of knowledge] have been concerned with the precise line which marks the frontier between their territories. Those who have made large claims for non-scientific knowledge have been accused by their adversaries of irrationalism and obscurantism, of the deliberate rejection, in favor of the emotions or blind prejudice, of reliable public standards of ascertainable truth; and have, in their turn, charged their opponents, the ambitious champions of science, with making absurd claims, promising the impossible, issuing false prospectuses, undertaking to explain history or the arts or the states of the individual soul (and to change them too) when quite plainly they do not begin to understand what they are… because they will not, being vain and headstrong, admit that too many factors in too many situations are always unknown, and not discoverable by the methods of natural science.

-- Isaiah Berlin (1953)

Considered more closely, it is evident that today's 'science wars' were begun by self-anointed paladins of science with the purpose of preventing just that merger, well under way, of the two cultures. Their crusade is directed against a dangerous heresy recently emanating from various fields of humanistic scholarship: denial that there is any rigorous distinction between allegedly objective fact and admittedly subjective value, with the claimed consequence that there is no inherent epistemic disjunction between the natural sciences on the one side and the humanities and social sciences on the other.

--Paul Forman (1999)

The purpose of this thesis is to compare the science wars of the 1990s with the two-culture debate of the 1960s. It is a work in the history of intellectual debates, focusing on contested concepts of science. Over the past decade, there have been numerous references made in science wars literature that evoke comparisons to the two-

culture controversy.[1] I intend to show that while these comparisons have merit for their popular cultural reference, they are not valid when we consider the structures of the two debates. Thus, I will compare those structures, summarizing the main points of argument between the relevant actors in each instance, to illustrate the differences. The thesis advanced by C.P. Snow in 1959, and responded to most pointedly by F.R. Leavis in 1962, was predicated on the existence of foundational differences between science and humanities (Snow 1959/1993; Leavis 1962/1972). The broader issues then were what validity a distinction between forms of knowledge had and which domain had the more reliable claim to knowledge. Just as the two-culture controversy called into question the credibility of literary knowledge, the credibility of science studies scholarship was ultimately at stake in the science wars, and is of central concern in this thesis. My contention is that recognizing the differences between the two-culture debate and the science wars can help guide the future of science studies, since those differences demonstrate the importance and validity of STS scholarship. When scholars ignore those differences, and presume that the two debates are comparable, they unintentionally give credibility to those who defend science against perceived assaults by STS scholars.

In this thesis, I will show that Snow's articulation of the two cultures rested on a particular view of science that has been analyzed and superseded by science studies scholarship. The enterprise of studying science has changed the concept of Snow's intellectual divide by reevaluating what science is and how it works, and by reconsidering the very premise of two sorts of intellectual inquiry. Thus, issues brought to the fore by science wars arguments must be understood in a context quite different from that of Snow and Leavis, and comparisons between the debates must be tempered with a fuller understanding of how science is conceptualized.

The title of the thesis, *Uniquely Structured?*, is meant to be ambiguous, indicating two things at once. First, there is the question of whether or not the two *debates* are uniquely structured. If they are, then comparisons between them are subsequently

[1] Barber (1998) *passim*; Bauer (2000) 53; Burnett (1999) 195, 207; Collins (1995) 306; Collins and Labinger (2001) Preface; Collins and Pinch (1998) 151; de Laet (1997); Dickson (1997) 333; Finneran (1998); Forman (1999); Franklin (1996) 151-167; Fuller (1995a) 117; Fuller (1995b) 21; Fuller (1996) *passim*; Fuller (2000) 180-190; Hakken (1995) 319; Hultberg (1997) *passim*; Koertge (1998) acknowledgements; Latour (1999) 17; Lynch (2001) 4-3 and 29-1; MacIlwain (1997) 331; Pinch (2001)

unremarkable. If they are not, then the specific forms of comparison need to be explicated. Considering the range of descriptive possibilities available in any debate, a variety of aspects—such as rhetorical, conceptual, epistemological, and practical factors—contribute to the examination of this question. I will address each of these factors; however, I will emphasize the conceptualizations of science that the opposing sides of each controversy brought into their debates.

This leads to the second interpretation of the title: whether or not *science* itself is uniquely structured. This notion illustrates the difference between the debates. Science in the two-culture controversy was conceptualized as a unique, morally superior, objective epistemology, best suited to guide the welfare of society. Science resided at the peak of a hierarchical structure of knowledge, whereby reliable evidence led to a "better future," as Snow put it. Leavis opposed this view in his placement of the literary humanities atop that knowledge pyramid. He did not propose equal footing for both cultures, but demanded that the moral purpose Snow saw with science was better fulfilled by the humanities. However, in the science wars, it was the very concept of science that was the topic of debate. Since Snow's day, science studies scholarship has come to conceptualize science as a contextualized, bounded knowledge-producer. This boundary model leads to many interpretations of how science is related to other forms of knowledge. Among them, the idea that science is culturally contiguous with, for example, the literary humanities, holds pride of place. If science is a culturally bounded social practice, then it can be conceptualized as deriving from one larger cultural foundation. Science and the humanities, in that case, both derive from the same source, and both can be described in a similar fashion. The boundary concept of science at issue in the science wars differs significantly from the hegemonic concept invoked in the two-culture debate and accounts significantly for the difference between the debates.

The question of whether or not science is uniquely structured carries with it implications for how the public will grant it authority and credibility. Therefore, we see that in the science wars, the grounds for debate were structured with the opposing views of "science as unique and superior" (what I call the *science-as-different* argument) and

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[1997 lecture at Duke entitled, "Reconfiguring the Two Cultures"] 2-1 and 2-7; Rorty (2000) 23; Segerstråle (2000) *passim*; Winner (1996) 102.

"science as just another way to know the world" (what I call the *science-as-same* argument). Those who decried the works of science studies were opposing not the entire academic field, but the scholarship that took science to be on an equal cultural footing with other forms of knowledge. Likewise, those who counter the accusations of the likes of Gross, Levitt, and Sokal are opposing the *a priori* supposition that science is a unique and superior cultural enterprise. Discussions of the science wars have often relied on debating the merits of constructivism, the accusation that science studiers are anti-science, and the political alliances of the participants. While each of these has a place in an analysis of the debate, none has the explanatory power to define it. Recognizing the basic opposition of belief in the uniqueness of science versus belief that science is culturally contiguous with other knowledge-producers offers the most thorough explanation of the science wars.

Steve Fuller most closely intimates my project in his review of *Higher Superstition*, stating that "the one didactic advantage afforded by [Gross's and Levitt's] monolithic portrayal of the natural sciences is that it licenses us to revisit the 'Two Cultures' controversy that C.P. Snow sparked….How much has changed in the interval?" (Fuller 1995, 117).[2] Although Fuller speaks briefly of political changes, he says nothing about how the two-culture construct has changed. We are left to wonder *how* and *why* the science wars license "us to revisit the 'Two Cultures' controversy"? How much of *what* has changed?

I have already referred to one significant aspect of this change: the move from a positivist view of science to science as a boundary concept. The complete details of that transformation, however, are far beyond the scope of this thesis, as they entail the disciplinary exegesis of probably a half dozen sub-disciplines in science studies. Instead of tracing this development across forty years, I will focus on the structure of the two debates themselves. I will contextualize the position of each member of the debate—Snow, Leavis, the science defenders, and the science studiers—paying particular attention to how the idea of science was employed by each in a sort of two-point analysis.

This last point about members of the debates, with respect to the science wars, requires a brief caveat on nomenclature, since the idea that the "wars" were fought

[2] Among science studiers, Fuller refers to the two cultures the most: see note 1.

between science defenders and science studiers will be explained in the chapters that follow. Taxonomy is a problem and a key feature of the discussion that follows, because not all "science studiers" were the target, and the name "science defender" is not adequately descriptive by itself. I should stress at the beginning of this thesis, then, that the term "science studiers," as I am using it, does not refer to the entirety of the field of scholars who study science. It is a sub-category of the far broader and more heterogeneous group of academics who research the history, philosophy, policy, and sociology of science, technology, and medicine. There is no one sufficient label that fully categorizes such a broadly defined field. Thus, throughout the thesis—and more prominently in the second and third chapters—my use of the term "science studiers" should be interpreted as shorthand for "those scholars who both study science and found themselves on the defensive against published attacks from defenders of science." Likewise, when referring to "science defenders" I mean "those scholars who published critical commentaries on the projects they called science studies," and not the broader, more diffuse assemblage of scholars who perform scientific research. In fact, it should become apparent by my third chapter that part of this thesis is intended to show the limitations of such labels.

In the first chapter, I detail the Snow-Leavis debate that followed Snow's two-culture lecture at Cambridge in 1959. Snow advanced his thesis for the purpose of announcing the widening gap between two cultures of contemporary British society, that of the literary intellectuals and that of the natural scientists. The circumstances that led him to articulate the problem, as he saw it, were the twin needs of fostering communication (*intra*-nationally, *inter*-nationally, and across disciplines) and improving the British educational system to promote science more heavily. Snow had been a scientist in the early 1930s, working on infrared spectroscopy at the Cavendish laboratory, but by 1935 had written two novels and moved away from his scientific research (Brand 1988). He thus felt well-positioned to make such a pronouncement.

What interests me in the first chapter is not only that Snow perceived a divide between two cultures—because that observation had been made for generations—but that

his observation was founded on the particular circumstances of British educational standards and references to science and humanities in the first half of the century. Therefore, after introducing the positions of Snow and Leavis, the chapter continues with two sections on the British views of science that fostered Snow's concept. The first of these is particularly important to the thesis as a whole, because it speaks to the early days of the history of science, and the moralizing purpose that discipline was founded to provide. Following World War I and in reaction to the perception of high German culture, the history of science in Britain was founded to provide a bridge between the two cultures, invigorating the materialist sciences with the moral stature of the humanities. These were the years of Snow's youth and education, and surely debates about the merits of science and its potential role in society pervaded British culture. The second section provides some background to the polarity between science and the humanities, with specific reference to the Cambridge History of Science Committee of 1936—a committee with which Snow was familiar. I will show that the divide invoked by Snow in the 1950s was grounded in the 1930s.

In the third section, the growth of the two-culture idea from a thesis to a debate becomes manifest when Leavis protests on several levels that Snow's construct is both ill-informed and dangerous to traditional ideas of education. I portray the structure of the debate as a disagreement between two monists, one demanding that science is the promise of the future, the other arguing that the literary humanities would stave off the repercussions of a technological society. For Snow, science was the moral choice of social responsibility. For Leavis, the intellectual, spiritual, and cultural needs of society could only be met by a deep study of, in Matthew Arnold's words, "the best that has been thought and said"—that is, the humanities (Arnold 1882/1903, 326).

In the second chapter, we move to the structure of the science wars. The chapter proceeds in a fashion somewhat parallel to the first chapter, although, by way of foreshadowing to the final chapter, some of the science wars debate cannot be structured in the same way as the two-culture controversy. I provide two analyses in the chapter, one contextual, the other structural. Thus, in the first half I develop a plot of the science wars, from exposition to dénouement. In each of these phases, I explain how the trajectory of the debate owed much to events that took place before the official science

wars began, but, as I explain in the second half of the chapter, an overarching structure of uniqueness versus contiguity was consistent throughout. By uniqueness versus contiguity, I mean those who argue that science is a unique and superior knowledge-producer versus those who maintain that science is culturally contiguous with other knowledge-producing enterprises, and is one among many ways to know the world. That is, in the science wars debate, the science defenders argue for *science-as-different* whereas the science studiers maintain a position of *science-as-same*.

Because the science wars were complex, it is difficult to identify key actors. Rather than an argument between two people, the debate was a more fundamental disagreement between two ways of conceptualizing science. Therefore, the onus will be, first, on prominent works that contributed to the science wars and, second, on the specific authors of those works. Presenting the debate this way explains why I reference some scholars often, such as Gerald Holton, Paul Gross, and Norman Levitt, even though the debate was not simply a disagreement between Gross and Levitt on the one side and Barnes, Bloor, Latour, or Harding on the other. Instead, I use two works, Gross and Levitt's *Higher Superstition* and Andrew Ross's edited volume *Science Wars*, to exemplify the differences (Gross and Levitt 1994/1998; Ross, ed., 1996).

Since the science wars were a more complex debate, I separate out which aspects of the debate have more explanatory power and which are subsidiary to those primary concerns. For example, among the numerous terms used in the debate, expressions such as methodological relativism, social constructivism, asymmetrical argumentation, anti-scientific rhetoric, epistemological hegemony, and political affiliation were common. While some of these terms were subordinate to the science warriors' broader concerns for authority and credibility, others were too intimately related with one another to be extracted as a single thread. The participants in the debate defined those terms based on how they conceptualized science, so that where authority was granted by hegemony, cultural contiguity was opposed to a hierarchical conception of science. In addition, the warriors invoked symmetry differently, depending on how each felt about hegemony and contiguity.

A main point of the second chapter is to show that there is a definite trajectory in the debate, and that sincere overtures towards resolution have occurred. Resolution, I

should stress, does not mean reconciliation between the two parties. Rather, it indicates that each side has had its say, and that scholars are referring to the debate as an event in the past. Contributing to the complexity of the debate, though, was a two-fold path of discussion that entailed a main line of debate between science defenders and science studiers, while a parallel line of debate sought to reflexively comment on the main line. The reflexive, meta-commentary analysis of the science wars began almost concurrently with the main path of debate, and sought throughout to establish resolution between the sides. By invoking this dual-characterization, I retain the trajectory of the plot from exposition to dénouement while admitting that attempts at resolution had accompanied the debate all along. Two works of the past year, *Beyond the Science Wars* and *The One Culture?*, serve to exemplify this final resolution phase (Segerstråle, ed., 2000; Collins and Labinger, eds., forthcoming 2001).

In the third chapter, I conclude that the science wars debate was not a homological recurrence of the two-culture debate, and to conceive it as such would be to deny the validity of science studies. The two-culture debate was predicated on the divide between science and the humanities, whereas the science wars debate was based on whether or not such a divide exists. With Snow and Leavis, we see a traditional argument about morality being played out by contrasting each epistemology with either responsibility or progress. That is, Snow argued that to deny science its role as a knowledge-producing leader is to be socially irresponsible, since progressive, cumulative, positivist science is rightly placed atop a hierarchical knowledge pyramid. Leavis argued that to allow progress to mean material progress provided by techno-scientific authority denied the humanities its educational responsibility of providing spiritual sustenance to society.

With the science wars, we see the science defenders calling for identification of a different kind of two-culture divide, such that science studiers, by being placed in opposition to the natural sciences, are necessarily excluded from having the authority to critique them. Since the defenders maintain a hegemonic concept of science, claims of irrationalism are conflated with charges of anti-scientificity, and science studies is denounced for positing that science is just another way to know the world. The science studiers, variegated as they are, use their boundary concept of science as a foundation for

studying the enterprise of science. They argue that the two-culture distinction is no longer valid as a presupposition for research. This position does not deny the differences between intellectual cultures, but does deny that the cultural field is bifurcated between science and non-science. Intellectual cultures are innumerable when the demarcation between them is no longer simply a negation; that is, for example, when the humanities are not just the opposite of the sciences. The concern over intellectual cultures has been, and remains, *who* has the credibility to say *what* about the world we live in.

CHAPTER 1: *THE TWO CULTURES*

In 1959, Charles Percy Snow gave the annual Rede Lecture at Cambridge University on "The Two Cultures and the Scientific Revolution." His thesis was that there existed a widening gap between the two cultures of contemporary British society, that of the literary intellectuals and that of the natural scientists. The circumstances that led him to articulate the problem were the twin needs of fostering communication (*intra*-nationally, *inter*-nationally, and across disciplines) and improving the British educational system to promote the natural sciences. Snow had been a scientist in the early 1930s, researching infrared spectroscopy at the Cavendish Laboratory. However, an interest in writing fiction emerged, and by 1935 he had written two novels and abandoned his scientific research. During World War II, he excelled in a British Civil Service post, recruiting scientists to help the Allied effort. After the war, Snow accepted a position with the Civil Service Commission, continued writing novels, and expanded his influence with advisory roles in private industry. By 1959, when he was asked to deliver the prestigious Rede Lecture, Snow had resigned his formal posts due to the success of his novels, and thereafter devoted his time to writing and lecturing (Collini 1993, xxi).

The two-culture lecture was Snow's first as a public figure, and by far his most famous. It is an event that has been widely discussed since then and taken as a focal point for articulating the separation of scientific from other forms of knowledge. The gap between literary intellectuals and natural scientists was purportedly widening. One point stands out: Snow was concerned about the practitioners of science and literature, the scientists and literary humanists. He began with individuals and generalized to the cultures of those practitioners. As he continued his lecture, then, he moved from the level of the practitioner to the field. When he spoke that day in 1959, Snow engaged the audience with a deliberate speech about the people he had encountered in his professional life. His plea was not an arcane philosophical argument, nor did it attempt to cull sociological, empirical evidence to support his claims. He provided no more than anecdotal evidence and personal recollections to assert his position. In the role of public intellectual, Snow had only to pontificate on his view of the world. The impetus for the lecture, he claimed, was his consideration of the scientific question "Can you describe the

Second Law of Thermodynamics?" He suggested that such a question was "about the scientific equivalent of *Have you read a work of Shakespeare's?*" (Snow 1959/1993, 15). Snow's disappointment that a literary intellectual could not answer the former, while it was likely a scientist could answer the latter, framed the divide.

Debate over the two-culture thesis began almost immediately, with a series of letters and responses in *Encounter*, where the lecture was printed in two parts.[3] Similar replies had followed the original, but shorter, publication of the thesis in the *New Statesman and Nation* in 1956.[4] On both occasions, the letters were cordial, whether they were in support or opposition to Snow's position. However, the first rounds of the debate had little impact on wider audiences until the literary critic F.R. Leavis formally replied in 1962. What we historically call the two-culture debate is often known synonymously as the Snow-Leavis debate.

In this chapter, I will examine the structure of the debate, with specific reference to the concept of science that Snow and his supporters invoked to oppose literary humanities. I will not apply the same rigorous analysis to conceptualizations of the humanities.[5] Observations of a gap between science and non-science have recurred throughout history, as I will show. In each instance, "the humanities" and the "arts" were either conflated or used in inconsistent ways.[6] For ease of terminology, and since Snow used the term, I will refer to the "humanities" in my discussion unless citing a historical contrast of "art" and science.

First, I provide a brief overview of the positions taken in the debate between Snow and Leavis. Second, I contextualize Snow's concept of science by briefly referencing previous debates between science and the humanities. In the inter-war period in Britain, when Snow finished his education, began and ended his scientific career, and launched his literary life, two relevant and interrelated issues stood out. These were the

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[3] See *Encounter* (1959) volumes 12 and 13, where the article appeared in June and July, with letters in response in July, August, and September. In addition to the letters, the August issue contained a special forum devoted to the article. Also, Michael Polanyi wrote a follow-up piece on the theme of "The Two Cultures" in the September issue, focusing more on the relationship of science to culture than between science and the humanities (Polanyi 1959).

[4] See volumes 52 and 53 of *New Statesman and Nation*, a weekly, where the article was published on 6 October 1956, with a total of five printed letters (two in support, one in disagreement, and the other two seeking to add historical perspective to the view) appearing in response over the next few weeks.

[5] This different level of analysis is not meant to downplay the importance of Leavis's position or to suggest that the humanities have not undergone reexaminations as readily as the sciences have. My focus merely reflects the overall point of comparison between concepts of science that I will make in the thesis.

neglect-of-science debates that sought to reform national educational standards for the purpose of reinforcing British morality and early efforts to establish a discipline of the history of science with the goal of moralizing science for a new generation of students. Since the structure of the two-culture debate depends primarily on how science can or cannot achieve the goals Snow believed it could—progress for society, wealth to the poor, international peace—this background is requisite for our understanding of the debate. Third, I address more directly the problems Leavis had with the thesis, using his criticism as a means to frame the structure of the debate. In the final section, I comment on the legacy of the debate.

Snow the scientist, Leavis the literary critic

Snow was motivated by his concern that the natural sciences were not properly emphasized in contemporary British education and that there was poor communication between the culture of science and that of the humanities. He had argued that "the clashing point of two subjects, two disciplines, two cultures…ought to produce creative chances…The chances are there now. But they are, as it were, in a vacuum, because those in the two cultures can't talk to each other" (Snow 1959/1993, 16). Such an assertion was not surprising as debates over the relative merit of science and humanities were longstanding in British culture. What was more contextually specific for Snow was the reverence for the power and authority of science that he had gained before the war while at Cambridge, during the war as a government official, and then after the war as a public official and science popularizer via his novels. Furthermore, there was a heavy strain of economic forecasting running throughout the two-cultures lecture.[7] Snow believed wholeheartedly that more scientific development was the answer to poverty, that the gap between rich and poor would inevitably close "once the trick of getting rich is known" (Snow 1959/1993, 42). That "trick" was a continuing scientific revolution that required three things: machinery (technology), trained scientists and engineers, and an educational program (Snow 1993, 46-48). Snow's belief and idealization of the unbounded promise of science led him to posit that the three menaces of society—atomic

[6] "Art" has been used in these debates to mean either literature, poetry, painting, or a combination thereof.
[7] The title of the fourth part of the lecture is "Rich and Poor".

war, over-population, and the rich-poor gap—were all reconcilable not only in Britain, the U.S. and the U.S.S.R., but also in poor countries.[8]

Leavis argued, to the contrary, that literature was the wellspring of true culture and morality. His was a more individualistic view, concerned with the human spirit and the individual's place in the world. For him, what was most important in the education of British youth was a strong moral foundation derived from literary expression. A standard liberal arts education, as we might say today, would supply the intellectual, spiritual, and cultural basis for the individual in society. A scientific education alone was the very antithesis to such a firm grounding in moral culture. Terms like "culture" and "morality" and "education" were therefore at the root of the disagreement, yet they were not concepts that Snow or Leavis could clearly articulate. The key structural elements of the debate were those of authority and credibility. What was at stake was who had the authority to prescribe how the future would be built. The emphasis placed on those values—authority and credibility—would determine the future of education, culture, and morality in British society.

As Neil Annan, a friend of Snow's and target of Leavis's, described it in 1987, the two-culture debate was one between two monists. Both Snow and Leavis "saw reality as a set of huge blocks that could be comprehended in a single vision" (Annan 1987, 5). Snow believed that the virtues of science were those of a moral society—rational, communal, and fair. "[T]he greatest enrichment the scientific culture could give us is…a moral one" (Snow 1956, 414).[9] Science had demonstrated its credibility in producing knowledge of the world, and thus had the authority to guide the future. Leavis disagreed, taking the opposite view on each point. This mirrored opposition characterized the basic rhetorical structure of the debate. The defining conceptual structure followed from the position of the two monists: the singular view of reality that characterized Snow's position was rooted in a positivist notion of science and opposed to the monistic view of reality proposed by Leavis and the literary establishment.

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[8] He frequently contrasts wealthy nations with poorer regions or specific countries. For example, "India, Africa, South-east Asia, Latin America, the Middle East…" (Snow 1993, 46).

[9] Below, I discuss the original moralizing purpose for the history of science during the inter-war period. It would seem that Snow took this moralizing purpose to heart so much that he forgot that science before his time was thought to be *in need of* moralization, not the reverse, as he suggests in the passage quoted here.

Snow's was a truly optimistic perspective, one that seemed to carry with it either an anachronistic colonialism or a progressive scientific imperialism (or both). To recognize Snow's perspective, though, we must discuss the prevailing views of scientific education in Britain at the time and the philosophy of science that underlay Snow's optimism. These two concepts—first, the role of science in education and second, the idealization of science as progressive and certain—were central to the later representation of a cultural divide. A short history of the burgeoning field of the history of science in the early twentieth century demonstrates that these two concepts were linked for at least several generations before Snow. In fact, the history of science as an academic discipline was formed to address the idea of a cultural gap between science and the humanities in education and as a solvent to eliminate the barriers of that divide. It is to this history that I turn first.

Moralizing science

Conflict between science and humanities—variously construed as a science-art, science-non-science, and science-humanities split—had often turned on issues of education and morality. A famous quarrel between zoologist Thomas Henry Huxley and poet Matthew Arnold took place in the 1880s over those issues, with Huxley espousing the virtues of a scientific background and Arnold forwarding his oft-repeated notion that the criticism of life was best given foundation by a classical liberal, literary education. In an address, "Science and Culture," given at the opening of Sir Josiah Mason's Science College in Birmingham in 1880, Huxley said:

> Mr. Arnold tells us that the meaning of culture is "to know the best that has been thought and said in the world." It is the criticism of life contained in literature. That criticism regards "Europe as being, for intellectual and spiritual purposes, one great confederation, bound to a joint action and working to a common result…." We have here to deal with two distinct propositions [of Arnold's]. The first, that a criticism of life is the essence of culture; the second, that literature contains the materials which suffice for the construction of such criticism. I think we must all assent to the first proposition….But we may agree to this, and yet strongly dissent from the assumption that literature alone is competent to supply this knowledge (Huxley 1880/1968, 142-3).

Here, the divide was the same and was debated in much the same manner as Snow's later formulation. Huxley believed that "…all the subjects of our thoughts…may be classified

under one of two heads—as either within the province of the intellect…or as within the province of feelings…[as] matters of science and matters of art" (Huxley 1882, 175). The context was different and the debaters had grander goals, to be sure, but the structure was similar.

Huxley reacted to the forceful assertion of Arnoldian culture—"the best that has been thought and said"—with the observation that literary humanism's monopoly on culture was no longer tenable by the late nineteenth century. The age of the humanist was the Renaissance, Huxley observed, but in the daily life of the nineteenth-century citizen, natural knowledge, forced to the fore by the physical sciences, influenced the "theory of life" (1880, 142-149). As Huxley put it: "…the pretensions of our modern Humanists to the possession of the monopoly of culture and to the exclusive inheritance of the spirit of antiquity must be abated, if not abandoned" (152).

The context of the Huxley-Arnold debate was the industrial revolution and the Victorian Age of promise and progress. Arnold's view of a liberal education grounded in literature was meant to encompass science, not to excise it. In the 1882 Rede Lecture (the same one, in the same place, that Snow gave 77 years later), Arnold addressed the topic of "Science and Literature" with an eye towards treating both as parts of one system of knowledge. The texts of science could be read and taught just as the texts of literature, he argued (Arnold 1882). On this account Arnold would seem to anticipate the science-as-discourse claims made a century later in fields such as Literature and Science and in methodologies such as discourse analysis. Huxley argued for a concentration on science while Arnold maintained a one-culture perspective. Even though their disagreement was not predicated on an extant science-humanities cultural divide, the spirit of the Huxley-Arnold debate did follow that structure. It is interesting to note that although Arnold's one-culture viewpoint was a common reply to the science proponents, his singular culture was structured with the humanities subsuming science in its project—that is, a hierarchy of knowledge was maintained that kept literature on top (or, in front).[10] Huxley's view of scientific education was geared towards acknowledging the dynamic growth of human knowledge, away from classical training and towards a concentration on natural

[10] Later in this chapter and throughout the present thesis we will see that this one-culture pronouncement recurs with each science-humanities debate. However, the means by which "one culture" is conceived changes when we get to the science wars.

knowledge. Both men sought to reform education. As such, they provide an important link in a chain of British reformists of which Snow was only one part.

Neglect-of-science and the History of Science

Huxley's pronouncements seemed to have been forgotten during the neglect-of-science debates that surrounded World War I concerns over education reform.[11] That debate began when thirty-six British scientists announced that the success of Britain during and after the war depended on "the possession by our leaders and administrators of scientific method and the scientific habit of mind" (Allbutt, et al. 1916, 28). In these discussions, initiated because of national comparisons to Germany in 1916, the concern for reform had its roots in a recurring antithesis between progress and morality (Layton 1978; Turner 1980; Mayer 1997). Anna-Katherina Mayer, an historian of science, has written that this antithesis was expressed in recurring efforts to contrast traditional liberal education with compulsory scientific education (Mayer 1997). She notes that at a meeting between the Councils of the Classical, English, Geographical, Historical, and Modern Language Associations a resolution was passed recommending "that scientific training provided no genuine education, no 'training of human beings in mind and character, as citizens of a free country'" (Mayer 1997, 52). The discussions surrounding the neglect-of-science debate thus fell starkly to the morality side of a progress-morality divide, wherein material progress was defined in opposition to the maintenance of a traditional moral structure. This moral positioning was critical for national identity and for the reassurance of a high British culture based on strength of character in the face of ongoing German destruction. The main point for our discussion, though, is that the science-humanities divide as articulated by Huxley and Arnold in terms of educational philosophy was formalized and enunciated by the neglect-of-science debaters in the 1920s as a matter of practical public policy (see Turner 1980; Gieryn 1999, 37-64).

This dichotomizing of morality and progress was employed by the debaters during World War I to discount the apparent successes of German material culture. While the Germans showed great efficiency and well-admired organization of material

[11] The full text of the memorandum "The Neglect of Science" was printed in *The Times Educational Supplement*, 7 March 1916. It was signed by thirty-six scientists.

resources—these being perceived as scientific areas of superiority—they had failed miserably in the department of moral conduct. For the English, this German moral failure indicated that science could not be the totality of education, and that science must be subordinated to other bases of education or taught only for its moralizing effects. William Temple, future archbishop of Canterbury, had given an address to the British Academy for the Advancement of Science (hereafter BAAS) in 1916, observing that

> The present interest of Englishmen in education is partly due to the fact that they are impressed by German thoroughness…. [However] the war has shown the effectiveness of German education in certain departments of life, but it has shown not only its ineffectiveness, but its grotesque absurdity in regard to other departments of life…which are, even in a political sense, the most important (Temple 1916, 113).

The moralizing effects that science could bring to Britain were predicated on the recognition, as Huxley had observed a few generations earlier, of the influence of the physical sciences and natural knowledge on society. With the example of German techno-scientific efficiency, the British reformers recognized that science was valuable for national security reasons. Thus, one popular solution for reconciling the progress-morality antithesis while continuing the classical literary tradition was to emphasize the moralizing impact of science. To do this, however, as Arnold had contended, required that the sciences be taught within a humanistic framework.[12]

It was into this atmosphere of post-War moral concerns that the protagonists of the history of science of the 1920s promised a historical treatment of science that would single-handedly "disarm…the existing *polarity between the sciences and the arts* [my emphasis]" (Mayer 1997, 53). Thus, the ideal that Snow later espoused, of closing the gap between science and the humanities through educational reform, was already being proposed during and after World War I. The BAAS report of 1917 that was aimed at revising the method and substance of science teaching conceived of the history of science as providing "a solvent to the artificial barriers between literary studies and science" (as quoted in Mayer 1997, 55). This trope was taken up repeatedly in the years to come as proponents of the history of science sought to provide a bridge between the two differing

[12] The complete details of moralizing science in the British 1920s are given in Mayer (1997). My thanks to A.-K. Mayer for her help via personal correspondence.

approaches to education. In the 1920s, at least, humanities scholars were culturally dominant enough to subsume science teaching and to justify their endeavor by arguing for the humanistic, moralizing effects of a humanities-based enterprise. The language of a divide was present, as it had been at least since the mid-nineteenth century, yet its presentation oscillated: that is, Huxley had almost vaulted science education to the fore in the 1880s, but the humanities had proven to be more all-encompassing (Turner 1980). This conception of the humanities as subsuming the sciences was perhaps ironic after World War I, given the fear-of-Germany impetus, since it approached the sense of the German word *Wissenschaften* which encompasses the whole of inquiry into the world, not just the natural sciences. A generation later, Snow would attempt to place science at the forefront again.

Envisioning a polarity

Teaching the history of science to students would perform a moralizing service, rendering science an arm of humanities. The premise of those lessons was that students did not know or did not appreciate that science had a history. There was much talk of favoring a history of civilization that would organically include science by a 1918 Committee led by the eminent scientist J.J. Thomson (Thomson 1918). A decade later, in a 1927 passage, Charles Singer was making the same claims (Singer 1927, x). In his address at the first general meeting of the British Society for the History of Science in 1948, Singer credited Sarton as laying the foundations for the discipline, noting Sarton's own perspective of encompassing the history of science within a wider history of civilization (Singer 1949).[13]

Sarton founded the History of Science Society in 1924 to promote the study of the history of science (Sarton 1924, 4). He also articulated the two-culture problem in 1930, writing that "The most ominous conflict of our time is the difference of opinion between...the so-called humanists, on the one side, and the scientists on the other" (Sarton 1931/1962, 54). The historian Tore Frängsmyr suggests that Sarton's inspiration for the new discipline can be traced to a continental tradition, most notably that of August

[13] Additionally, see Cantor (1997), who provides other British antecedents to the formal history of science in his essay on Singer.

Comte. Sarton *intended* to provide a bridge between the sciences and humanities, combining positivist philosophy of science with new ideas in studying the history of civilization (Frängsmyr 1999). A common, international (or at least anglophonic) current ran among academics who had a part in founding the discipline of the history of science: each scholar sought to provide a bridge between two schools of thought.

Introducing science into the curriculum in the inter-war era was crucial to Snow's later perspective of the relationship between science and the humanities on several counts: first, Snow himself was educated within this evolving system of education during World War I[14]; second, by the early 1930s he had been trained as a physicist and was working at the Cavendish laboratory, when in 1935 he decided to quit and pursue his literary pursuits; and third, his academic development, having already been guided by the dominant positivist spirit of science, was complemented by the formation of the Cambridge History of Science Committee of 1936.

That committee of 1936 helped start the most enduring British version of a history of science program, and also illustrated through its gradual evolution to the early 1950s the tensions between scientists and humanists in their efforts to communicate. The original committee was headed by Joseph Needham and Walter Pagel, both of whom were accomplished scientists who went on to become well-known historians of science. Historians Herbert Butterfield and A. Rupert Hall were also present. Butterfield's role, in particular, serves to illustrate the mood of two cultures, because the Committee's transformation from the leadership of the scientists, Needham and Pagel in the 1930s, to the historians, Butterfield and Singer by the late 1940s, corresponds to the history of science's ultimate birth as an autonomous discipline in Cambridge.[15] For our purposes, the Committee is important because it exemplified the dominant academic view of the differences between science and the humanities. The committee eventually recognized that "the history of science was far too precious to leave to scientists," to use Mayer's characterization of Butterfield's view (Mayer 2000, 669). Thus, the Committee asserted that non-scientists were qualified to speak about science.

The evolution of the Cambridge Committee shows that the polarity between science and humanities had become prevalent enough to transcend the former underlying

[14] Snow was born in 1905 and completed his secondary education in 1923.
[15] See A.-K. Mayer (2000) for a thorough history of the committee between 1936 and 1950.

credo of moralization; the issue was refashioned as a basic issue of communication. Although the Committee aimed to bridge the two academic cultures, its existence demonstrated that Huxley's assertion a half-century earlier on the prevailing influence of science had become common knowledge. The need to understand scientific history as a part of human history was no longer just a suggestion, but a social obligation. After World War II, this credo was even more pronounced. In 1949, Butterfield broadcast a series of radio lectures. One of these was titled "A bridge between the arts and sciences," illustrating the then-common perception of a divide and showing Butterfield's interest in finding a solution to it (Butterfield 1948; also, see Butterfield 1949/1997). It was apparent to him, and to the other members of the Committee, that there was a basic split in academia.

The original goal of the Committee was to bring together members from both cultures so that they might a mutual understanding.[16] Snow was at Cambridge at the time (in the 1930s) and fully aware of the Committee and its function. Reporting on the "electric atmosphere" of the committee meetings, he was particularly impressed by "hear[ing] of the great discoveries by people who had seen them happen under their own hands" (Snow 1938). Apparently, Snow was smitten by the history of the great discoveries of science made by the great men of science.[17] Snow did not follow suit when Butterfield and Pagel encouraged more context-rich and less present-centered historiographies in their work after the war.[18] It seems that Snow's short experience as a practicing scientist left him with a complete idolization of the scientist and the enterprise of science. He appreciated and contributed to the hagiography of great scientists in the plots of his novels.

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[16] A similar effort was launched in the US. James B. Conant's General Education program of the late 1940s a Harvard was an effort to teach the manner of scientific inquiry to non-scientists. I.B. Cohen writes that Conant's "theme was that the war had shown that nonscientists simply had no sense of what science does, how it operates, or how it either reaches or validates its conclusions" (I. Cohen 1999, 38).

[17] For Snow, they were all men. I have not found reference in Snow's writing to female scientists. John Hultberg also comments that "it is mainly male scientists who appear in Snow's novels" (Hultberg 1991, 156).

[18] Mayer (2000) concludes that the historiographical reform movement that led away from positivist history was not indebted to historians alone, referencing Pagel's contributions as an example. I use the example differently here, to show that Snow caught on to the front end of the history of science (the positivist beginnings) and took valuable lessons from it, yet retained these lessons when the field evolved away from them throughout the post-war era.

Snow's scientism

The influence of the members on the committee, as well as the prevailing philosophy of the time, allowed Snow to put forward his positivist view of science in 1956 and 1959. True, he was not a historian of science, and his claims to being a scientist were fading even as he became a more prominent public intellectual. Snow's perspective was strengthened by an unwavering faith in the promise of science that he elaborated in most of his novels.[19] The effects of atomic energy did little to dissuade him of possible drawbacks to scientific promise.

Snow had a lifelong commitment to an ideal vision of a science that gained credibility tautologically: science could find the truth by basing its claims on a devout realism, while it was epistemologically validated by the truth it found. Science was all things good to all people. That is, science was cumulative, certain, collective, truth-seeking, and self-correcting. A few excerpts from Snow's work illustrate this point:

> "…our civilization, if it does not break down completely, will call increasingly on science, and those living in it will find it alien unless they understand the mechanism they use" (1936, 1074).
>
> "[Scientists] have become technocrats of good will…robust and in earnest and their own consciences are clean" (1958, 108).
>
> "[Scientists] know that the truth…is what makes science work (1960/1971, 191).
>
> "Scientists cannot escape their own knowledge, they also won't be able to avoid showing themselves disposed to good" (1960/1971, 198).
>
> "[Science] is a search, and a successful search, for agreement" (1970/1971, 94).
>
> "[It has been] found possible to reach a level of agreement: and to build upon this, by the same process, brick by brick, incorporating what had been previously done into the growing structure" (1970/1971, 94).
>
> "[Science] is cumulative, incorporative, collective, consensual, so designed that it must progress through time" (1970/1971, 96).
>
> "Men are attracted to science often because they like the concept of progress and of being engaged in a collective enterprise" (1970/1971, 97).

[19] See Hultberg (1991), especially chapters 3-5, for extended analysis of the positivist scientists in C.P. Snow's novels.

Again, Snow easily made the transition from specific to general, from individual to group. Scientists were robust, earnest, and good-willed, therefore the scientific enterprise was the institutionalization of these virtues.

Nobel laureate I.I. Rabi provides an interesting comparison of the nuances of scientific optimism in a piece he published nearly concurrently with Snow's 1956 two-cultures article (Rabi 1956).[20] Rabi also lamented a science-humanities split, but he was far more forthcoming in discussing ramifications of a strictly technoscientific world. He observed that "the knowledge and techniques developed through science for the illumination of the mind and the elevation of the spirit…have been used for the destruction of life and the degradation of the human spirit" (Rabi 1956, 64). Seeking wisdom, he suggested an interdisciplinary approach of science and humanities, a "unified effort", as the solution.[21]

It is tempting to see Snow's optimism as characteristic of his era. His two-culture concerns stemmed from a desire to spread the scientific word to the masses who would, presumably, be receptive to such a common plea. However, his optimism was neither so widespread nor representative of all science as he indicated. Rabi, having won the Nobel prize in physics in 1944 for atomic nuclei work, was certainly more prone to recognize flaws in a scientistic world. Snow was removed from front-line atomic research, enabling him to glorify all that was good about it, and to downplay possible negative effects. There was no reference in any of Snow's work to Critical Theorists like Max Horkheimer and Theodor Adorno, or to explicit philosophical and social objections to what Walter Benjamin called the age of mechanical reproduction (see Horkheimer and Adorno 1972; Benjamin 1968). Nor did Snow view possible scientific repercussions with anything close to the same degree of horror as did the critical theorists.[22] Snow retained the mood of scientific promise from his pre-war days, provided by the examples of progress and discovery at the Cavendish and at meetings of the Cambridge History of Science Committee in the 1930s. In the face of possible negative repercussions, he posited the 'scientific fix' and increasingly presumed that any scientifically related

[20] This article was published in the US in *The Atlantic Monthly*, thereby confirming not only British, but American recognition of a divide too. Rabi's article was reprinted in Levin and Thomas, eds. (1963).
[21] In hindsight, I might suggest that Rabi's take on the situation did not provoke such a heated response as Snow's did, because his ideas were more even-handed. However, this is only conjecture.
[22] Though, of course, he views the issue of atomic power as one of great significance, he does so to support his claim that to temper the possible negative effects one needs a more focused scientific education.

problems were the fault of those who did not understand science. This attitude should not surprise us, given the legacy of the science education reform debates of the interwar period. Although he was not involved in the debates then, Snow was influenced by their spirit.

Internationalization

Charles Singer had said in 1917 and again in 1948 that "Only by the aid of science can man truly know either his fellows or himself. Should science cease to be international, we may know of a surety that the end of civilization is at hand" (Singer 1949, 18). Snow apparently took Singer's words to heart. Ostensibly, Snow wanted to foster communication between the sciences and humanities. However, his idea of communication was more to bring the humanities scholars up to the level of the scientist than to equalize conversation between the two. Snow's idealized positivist scientists could accomplish two goals with better communication: one, they could improve the material conditions of the world; and two, they would remain politically neutral, thus acting as good will ambassadors among enemy nations. This international appeal was an important strain in the *Two Cultures* thesis. Although we can presume that Snow felt comfortable talking across the two cultures, his lament was on a grander scale. He wanted to emphasize the need for a shift in cultural standards to ensure a "better" future, not only for his native Britain, but for all the world. He envisioned science as that culture which would foster international communication, especially between the United States and Soviet Union, since he believed the culture of science was universal.

Another impetus for the *Two Cultures* pronouncement was a standard plea for the glory days of the Visible College of the 1930s, which Snow conceived of as exemplifying communal scientific activity (see Werskey 1978). He reflected on this several years after the lecture's publication, saying that for Rutherford in the 1920s, "the world of science was a world that lived on a plane above the nation-state…." (Snow 1970, 195). The fair-minded yet radical community of scientists was not only locally collegial, but globally value-free. The strong Bernalism of the 1930s, based on socialist principles of the

function of science for society, heavily influenced Snow (Hultberg 1991, 172).[23] However, in terms of political commitment, we find Snow shuffling between the socialist ideals of Bernal and the liberal internalism of Polanyi, between the beloved ideals of agreement and community spirit, on the one hand, and unchecked creative opportunity on the other.[24] Nonetheless, the virtues of science have an additive effect for Snow: he takes the virtue of progress, adds the virtues of certainty and morality, and ends up with the virtue of international appeal. The former days of science up on "a plane above the nation state" were just what were necessary, in Snow's opinion, as the Cold War became cast in stone. The widening gap between the two cultures—which was not such a big deal with Rutherford or the Bernalists of the 1930s, he thought—was the cause of international tension, and yet could be remedied by allowing science to take the lead. Snow extrapolated the collective ideal of research practice at Cambridge to posit the scientist as an international ambassador. He extrapolated the cumulative ideal ("brick by brick") to credit science with unending progress and prosperity. By its very definition, science would save the world.

In strengthening the view that "our civilization, if it does not break down completely, will call increasingly on science, and those living in it will find it alien unless they understand the mechanism they use," Snow was advocating putting science at the peak of a knowledge pyramid. This view undergirded his argument for scientific supremacy both in his "Two Cultures" lecture in 1959 and within his life's work.

From thesis to debate – against Leavis

The changing views of science discussed in the preceding sections were the context for Snow's two-cultures thesis, as presented in the *New Statesman* in 1956, given as the Rede Lecture in May 1959, and published in *Encounter* two months later. Snow portrayed a society in bad shape due to (1) a growing gap between the rich and the poor, (2) fears of thermonuclear war, and (3) a widening chasm between the two factions of an educated citizenry—science and the humanities. He thought a solution to the science-humanities gap would go far in resolving the income gap and the arms race. What

[23] Hultberg finds that Bernal was the model for a character in one of Snow's early novels, *The Search* (1934).

society needed, said Snow, was educational reform that would emphasize an understanding of science and its methodologies.

In 1962, three years after the Rede lecture, the noted English literary critic F.R Leavis forcefully challenged Snow's thesis with his essay "The Significance of C.P. Snow" in *The Spectator* (Leavis 1962/1972). Leavis took great exception to the suggestion that the sciences deserved a place of greater prominence than the humanities, forgoing etiquette in favor of near-libel in his response to Snow. Leavis felt compelled to defend deeply-rooted notions of British culture that had relied heavily on literature and longstanding tradition.

The response to Snow and the ensuing "debate" are now famous. The reasons for the sustained public interest in the thesis and debate then, and now, were many.[25] For one, Leavis's ad hominem attack on Snow was unprecedented. He not only questioned Snow's authority to identify two cultures, but at one point exclaimed that "as a novelist, he doesn't exist; he doesn't even begin to exist" (Leavis 1972, 44). Leavis did not mince words, as in the following: "Snow is in fact portentously ignorant" (41), "he is intellectually as undistinguished as it is possible to be" (42), "He doesn't know what he means, and doesn't know he doesn't know" (43),"exhibits an utter lack of intellectual distinction and an embarrassing vulgarity of style" (44).[26]

A second reason for widespread interest in the debate was the publicity it received. The response from the intellectual community, via letters to the editor of *The Spectator*, reinforced the dichotomy Snow had posited. On the whole, the same structure of support or rebuttal had appeared in letters to *New Statesman* in 1956, and to *Encounter* in 1959. Respondents took sides, favoring Snow or Leavis instead of questioning the validity of a two-culture construct, thereby strengthening Snow's construct. For example, the American literary critic Lionel Trilling reported that of the 32 letters published in the weeks after Leavis's publication, twenty-four sided with Snow (among them the scientist

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[24] This form of a divide—the socialist-individualist one—becomes even more interesting later, when Leavis invokes Polanyi as an ally on his side of the argument over the *Two Cultures* (Leavis 1972, 21-24.)

[25] The lecture was reprinted eleven times in just three years (before Leavis's counter-attack), and the paperback copy has had over twenty printings in thirty years, indicating that despite the academic tinge, there was a legitimate and interested public audience.

[26] For more insight into Leavis's standard demeanor, consider that in April, just three issues prior to the June *Encounter* that contained "The Two Cultures," a short essay had decried Leavis's previous attack on T.S. Eliot (Grigson 1959). In the same June issue (page 88), Leavis replied with a letter to Grigson in the

J.D. Bernal and historian and philosopher of science Stephen Toulmin), eight with Leavis (Trilling 1965,130). Even if responses to Snow's thesis and Leavis's denouncement of it strayed from an either/or viewpoint—for example, suggesting that there were more than two cultures, that the term 'culture' was misplaced, or that the true divide was not between science and the humanities—there were few alternative proposals suggested. And in any case, such disapproving responses were the exception, not the norm. In the broad view, the apparently British nature of the debate was more a matter of which upper class, elitist education was better, the literary humanistic, or the scientific one.[27]

The structure of this debate never formally took shape, as Snow and Leavis were never to meet in person or reply in kind to one another's comments. Yet, by proxy, in the journals and around university halls, the lines in the debate were drawn. From one side it looked like this: forward-thinking scientists attempted to depose anachronistic literary humanists, who could not be counted on to prepare the leaders of tomorrow for a scientific, technologically revolutionized society. The other side looked this way: well-rounded intellectuals, grounded in an essentially moralistic education along the lines of Arnoldian culture—"the best that has been thought and said"—who opposed technocratic purveyors of a mechanical, material future. The lieutenants of Snow and Leavis did much to establish the thesis as a full-blown debate, and those responses and commentaries served to solidify the main battle lines, even if they diverged from the initial points. For example, Leavis's reply was published alongside a response by the chemist Michael Yudkin, both of which took Snow to task (Leavis and Yudkin 1962). Yudkin's reply should have carried more weight, not only because he too was a scientist, but also because he avoided Leavis's personal rancor. Yet, it was precisely because Leavis was so intemperate that his name and his ideals became attached to the debate. His reply demanded an answer, because he had broken the rules of mild-mannered intellectual debate. Since my purpose here is to concentrate on the positions of the

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same language of haughtiness and pretension that characterized his attack on Snow. Leavis, it seems, was a loose cannon.

[27] Snow recognized this possibility also—of British specificity—by noting the Royal Society's exclusion of the social sciences and "other fields of learning which, in other countries, would be regarded as part of 'science' in its universal sense" (Snow 1959/1993, 105). This definition can be contrasted with "science" in the German sense of *Wissenschaft*. Additionally, one would think that the layman would have better things to worry about than such eclectic squabbles, since the debate took place within the ivory tower of Cambridge and not at the corner pub. With this in mind, it seems difficult to derive any deeper meanings about public perception. However, the above data about reprintings (see note 25) indicate otherwise.

primary actors in the debate, I will focus on the opening and closing remarks by Snow and Leavis.

Snow, of course, had the "Two Cultures" lecture published in 1959 (Snow 1959/1993). Leavis replied in his Richmond Lecture in 1962 (Leavis 1962/1972). As mentioned, a flurry of activity followed Leavis's rebuttal. Although Snow did publish "A Second Look" in 1964, he did not address Leavis's comments directly until 1970, in his article "The Case of Leavis and the Serious Case" (Snow 1971). In the meantime, Leavis publicized his argument in public lectures and summarized it again in "Luddites? Or There is One Culture" (Leavis 1972).[28] His essays were all compiled in *Nor Shall My Sword* (1972), the preface of which reiterated his preference for William Blake over Lord Rutherford, and the bulk of which more or less served as a coda to his career. Likewise, Snow's *Public Affairs* was published in 1971. It was a collection of his works relating to two-culture tensions, and served almost the same purpose as Leavis's collection: to reiterate and finalize his two-culture position.

For analysts of the debate, it was difficult at first to extract Leavis's critical rebuttal from his personal attack against Snow.[29] Snow had given his lecture, received mild replies, and moved on. Leavis had heard enough of it second-hand by 1962 that he was inclined to "lay down three and sixpence" to buy the reprinting (Leavis 1972, 43). He was appalled for two reasons: first, that Snow considered himself a credible enough intellectual to make judgements against the moral stature of literary types; second, that Snow's claims about the moral superiority of scientists were incorrect and damaging to a cultured sensibility. "For the suppression, in what should be the field of real intellectual and spiritual authority, of serious criteria by the power of creating publicity-values is a frightening manifestation of the way our civilization is going…concomitant of the technological revolution" (Leavis 1972, 68). Leavis's purpose was to point out "the cultural consequence of the technological revolution" (73), meaning that Snow's role as a public intellectual and the reception of the two-cultures lecture were the consequences of

[28] "Luddites…" was given as an address at Cornell and Harvard in 1966 and his "'Literarism' versus 'Scientism': the Misconception and the Menace" was addressed to the University of York in 1970. Both are included in Leavis 1972.

[29] Lionel Trilling, America's foremost literary critic of the century to that point, took this line in his even-handed commentary on the Leavis-Snow case. He explained first that Leavis's tone was nothing but impermissible, but still took the side of the literary humanists against Snow. His concern with Leavis was

the very technological revolution that Leavis railed against. That is, the legacy of technocracy was to diminish true culture. Thus, his dually-conceived reply was also formulated on coextensive conceptual levels. On one level, the technocratic age should be lamented for its role in lowering the standards of culture (a diminution in standards that Arnold would have also abhorred, and that he argued against in 1882). On another conceptual level, the age of technocracy deserved the credit for giving so poor a novelist as Snow the authority to elevate those same standards (Hollinger 1995, 449). The problem for Leavis was the self-serving, tautologically reinforced virtues of Snow's scientism. "The scientist very well may…derive great satisfaction from his work. But he cannot derive from it all that a human being needs—intellectually, spiritually, culturally" (Leavis 1972, 87).[30] Here then was a firm point of opposition, since Leavis's argument highlighted the moral bankruptcy of technocracy, while Snow sought moral guidance from science in the form of responsibility.

Snow constructed a dichotomy so that he could highlight the superiority of science. His position can be understood from the following:

> …we seem to have reached a clear divide between two cultures or traditions. One is cumulative, incorporative, collective, consensual, so designed that it must progress through time. The other is non-cumulative, non- incorporative, unable to abandon its past, but also unable to embody it… (Snow 1970/1971, 96).

Leavis's (non-polemical) thoughts on the matter follow:

> …a prior achievement [to science] of human collaborative creativity is the creation of the human world, including *language*….It is in the study of literature, the literature of one's own language in the first place, that one comes to recognize the nature and priority of the…realm which is neither private nor public in the sense that it can be brought into the laboratory or pointed to (Leavis 1962/1972, 61-62).

Snow defined a science that would unite the world from its epistemological foundations alone. Leavis believed those foundations had long existed and were present in the form of language. Thus, Leavis argued, if Snow was going to forward his agenda on the basis

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that Leavis had forgone the opportunity to reply as a critic should. His concern with Snow was that the two-culture argument was poorly structured and ill-conceived (Trilling 1965).

[30] This comment comes from the essay "There is Only One Culture," in which for Leavis the one culture was literary (Leavis 1966/1972). This point of view would be opposed to the one culture of science, Snow's line in the debate, and not, as we will see in the following chapter, an overture to a common foundation of culture that provided for both science and literature. See Levine (1987) and Collins and Labinger (2001).

of cumulative, collective knowledge, he should at least be aware that his other vocation, that of novelist, already relegated him to a tradition of collective thought. Leavis's critique was positioned to answer both his qualms at one time. He could point out that Snow's philosophical basis for conceiving of the superiority of science was not unique to scientific thought or practice, and that if Snow really was anything of a two-culture man—a former scientist and current novelist—he should have understood the history and moral function of literature.

In a recent account of the sustainability of the two-culture divide, Graham Burnett writes that "Leavis found Snow's optimistic scientism a testament to the bleak condition of intellectual life" (Burnett 1999, 205). Burnett adds that Leavis viewed Snow's rise to fame as "a sign of the deep illness of the body politic" (206). Snow had been speaking primarily to practitioners, having written about scientists and their role as citizens in his novels. His lecture was aimed at a vocational contrast: scientists versus literary humanists. With Leavis's counter-proposal the two-culture issue moved to another conceptual level, that of debate, wherein two intellectuals argued over which of their ideas was more valid. Constraining the debate was the deeper divide in which science and the humanities were set against each other as opposing epistemologies.

Snow's articulation of the widening gap between science and the humanities occurred in an era of increasing Cold War tensions. John Hultberg, who has written at length about Snow's concept of science, comments on the impact of the popularization of science on bridging the two-culture divide (Hultberg 1997). He contextualizes Snow's thesis within the era when British faith in its colonial superiority had ended, suggesting that Snow's proposal contained elements of globalization even while it was framed as a local British concern. "Snow is, in this way, part of the general internationalization of science: the effort in the wake of World War II to promote economic and democratic growth through a global scientific spirit. Scientists were the citizens of the world" (Hultberg 1997, 200). Britain, in the aftermath of the war and in the midst of solidifying power alliances, had to provide for its future. Yet, while the scientistic and Cold War elements of Snow's lecture can contextualize his thesis, there was a more important issue that the two-culture construct suggested: how might different domains of knowledge and different ways of knowing the world structure how we live in the world?

Concluding the debate inconclusively

Science, for Snow, was forward-looking and future-oriented; the literary humanities were retrospective. Snow wanted the world to utilize science and technology as tools to solve the problems of mankind. He believed that it was via the international culture of science that disputes could be settled and communication fostered. Science, credible on epistemological, practical, and moral grounds, could be a savior of society. For Leavis, in contrast to Snow, the two-culture issue was individual and spiritual. Leavis's proposal was to rely on the literary humanities to supply the basis for individual character and social responsibility. He believed Snow's ideas were not only ill-conceived, but offered by an unqualified pseudo-intellectual. Morality was coupled with spirituality for Leavis. For Snow, it was coupled with material responsibility.

The debate that began in 1962 did not end with Leavis and Snow's essay compilations in 1971 and 1972, because there was no resolution of the issues nor any conciliatory efforts to understand one another. There was a beginning, a period of responses and replies, but no end. Instead, participants in the debate such as those in *Encounter* and *Spectator* and in academic circles reinforced the divide, choosing one side over the other. Book-length commentary from outside the main lines culled historical material to provide perspective on the dichotomy, but did little to suggest how to resolve the debate. Thus, a 1963 volume, *The Scientist vs. the Humanist*, presented examples of two-culture concerns ranging from Jonathan Swift to Isaac Asimov (Levine and Thomas 1963). A collection from 1964, *Cultures in Conflict: Perspectives on the Snow-Leavis Controversy*, served basically the same purpose (Cornelius and St. Vincent 1964). Aldous Huxley provided his take on the matter, with special literary cultural authority and reference to his grandfather, in a 1963 Work, *Literature and Science* (Huxley 1963). Huxley's work was also aimed at offering a more sophisticated and historical view of the divide than Snow had given, but not at suggesting alternative viewpoints or options for reconciliation.

Given the century of precedent for Snow's articulation, this lack of resolution to the debate is not surprising. The view I have provided places the two-culture thesis along a historical continuum, rather than as an isolated academic incident. To be sure, Snow should be credited with coining the "two cultures" slogan. The ease of reference to that

catch phrase by later scholars helps to explain much of the credit Snow has received for purportedly identifying the divide. I suggest that this credit is based more on nominalism than theoretical insight. The vast array of reflections on the debate supports this assertion, since one of the most common forms of interpretation has been the two-culture "revisitation."[31] The split between two cultures could be seen within the academy (a practical observation), by the personalities of their respective practitioners (a psychological observation), and from the theoretical foundations of the fields (an epistemological observation).

Revisiting the two cultures in the years after Snow and Leavis's contributions often implied that Snow's thesis itself was a revisitation of previous instances of a cultural gap. But, even though I place his thesis along a historical continuum, there were contextually specific concerns for Snow. Thus, references to Arnold and Huxley hold up from a rhetorical standpoint, since the structure of argument in the 1880s was similar to Snow and Leavis. However, those comparisons lose cogency when we try to assimilate the idea of science in the Victorian Age to that of the Cold War. For one, the authority and material promise of science as a knowledge-producer was less stable for Huxley in 1880 than it was for Snow in 1959 (Turner 1980). So, while we can point to historical recurrences of a two-culture divide, the continuities and discontinuities between each instance need to be examined. This point is important when we enroll Arnold and Huxley as predecessors to Leavis and Snow and claim that the two debates were the 'same.' The idea of two forms of intellectual inquiry is consistent in recurrences of the two-culture divide, such as between Huxley-Arnold and Snow-Leavis. But the contextualized concept of science being discussed changes in the years between those two debates. This point is especially significant when we consider whether or not the science wars were a recurrence of the two-culture debate.

The founding of the history of science as a means to moralize the sciences after the World War I era also provides a valuable reference point for Snow's concerns. In the

[31] In fact, since there are so many discussions in the style of "the two cultures revisited" that I have included them in Appendix A, instead of listing them in a footnote. That list is restricted to those revisitations published in journals, for the most part, since it became too unwieldy when I considered the plethora of course syllabi and seminars devoted to the topic.

first half of the twentieth century, the gap between science and the humanities had been identified by the BAAS, Sarton, Singer, and Butterfield.[32] Furthermore, Snow became directly familiarized with the divide through his acquaintance with the Cambridge History of Science Committee of the 1930s. Yet, by the 1960s, the history of science that had been founded as a bridge between the two cultures was well on its way to moving beyond the hagiography that Snow espoused. The two-culture debate was structured without reference to then current philosophical or sociological arguments or burgeoning interdisciplinary programs like the History and Philosophy of Science. Neither Snow nor Leavis took heed of Thomas Kuhn's *Structure of Scientific Revolutions* nor the role it would play in launching a reexamination of conceptualizations of science (Kuhn 1962/1996; see Golinski 1998, 1-27).

The notion of a historical recurrence of the two-culture debate takes on greater significance when we consider the following. One, the arguments in the science wars of the 1990s have been compared to those of the two-culture debate. As such, the science wars are called another two-culture revisitation. In that case, Snow not only had historical antecedents, but now has descendants as well. Two, those science wars were predicated on a reaction to the scholarship of some forms of interdisciplinary science studies that grew out of the philosophical arguments of the 1960s and 1970s. That is, it was precisely the increased attention to studies of the natural sciences by non-scientists—ignored by Snow—that led to a backlash against communication across the supposed cultural divide.

Kuhn understood the significance of a cultural divide, in the words of historian Robert Westman, having been "called upon to make the powerful, muscle-flexing expertise of science palatable to a new lay audience" (Westman 1994, 86). Westman continues, "Kuhn constitutes his scientific revolution as a version of the "two cultures" problem" (Westman 1994, 81). Additionally, Sarah Kuhn has said that her father was deeply impressed by Snow's thesis (see Andresen 1999, 55). Given the foundations of the history of science described earlier, this impression certainly had more to do with

[32] Kevin Grau (1999) notes that the underlying rationale for founding the History and Philosophy of Science program at the University of Indiana in 1960 "reflected the concerns of the time and the perceived "gap" between science and the humanities" (Grau 1999, 300). Edward Grant and Norwood Hanson, of the University of Indiana, wrote about the gap between the sciences and the humanities in the early 1950s, but when the department was founded in 1960 they did not reference Snow, nor did they cite earlier claims (by Sarton, or Singer, for example) that the history of science alone could serve that purpose.

Kuhn's involvement in the bridging mechanism of the discipline and his own teaching of science to non-scientists than any purported novelty in Snow's thesis. Furthermore, given the description of Kuhn as "the harbinger of the constructivist movement," Kuhn and his influence on the constructivist movement and science studies were crucial to approaching the two-culture problem (Golinksi 1998, 13).

Snow and Leavis carried on their debate without reference to the history or philosophy of science and without recognizing the broader cultural changes underway with 1960s campus radicalism. As the two debaters wound down their contributions to the issue with the waning era of post-World War II scientistic optimism, so too did the historical context begin to change. Studies of science and technology blossomed alongside the political response to the impact of science and technology on society (see Cutcliffe 2000, 1-15). The critical tone of those initial responses mounted over the next few decades, eventually meeting with an equally critical response in the form of the science wars. However, criticism and explication do not always imply negation and denunciation and the matter of the science wars was never a straightforward issue of response to critiques of science and technology. In the following chapter, I elaborate on the meaning of the science wars for science studies and for society.

CHAPTER 2: *THE SCIENCE WARS*



Calvin and Hobbes, 10 January 1992, Bill Waterson

"The artist has always had to contend with the hated critic. But whence comes this new thing, the science critic?"[33]

The 1994 publication of *Higher Superstition*, by biologist Paul Gross and mathematician Norman Levitt, constituted a clear frontal assault on the scholarship of science studies (Gross and Levitt 1994/1998). The book was not the first such critique of the diverse science studies program, nor was it hampered by the heterogeneity of the very label "science studies" that might have otherwise restrained a distinct attack.[34] The subtitle to the book, "the academic left and its quarrels with science," indicated the tone and direction of the author's critique. Gross and Levitt's concern was positioned against the encroachment of postmodernist theorizations of science that they believed sought to undermine the epistemic authority of science. In the polemic, the two authors cautioned natural scientists against "the systematic disparagement of modern science" being wrought by scholars outside the scientific community—scholars who were unqualified to speak about the cherished pinnacle of Western rationality (Gross and Levitt 1994/1998, ix). Although social constructivist members of the "academic left" received the brunt of the criticism, the rhetoric in *Higher Superstition* was aimed at the perception of a broader historical trend that questioned the legitimacy of scientific intellectuals to act as true arbiters of culture. And although both sides of the debate were composed of a diversity of members, if any authors have the right to claim representation for one side of the "wars" they would be Paul Gross and Norman Levitt. For science defenders, the *Higher*

[33] Forman (1999), 115

Superstition polemic identified the problems of science studies and constructivism; for science studiers, it illustrated how the work of science studies had been misunderstood and misrepresented.[35]

Gross and Levitt's main concern was to attack irrationalism. The defining feature of the science defenders was a reproach of science studiers for questioning the privileged epistemology of science. Since science is a proven and superior means to reason about the world, the defenders claimed, critics of science are irrational. In his 1993 *Science and Anti-science*, historian and physicist Gerald Holton had already provided the equation between science studies and anti-science; Gross and Levitt simply bolstered it (Holton 1993). For Gross, Levitt, and Holton science stood for objectivity and truth, while "postmodernism" and "constructivism" implied subjectivity and contingency. The science defenders argued that the superiority of science was guaranteed by its unique foundational structure. "Outwardly or covertly, [those of the academic left] insist on supplanting standard science with "other ways of knowing"…" (Gross and Levitt 1998, 249). Treating science as just another way to know the world was anathema to proponents of rationally-based epistemic authority.

One of the key issues in the debate turned on what it means to be socially constructed, and if the phrase "human construct" is or is not preceded by the modifier "nothing but." However, when commentators on the debate mention miscommunication, misunderstanding, or misreading, as they have, they are addressing two subordinate issues that derive from this larger one of rudimentary misunderstanding, namely: is science studies in fact a unified approach that can be argued against in a totalizing fashion? and does science studies have the authority to explain how science works?

Just as the science studiers under attack were a diverse group, so too were the attackers. The science defenders were not all physicists, not all scientists, and not merely realists, nor did their position stem wholly from misinterpretations or professional prejudices. Underneath several layers of superficial commentary there were important, substantive issues about the implications for certain evaluative works of scholarship.

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[34] See Biagioli (1999) xi-xvii, for recent, and concise, commentary on the "category" of science and technology studies.

[35] For clarity, I borrow Thomas Gieryn's choice in labeling by referring to one side as the science defenders, or "those who see science as under attack," and the other as science studiers, or "those who examine science as a historical, sociological, and cultural phenomenon" (Gieryn 1999, 342). These labels

When do descriptions become prescriptions, when do relativist methodologies become relative ontologies, and how might public perception of objectivity relate to public funding of pseudo-objective enterprises? These questions all relate to issues of authority and credibility, both of which were the salient issues at stake in the science wars debate.

The purpose of this chapter is to recount the events of the science wars and to analyze their structure. In the first section, I tell the story of the debate, from exposition to resolution. I begin by briefly discussing the border skirmishes that preceded Gross and Levitt's 1994 attack (Wolpert 1988; Weinberg 1992; Wolpert 1992; Fuller 1994; also, see Gieryn 1999, 337-363 and Segerstråle 2000, 87-94). Then, I carry the story forward with the battles that followed the publication of *Higher Superstition* (Gross, Levitt, and Lewis, eds. 1996; Ross, ed. 1996; Sokal 1996). However, telling a linear story is not a simple task, because there have been scholars seeking a truce to the wars since the very first battle. Those truce-seekers—sometimes attempting to resolve the conflict, sometimes asking for peace—offered commentary that paralleled the main line of debate (Fuller 1994; Labinger 1995; Segerstråle 2000; Collins and Labinger, eds. 2001; also see Gieryn 1999 and Hacking 1999 for summaries of these commentaries). Thus, I distinguish two distinct lines of contribution to the "wars" and discuss them separately (see Figure 1). In the final section, after commenting on the broader historical context into which the science wars fit, I discuss the structure of the debate and then analyze the terms of that structure.

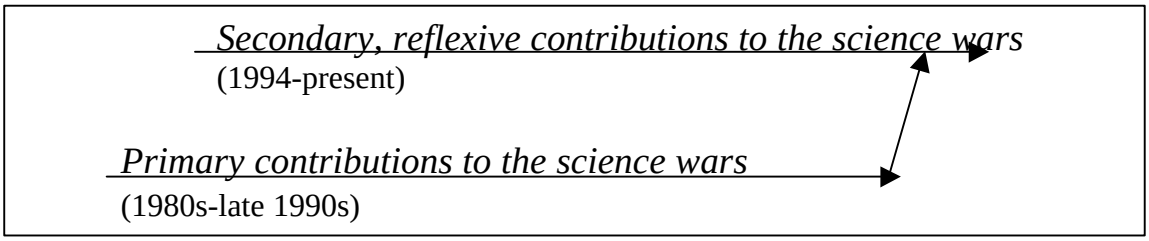


Figure 1. The two-fold path—one defined by primary contributions, the other by reflexive analysis of them—that was the science wars. It is easier to recognize the divergent efforts towards resolving the science wars by separating two lines of contributions. This two-fold path clears up the temporal confusion between attempts to understand the science wars and attempts to continue them. Those two forms of contribution were nearly concurrent.

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are not wholly adequate, but I address that deficiency as part of my discussion in the second half of the chapter.

Who was fighting whom?

Border Skirmishes

Gross and Levitt's attack in 1994 was not launched without historical precedents. Sniping against supposed anti-scientific science studiers had occurred at least since the mid-1980s. In a 1987 *Nature* commentary, two British physicists, T. Theocaris and M. Psimopoulous, blamed the philosophy of science for recent cuts in national research funding (Theocaris and Psimopoulous 1987). Their contention was that the mere investigation of scientific epistemology led to the loss of scientific epistemic privilege. Sociologist Ullica Segerstråle points out that there were "clear structural parallels" between these British physicists, in the 1980s, and Gross and Levitt in the mid-1990s, especially in the manner that these anti-antiscience writers cast their remarks as a call to arms for scientists (Segerstråle 2000, 91). In 1988, Lewis Wolpert, a British biologist, commented on the work of Steve Woolgar in an article titled "A Sociologist Challenges the 'Validity of Science'" (Wolpert 1988). Therein, Wolpert denounced the anti-scientific rhetoric of Woolgar and decried the fact that such insights were wasted on attacks when they could be used for creating an understanding of science's positive role in society. Certainly negative reviews are a daily affair in academia, but this example highlighted a proto-science wars sentiment that Woolgar's rhetoric was anti-scientific. Wolpert, a prominent spokesman for the public understanding of science in Britain, was disappointed that scientific distinctness was not being heralded. Theocaris and Psimopouous similarly felt threatened that the sciences had lost their privileged status.

In 1992, two books were published that provided some of the earliest sustained critiques by natural scientists of science studies. The physicist Steven Weinberg's *Dreams of a Final Theory* and the aforementioned Wolpert's *Unnatural Nature of Science* were not predicated on critiquing science studiers, although both books contained cautionary statements against allowing unqualified outsiders to critique science (Weinberg 1992; Wolpert 1992). Weinberg's book was a restatement of optimistic, progressive, and cumulative physics. Wolpert expounded on the unique craft of science, in theory and in practice. The philosophers and sociologists, whom Wolpert lumped together, simply did not have the authority to explain how science worked, both authors

claimed, and doing so would debase the moral authority of scientific practice.[36] Those arguments began as an attack by science defenders against social constructivists. At the outset, scientists like Weinberg and Wolpert denounced a perceived constructivist view that "there is no reality out there," that everything that exists is made up—*constructed*—by humanity.[37]

The next year, Gerald Holton's *Science and Anti-science* was published as an effort to place anti-scientific rhetoric into a historical perspective (Holton 1993). Holton cautioned against "delegitimators of science" such as Bruno Latour and Sandra Harding, and sounded a more general warning about the consequences of allowing irrational, anti-scientific rhetoric to infiltrate political decisions (see Holton 1993, 145-189). Holton, a well-known historian of science and physicist, did not conceive of science as a form of knowledge culturally contiguous with others. His argument was against "a type of modern philosopher who asserts that science can now claim no more than the status of one of the "social myths"" (Holton 1993, 153). For him, science was and is a unique cognitive enterprise that needs to be understood; thus, the history of science can help society by explaining the performance and contributions of science to the broader public, in a manner not wholly inconsistent with the moralizing purpose the history of science had assumed in post-World War I Britain. If we understand this perspective, it is easy to see why any scholarship that either studies science without focusing on its unique properties or without at least granting an *a priori* distinction of supremacy to science-as-epistemology would be perceived as an attack on science. Holton provided a more nuanced view of the more standard concern that the authority of science could be undermined if scientific knowledge was thought to be constructed by fallible, subjective humans. Taking the uniqueness of science as a starting point, Holton was able to blame everything from Fascism to irrationalism on a denial of the epistemic privilege of science.[38]

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[36] Fuller (1994) reviewed the books together in *Social Studies of Science*. Thus, it was in 1993, when the review was composed, and 1994, when it was published, that the first reply-counter-reply took place between a science studier and a science defender.

[37] Ian Hacking (1999) deflates this view of constructivism with his parsing of the term "constructionism" into six types.

[38] Accusations that science studiers are similar to Nazi fascism of Stalinist communism are so readily invoked that deciphering them helps explain nothing. See Holton (1993) 180-181, and Gross *et al.* (1995), for accusations of the sort. It seems that totalitarian accusations cut across all parties in the science wars debate just as in the earlier culture wars. Because of this diffuseness, they do not provide useful explanatory power.

With Wolpert in the late 1980s, and Weinberg and Holton in the early 1990s, the tone for the science wars was set. But these isolated attacks had yet to form a true alliance until Gross and Levitt's 1994 attack fired the first concentrated cannon shots against what they deemed unqualified scientific commentary. In each instance, the authors argued for the uniqueness and superiority of science and charged that science studies was anti-scientific. The science defenders' fundamental disagreement with science studiers was supported by identifying anti-scientificity with irrationality. Although those science defenders rhetorically situated their arguments against irrationalism, it was a belief in the cultural and epistemological superiority of science that guaranteed their positions.

The wars continue…

The next phase of the campaign saw the argument against science studies move from isolated books and reviews to conferences and published journal and magazine pieces. So, while *Higher Superstition* was the first frontal assault, several events over the next year firmed up both camps in prelude to Alan Sokal's hoax of 1996. In 1995, Gross and Levitt helped call for a meeting of the New York Academy of Sciences to further the defense of science. Along with Gross, Levitt, and Holton, the organizing committee consisted of philosopher Susan Haack, professor of geography Martin Lewis, and former President of the New York Society for Physical Medicine and Rehabilitation Loren Fishman (Gross, Levitt, and Lewis, eds., 1996). Though all participants were academics, the diversity in backgrounds was astounding: eight philosophers, seven physicists, four anthropologists, three mathematicians, three professors of medicine, three English professors, two biologists, two political scientists, two psychologists, and one each from economics, history, geography, classics, chemistry, theology, and sociology departments. The interdisciplinary assortment of scholars called their conference *The Flight From Science and Reason*, perhaps redundantly, since science and reason were not separable in the defenders' view.

In the opening remarks of the conference, Chairman of the Academy Henry Greenburg stressed the "threat" to the hard physical and biological sciences from

illegitimate critics. Greenburg recalled Holton's comment in *Science and Anti-science* when he cautioned that "a failure to defend science from its irrational critics can set the stage for a lethal blow" (Greenburg 1996, x). The end of this opening address reinforced the main structure of the debate introduced earlier with Holton, Weinberg, and Wolpert: "If science cannot claim a *preeminence* for its intellectual virtues or an excellence for its methodologies and sense of design, then it will have a great difficulty laying claim to a rational share of the nation's resources for its perpetuation" (Greenburg 1996, x; emphasis added). Greenburg feared a loss of funding because of irrational criticism and offered what he must believe is a mundane observation, that science is a preeminent form of knowledge.

Paul Gross emphasized authority in his opening remarks, worrying that scientists were the most recent targets of pop epistemology and that for "criticism from commentators who may know little or nothing about the work [of science] itself…awareness of what is going on is spotty at best" (Gross 1996, 4). The gist of his argument was that science studiers should respect Wittgenstein's exhortation that "whereof one cannot speak, thereof one should be silent." The clear implication was that science studiers—humanists—lacked the authority to explain science.

Two themes ran through the conference proceedings: science is preeminent; criticism of it is ill-informed and unauthorized. The perspective that humanist intellectuals were encroaching on scientific terrain dominated the tone of the conference rhetoric. For the science defenders, the debate was a turf war fought for the purposes of reasserting inclusion and exclusion. Sociologist of science Thomas Gieryn views this facet of the argument as the key to the entire science wars debate:

> Defenders of science effect a volatile double exclusion: science studies is located outside the cultural space for "science," which raises doubts about its ability to comprehend or interpret that which it is not a part of and about its general ability to produce credible (accurate, reliable, honest) accounts of anything—on the assumption that such credibility marks the genuinely scientific (Gieryn 1999, 347).

This science defense derived from conceptualizing science as the preeminent form of knowledge. With such a view, excluding those who do not understand science—by definition, those who are outside of science—was a logical rhetorical maneuver. The most prominent features of the *Flight from Science and Reason* conference can be

distilled as authority's double exclusion: those who do not understand, should not critique;[39] and those who disavow the scientific privilege (authority) to explain the world cannot possibly understand.

The 1995 conference of science defenders was followed by the Spring 1996 "Science Wars" issue of *Social Text*. This now (in)famous issue contained the contribution from physicist Alan Sokal now known as the Sokal Hoax (Sokal 1996).[40] Andrew Ross, the journal's editor, published a separate volume of the special issue the same year, sans Sokal, attempting to show the science studiers' defense of their own work (Ross, ed. 1996). This volume of essays highlights the science studiers' position in the debate; it shows the studiers' point of view that science is culturally contiguous on a foundational level with other knowledge-producing enterprises. Many of the contributors to the volume were the targets of Gross and Levitt's 1994 assault—Sandra Harding, Steve Fuller, Stanley Aronowitz, Sharon Traweek, Hilary Rose, N. Katherine Hayles—making the polarization more stark.[41]

Contributors to the *Science Wars* volume exemplify the view that science is "one way among many" to know the world, that it is culturally contiguous with other forms of knowledge. For example:

> "This epistemology [of science] supports thinking with/between more than one knowledge system…" (Harding, 18).
>
> "[I have]…treated scientific forms of knowledge as one strand among the many that make up knowledge about the body" (Martin, 61).
>
> "…defenders of science are seeking to police the boundaries of knowledge…against [those seeking to]…dissolve the boundaries between the privileged truth claims of science and other knowledge" (Rose, 80).
>
> "Science is [not] an epistemologically decisive [discourse]" (Levine, 126).

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[39] As a reflexive comment on this, the same criticism was given by the science studiers who felt that their work had not been understood. Roger Hart (1996), in particular, took the time to refute Gross and Levitt's understanding of many of the science studies features they critiqued in *Higher Superstition*.

[40] The most pertinent contributions to the sub-debate that ensued from the Sokal Hoax have now been collected by the editors of *Lingua Franca* (2000)—where Sokal revealed the ruse—into one volume, thereby, apparently, justifying the capital 'H.'

[41] Levitt (1998, 282), for one, clarifies his list of "radical" science studies scholars as follows: "Paul Forman, Simon Schaffer, Karin Knorr-Cetina, Steve Fuller, Sandra Harding, Donna Haraway, Steven Shapin, Bruno Latour, David Bloor, Barry Barnes, Steve Woolgar, Evelyn Fox Keller, Stanley Aronowitz, Sharon Traweek, Trevor Pinch, Shiela Jasanoff, Harry Collins, and Hilary Rose."

> "…science is now up for deconstruction just like the rest of the Western canonical fare" (Franklin, 152).
>
> "[Science is] a struggle… like other human activities" (Hubbard, 168)
>
> "Science is not uniquely different from other modes of learning…" (Levins, 180).
>
> "[S]cientists…constitute a series of communities, no less than industrial workers or the American Bar Association" (Aronowitz, 204).

Ross and his contributors opposed hegemonic science. Therefore, science does not have a unique privilege to explain reality, and whether one is outside or inside science does not exclude one from critique. It is no wonder that the art critic is commonplace—society grants no epistemic privilege to artistic explanations of the world. But the science critic cannot enter the fray with the authority of an art critic if science and art are not on an even playing field. The science critic *can* enter the fray if science is just one among many ways to know the world.

Thus, we expect asymmetrical commentary in this debate. Michael Lynch cast it as such in the *Science Wars* volume: "Asymmetry provides both a warrant for Gross and Levitt's analysis and a basis for their advice on how universities should deal with the antiscience rabble who have crashed the gates of the academy" (Lynch 1996, 249). Dorothy Nelkin made the same observation, observing that "the theme [from the defenders] is clear. Science is being defiled and debased by uninformed outsiders…" (Nelkin 1996, 115). And Stanley Aronowitz contributed a similar view: "While everybody, including physicists and molecular biologists, is qualified to comment on politics and culture, nobody except qualified experts should comment on the natural sciences" (Aronowitz 1996, 203). Unfortunately for the likes of Nelkin, Lynch, and especially Aronowitz, the fact that Alan Sokal was able to get his article past the editors of *Social Text* went far in supporting the asymmetrical contentions of the science defenders. The Sokal Hoax also provided a cross-over between the broader "culture wars" and the upstart science wars, since *Social Text* was more clearly defined as a cultural studies journal rather than one of science studies.

The wider campaign of the "wars" continued in the mid-1990s, as science studiers and science defenders were in dialogue with each other —not only in conferences, but also in professional and popular journal pages. *Nature, The Chronicle of Higher*

Education, *Physics Today*, *The New York Review of Books*, and *Science* published book reviews and rounds of letters to the editor. In 1996, the Sokal affair made the front page of the *New York Times* (18 May), *New York Review of Books* commentaries appeared in August and October, and physicist David Mermin and science studiers Trevor Pinch and Harry Collins exchanged letters in *Physics Today*. In 1997, a wide range of contributions were published, including the following: *Nature* correspondence (January, April, and May), commentaries in the *Chronicle of Higher Education* (May and July), *Science* letters (January and May), a continuation of *Physics Today* letters (January and March), and a two-page spread in *Newsweek* (April). This escalation in participation changed the location of the debate from its strictly academic grounding to more public forums. An editorial in *Nature* even observed that "Indeed one of the ironies of the debate is that the avowed goal of the so-called constructivists is one that, in principle, many of their critics avidly endorse: the increased public understanding of science" (*Nature*, 30 January 1997, 373). After this flurry of activity, there were more book-length contributions to the debate from the science defenders containing the same arguments already articulated in the 1995 *Flight From Science and Reason* conference (see Koertge, ed. 1998; Levitt 1999; Sokal and Bricmont 1997/1998). However, even though these battles extended to the late 1990s, efforts towards seeking a truce—primarily by the science studiers—had been running parallel to the battles since at least 1994.

Seeking truce

> The entry fee [to the science wars] for the non-serious science warrior is very low. You do not have to do any field work or empirical research, you do not have to read much, and you do not have to understand what you read; indeed, the less you understand the easier it is. To reiterate the *tu quoque* argument – 'If you say everything is relative, why should we believe what you say?' – involves almost no effort at all (Collins 1999, 291).

The fact that meta-commentary has paralleled the concerns of the science defenders since the earliest contributions is not a surprising revelation given the experience in reflexivity of science studies. Hacking has a flashier way to describe this when he says that the debate would not have "caught on if [it] did not suggest gladiatorial sport. It is the bemused spectators who talk about the 'wars'" (Hacking 1999, 4). This outside commentary is typical of a debate. In the case of the science wars, though, that

commentary did not come from outsiders, but from the meta-scientists themselves, the science studiers. The existence of this reflexive path was the means by which science studiers could continue to conduct their own research, grapple with their own identity, and respond to the call of the science defenders. The reflexive commentary disrupts the flow of a linear plot: although aimed at either calling for a truce or resolving the conflict outright, those reflexive contributions were offered at the same time the main battles were being fought, not afterwards.

Two examples from the earlier years of the debate (1994 and 1995) and two from this past year (2000 and 2001) illustrate the trajectory of the "wars" more clearly. In 1994, Steve Fuller reviewed Wolpert and Weinberg's books in *Social Studies of Science* and organized a conference at Durham to bring together science defenders and science studiers. This episode was a first attempt at resolution of the main debate. Fuller recalls the Durham Conference of 1994 as "the first encounter between scientists and STSers with the explicit purpose of coming to terms with each other" (Fuller 2000, 199). However, Fuller's summary of the event indicates two significant points that characterized the science wars debate as he sought to resolve it: (1) the conference exhibited the diversity of both sides, showing that for analysts to dichotomize the participants' views was a tenuous effort at best; and (2) when pressed, scientists appreciated STS insights only when those insights either reinforced the authority of scientific knowledge or derived from authoritative scientific sources themselves (Fuller 2000, 200-201). The two points are in tension with each other. Our difficulty is that if we accept (1) the diversity of both sides, then (2) stating any one common thing about either side is problematic: how can we talk about what the "scientists" believe, or what the STSers believe? If the dichotomizing of science versus science studies has been flawed, then how can we say that scientists disapprove of science studiers?

Fuller continued his dual role of participation and reflexivity as he engaged in a response-reply series with Wolpert and Weinberg earlier that year about his review of their work (Fuller 1994a and 1994b; Weinberg 1994; Wolpert 1994). Although the details of Fuller's review are interesting, we can focus on the account as exemplifying the structure of the debate. Wolpert's reply to Fuller is significant, since he observes that "a key point [of disagreement between him and Fuller] is the relativists' argument for the non-uniqueness of science" (Wolpert 1994, 746). Fuller had earlier forwarded his view

that "contemporary science is merely the product of following *one of several paths* [my emphasis] that had been equally open at an earlier point in our own history" (Fuller 1994b, 147). The precise dividing line between scientists and STSers at the Durham conference, enunciated in the response from Wolpert, was "the absurdity of drawing a hard, virtually essentialist distinction between scientists and non-scientists" (Wolpert 1994, 162). In the end, Fuller's efforts to come to terms with the scientists' opposition to STS scholarship fueled the science wars rather than resolving them.

In 1995, a contribution to *Social Studies of Science* from Cal Tech chemist Jay Labinger, along with a series of replies, characterized the first attempt at resolution from the meta-commentary (reflexive) side of the debate (Labinger 1995). In his article, "A View from the Petri Dish" Labinger addressed concerns with science studies scholarship and methodology. Respondents to the article applauded him for avoiding the tone of snideness and ad hominem Gross and Levitt had taken. To wit: Labinger "demonstrates the proper manner to debate the issue" (Collins, 307); "offers the best model to date for fruitful science-science studies engagement" (Fuller, 309); "is to be congratulated for his principled effort…to open discourse…" (Hakken, 317); "is most welcome in the present climate of hostile polemics from scientists directed towards [STS]" (Pinch, 334).[42] Labinger viewed science studies scholarship as "characterized by the virtually total absence of any participation by practicing scientists" (Labinger 1995, 285-86). On this count, he cited Joseph Rouse, George Levine, and Steve Fuller in particular as scholars who excluded the scientist from studies of science. At the same time, Labinger feared neither the overthrow of the authority of science, nor the debasement of scientific knowledge, even showing surprise at how few scientists even knew what the science wars were.

The replies to Labinger addressed his criticism and sought to clarify it. Harry Collins, for example, spoke for SSK, asserting that its practitioners harbored "no ambition to change the practice or methods of scientists" (Collins 1995, 307). Fuller clarified that he "had not anticipated much of a natural science audience" in his book under attack by Labinger, *Philosophy, Rhetoric, and the End of Knowledge* (Fuller 1995, 310). And anthropologist David Hakken cautioned that Labinger's assumption of mutual exclusivity between the categories of science studies and science might perhaps be

[42] All quotes are from volume 25 of *Social Studies of Science* (May 1995).

reconsidered (Hakken 1995, 319). Hakken's comment shows the enduring reference to a two-culture divide and suggests that the divide could reside *within* science studies, rather than *between* science studiers and scientists.

Labinger had also taken issue with Wolpert's characterization that "scientists are fundamentally *different* than everyone else," expressing his view that science studies had "demonstrated… conclusively…that scientists are *not* fundamentally different from anyone else in any social, cognitive, [or] rhetorical…sense" (Labinger 1995, 289-90). With this perspective, Labinger offered a conciliatory position from which he sought more clarity and attention to the 'scientist' in science studies writing, while acknowledging the value of the scholarship. His article was important, because it offered the grounds for truce in the debate. The series of replies and responses showed that a substantive, engaging debate about science studies and science was concerned, not with considering scientific uniqueness and exceptionality, but with achieving insight into scientific operation and cultural significance on cognitive, practical, and rhetorical levels.

Above, I discussed two examples of attempts at resolution from the earlier days of the wars. Now I briefly discuss two recent examples that followed the main events of the wars. *Beyond the Science Wars*, published in 2000, is addressed to both science studies and scientific scholars with the goal of contextualizing the debate "from somewhere outside the constructivist/relativist approach—not because of the bad name it has acquired, but because of its too narrow focus on epistemological issues" (Segerstråle 2000, ix). The collection contains essays by science studiers, a natural scientist, and sociologists. Steve Fuller contributes the last essay and makes reference to the Durham conference of 1994. As such, this book is well-positioned to provide an example of dénouement deriving from the main strand of the science wars debate. By its very title the book represents overtures towards reconciliation and is a significant milestone in the trajectory of the debate.

The One Culture? A Conversation about Science, forthcoming in 2001, epitomizes the culmination of the reflexive path of the science wars (Collins and Labinger, eds., forthcoming 2001). Edited by Harry Collins and Jay Labinger, the volume derives from a Science Peace conference held in 1997, speaks explicitly to resolution, and contains contributions from science defenders and science studiers alike.

The collection is the most sustained and adamant attempt at communication between the combatants in the science wars, marking its place in the trajectory of the science wars by its very title, as well as providing the obvious reference to Snow's *The Two Cultures*. The very premise and literary structure of the collection is meant to force the issue of genuine conversation.[43]

In the preface, Collins and Labinger note the tension in the debate, taking the position that "it seems obvious that the authority of the scientific community must be a little diminished by admitting outsiders and taking them seriously" (Collins and Labinger, 1-7). The outside/inside dichotomy speaks to the efforts of various factions of science studies that provide a critique: Collins and Labinger estimate that most of the philosophy of science before Kuhn was an attempt to explain the success of science rather than challenging the scientific worldview and that dominant factions within the sociology of science since Kuhn (SSK specifically) have sought to place science alongside other cultures of expertise. Put another way, the hagiography that was so prevalent with pre-Kuhnian studies of science was downplayed as the symmetrical postulate of the Edinburgh School, for example, explained both success and failure on the same social grounds. Science, in those post-Kuhnian accounts, was no longer distinct.

The scope of the essays in *The One Culture?* is further bounded by consideration of a line from Steven Weinberg, which seems to establish a perspective-dependent definition of the debate: "philosophy of science is just about as useful to scientists as ornithology is to birds."[44] Weinberg's perspective is pertinent for three reasons: first is the perception that philosophy should be subservient to science (and not concerned with serving society, of which science is a part); second is the notion of the scientist-as-research-specimen, which was also invoked by Labinger in his "A View From the Petri Dish"; and third is the underlying assumption that science is different. The philosophy of science and science studies are irrelevant for Weinberg and science. This perspective is dependent on the position of Weinberg as a science defender. From the view of science studiers, on the contrary, it is not the philosophy of science that is irrelevant, but

[43] The first section contains commentary on the science wars from the likes of Jean Bricmont, Alan Sokal, David Mermin, Steven Weinberg, and Jay Labinger (all natural scientists) and Trevor Pinch, Michael Lynch, Steve Shapin, Peter Dear, and Harry Collins (all science studiers). The second section contains responses to the first section by the same authors; the third section finishes up with replies to the responses.
[44] As quoted in Collins and Labinger (2001), 1-4. The ornithology quote is credited originally to the physicist Richard Feynman. Also, see Kitcher (1998), 32.

Weinberg's perception of it. Science studiers seek to explain science as an important component to society. As such, they are not speaking "to birds," as Weinberg would have it, but to the world (society) of which the birds are a part.

Finally then, I can reference the epigraph by Collins at the beginning of this section—"the less you understand [about the science wars] the easier it is" to enter—because the most significant aspect of the wars that I have yet to discuss is the lack of requirements for participation, the free-for-all aspect of the whole debate. The often-made charges that the "wars" were predicated on misunderstanding or arrogance are likely to have their source in this lack of entry fee. If participants in the debate had discussed the scholarship under question in a seminar room, they might have gained a sense of the opposition's perspective and presuppositions.[45] However, the discussion went straight to print, making it more difficult for both sides to argue effectively and pointedly at the charges. But resolution could only come about when something new was brought into the discussion; yet because of the polemical outset, reflexive commentary, and priority in clarifying and defending past work, there had not been attempts at providing new ideas. Whether successful or not, the resolution attempted in *The One Culture?* is a sustained effort to offer some ideas to the science wars discussions.

The neologism "epistemography," coined by Peter Dear, provides us a final example of offering an innovative idea to the debate. Epistemography is "a loose grouping of the most central and characteristic kinds of work currently encompassed by the label "Science Studies"…. It designates an enterprise centrally concerned with developing an empirical understanding of scientific knowledge, in contrast to epistemology, which is a prescriptive study of how knowledge can or should be made" (Dear 2001, 10-2). Dear's move helps clarify the vexed issue of relativism. What are these central and characteristic kinds of work? His concept of epistemography delineates different relativisms: methodological, epistemological, and ontological. The latter two are typically coupled and labeled "philosophical" relativism. Epistemography deals only with "methodological" relativism as the core of science studies' constitution, excising the

[45] So, for example, it is only in the third round of discussion in *The One Culture?*, in a footnote (that runs to two pages in length), in a parenthetical aside inside that footnote, that Sokal and his recent co-author Jean Bricmont state outright that their most significant beef with science studies is with methodological relativism (Sokal and Bricmont 2001, 25-7). Labinger (2000) also said that this (fifth-order!) level of rhetoric was only clarified after several rounds of e-mail correspondence with Sokal and Bricmont during the editing stages of the manuscript.

other two relativistic variants from topics of research. Dear parses the term again, between truth and belief, and eliminates the discussions about truth. With epistemography at the core of their research program, science studiers deal with "methodological relativism about belief"—that is, why people *believe* the earth is round, that microbes can be bad, or that the early moderns did remarkable experiments. Not "what is *true*", but “why do we believe this is true"; not “why was Pasteur so great", but “why do we characterize Pasteur as a great scientist?” As Dear says, “If someone asked me why I believe the earth is round, it would little serve my case to reply that I believe it because it’s true” (Dear 2001, 10-5). An explanation of why we believe what we believe is the core purpose of science studies.

The proposition of epistemography is a win-win set-up for the science warriors: first, it is a clarification of what is going on in science studies and of what the science defenders *should have been* arguing against—not all the other branches of relativism that they so readily misapplied; and second, it is a *concession* that if science studies had communicated their research projects more clearly themselves, earlier on, and more frequently, these confusions might have been avoided. The practitioners of science studies “have all along engaged in an enterprise that we, too, have not known how to name” (Dear 2001, 10-1). Most importantly, though, to move beyond the debate, is a further concession and clarification by Dear. This acknowledgement is the recognition that epistemographical accounts are not immune from criticism, but that such accounts cannot be considered attacks against science. With this clarification, we find that epistemography avoids the distinction between treating science as “unique” and treating it as “one way among many” as *a priori* investigative stances, thereby progressing beyond the main presuppositions of the science wars debate. The key advantage to Dear’s proposition is that “the complete analytical divorce between truth and belief means that the epistemic relativism attaching to beliefs has no bearing on any kind of position that maintains that truth is somehow “relative”” (Dear 2001, 10-5). The charges by the most prominent science defenders, Gross, Levitt, Sokal, and Weinberg—that science studies deny scientific truth—are irrelevant. The charge, and misunderstanding, that science studies is somehow engaged in the same agenda as science is irrelevant. And the charge that a constructivist is necessarily anti-realist, or that a methodological relativist cannot be a realist away from the job, is irrelevant.

Culture Wars, Cold Wars, Science Wars

As we have seen, minor skirmishes in the 1980s and early 1990s preceded the opening assault on science studies at the point of Gross and Levitt's 1994 book. As a subset of the broader culture wars of the 1980s and 1990s, the science wars debate owed their genesis to more widespread philosophical disagreements than just the singular rise of science studies (see Bloom 1987). Furthermore, as historian of science David Hollinger has written, disputes over universalist constructions of the cultural meaning of science have recurred for centuries (Hollinger 1995, 441; also, see Latour 1999, 216-265). Even the "wars" nomenclature had gained wide currency by the early 1990s, with one author citing the etymological derivation from the sci-fi *Stars Wars* of 1977 (Labinger 1997, 203). Other cultural analysts, who paint those broader "culture wars" as a crisis of over-specialization in the academy, make the general observation that closer attention to fewer subjects leads to obscure writing and a undue complexity of language. According to cultural historian Russell Jacoby, this trend is evident with the "insistent argument that simplicity in language indicates superficiality, and that complexity indicates subversion" (Jacoby 2000, 48). Such complexity, with its concomitant obscurantism, applied to studies of science as much as anything else. Thus, the "science studies renaissance" that arose from the 1960s in the work of Thomas Kuhn and Derek de Solla Price, for example, came about "at a moment when academic intellectuals of a scientific orientation were being widely recognized as the basic arbiters of culture and the most vital policy resource for the nation" (Hollinger 1995, 451). Hollinger also recognizes that the emergence of this body of work "took almost for granted the political security of the enterprise of science" (450). By the 1980s, when the activism of previous decades that sought to temper this scientific polity had waned, the cultural authority of science was uniquely situated (see Lewontin 1995).

It is interesting, then, that the growing prominence of science studies—born from the political security of science—became aligned with postmodernist tendencies to view such authority as subversive. Deconstructing science, as with the tools of Derrida, or defining local and relative knowledges, as with the theories of Foucault and Geertz, became associated with scholarship that defined scientific knowledge as locally bounded

and contingent (see Fuller 2000, 211). The prevalence of a Foucauldian knowledge-power equation encouraged scholars to implicate science, the superior producer of knowledge, for its authoritarian nature. As the sociologist Ullica Segerstråle points out, "we might understand the current criticisms of science within the humanities [i.e., science studies] as part of the *humanists delayed counterattack* against the postwar cultural hegemony of science" (Segerstråle 2000, 104). As such, we can see the growing complexity of the science wars scenario, since attacks upon counterattacks had already begun within the academic culture wars of the late 1980s.

The conservative attacks against specialization and postmodernism in the culture wars compounded the humanists' counterattacks, as Hollinger and Segerstråle see it, against scientific cultural hegemony. When the culture wars and political correctness were becoming prevalent in the late 1980s, the confluence of these battles with the growing prominence and institutionalization of interdisciplinary science studies programs set the stage for the science wars. We should not be surprised that some critics have contextualized the science wars within the era of the end of the Cold War. Those critics have pointed to a change in public funding of science in the early 1990s (see Hayles 1996; Collins and Labinger 2001, 1-7) and have suggested that the defeat of communism dealt a blow to 1960s radicalism (see Gross and Levitt 1994/1998, 27-34 and 40; Forman 1999; Lewontin 1995). These arguments gain credibility when we examine the 1994 timing of Gross and Levitt's attack. However, given the broader context into which the debate was born explaining the reasons for the attack in economic and political terms alone is insufficient. So, while even the science wars owed a debt to previous constructions of intellectual cultural disputes, they were a distinct, historically-situated disagreement. Analyses of the debate have highlighted various dichotomies to account for the alliances in the wars. In the next section, I provide my own analysis that highlights the basic opposition of the science wars: the science defenders, or, those defending a *science-as-different* idea, versus the science studiers, or, those advancing a *science-as-same* concept.

The structure of the debate

My goal in this section is to analyze the dichotomizing structure of the science wars. This conflict has been described as natural science v. social constructivism, pro-science v. anti-science, and politically liberal v. politically conservative. While each of these binaries has a part in the debate, none of them can adequately explain it. Rather, the basic split that accounts for the various positions taken in the science wars and offers the most explanatory power is between those who conceptualize science as a unique and superior knowledge-producer and those who view science as one way among many to know the world. The "unique and superior" argument maintains that science is at the top of a hierarchical knowledge structure. The "one among many" argument maintains a view of science as culturally contiguous with other forms of knowledge. The different visual metaphors to imagine are a pyramid and a level playing field. For shorthand, I refer to the "unique and superior" side as *science-as-different* and the "one among many" as *science-as-same*. When we recognize this opposition, the issues of authority and credibility follow logically—that is, viewing science as superior and unique justifies its authority to explain the world; viewing science as one possible knowledge-producer among many justifies methodological relativism. Practitioners of the *science-as-different* view base their explanations of science on scientific hegemony. Practitioners of *science-as-same* make no a priori judgements of the epistemic uniqueness of science, even if they might conclude from their research that science is uniquely structured.

A basic opposition

The Paul Forman quote at the beginning of this chapter—"The artist has always had to contend with the hated critic. But whence comes this new thing, the science critic?"—provides the science studiers' attitude toward the science defenders' perspective of the debate. Although I used the *Calvin and Hobbes* cartoon above for caricature, that sketch, along with Forman's epigraph, demonstrates the central problem of communication in the science wars. That is, science studiers consider the enterprise of science a research topic, while the science defenders consider STS research uninformed criticism. Thus, "whence comes this new thing, the science critic" is open to two interpretations: for science defenders, science is being criticized in the negative sense by unauthorized personnel; for science studiers, it is being critiqued in the Kantian,

academic sense of the word, facilitative of growth and understanding, by qualified researchers. Science defenders want to know why science studiers seek to dismantle the cultural authority of science. They ask, do science studiers unmask the sciences for the purposes of disintegration?[46] The science studiers see the matter differently. They might ask in return, does science possess supreme cultural authority? Why? How and when did it come to be so? In posing and answering these questions, science studiers have challenged the epistemic authority of science.

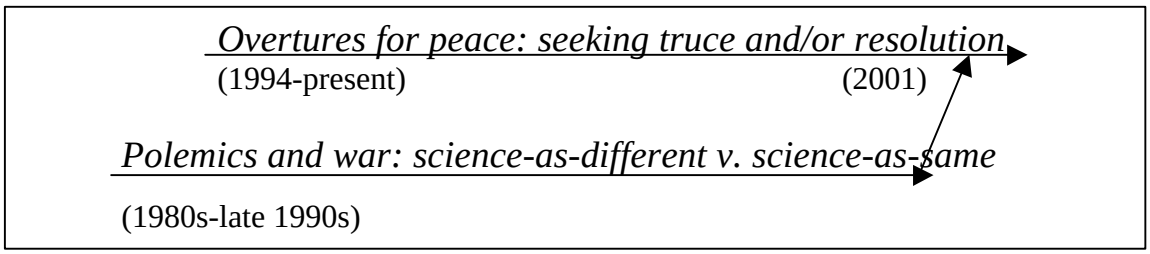


Figure 2. The two-fold path of the science wars, as in Figure 1, relabeled here to highlight the goals of each strain of the debate.

I characterized the science wars as a complex academic debate that fell along the lines of a plot structure from exposition, crisis, and climax, to resolution. Forgoing linearity, though, some debaters have sought resolution, with signs of reconciliation towards the end of the 1990s (See Figure 2). The evidence for resolution has come not just from those involved in the debate, but from commentary on the wars from outside observers. For example, the philosopher Ian Hacking, who can be considered an insider (as a science studier), wrote a very useful analysis of constructivism and the science wars as if he were an outsider, perceiving the debate as an event of the past (Hacking 1999). Sociologist Thomas Gieryn wrote an epilogue to his text about boundary work by applying that concept of cultural boundedness to the science wars itself, in the process providing extensive bibliographic references and a decidedly retrospective view (Gieryn 1999). One collection is actually titled *Beyond the Science Wars* (Segerstråle 2000) and another, *The One Culture?*, actively engages many prominent players in the debates in a concerted effort to move beyond a possible stalemate caused by misunderstandings (Collins and Labinger 2001).

[46] Ian Hacking (1999, 53-54) expands on the perceived unmasking of science in his estimate of the lines of battle, with reference to Karl Mannheim's use of the concept.

The retrospection of the above authors leads us back to my initial questions: what was the structural opposition in the science wars and where did it come from? Gross and Levitt's argument did not derive solely from a post-Cold War funding issue. Rather, their objections resulted from a general postmodern climate within academia that suggested science was merely one form of knowledge among many. However, postmodernism is as tenuous to define as science. Thus, for us to claim that the science wars were a reaction to "postmodernism" requires a significant degree of clarification, just as saying that Snow was reacting to the literary humanities required further contextualization. For example, the account I gave earlier, settling on postmodernism as the expression of Foucault's knowledge-power equation, indicated a partial view of postmodernist doctrine. Other tenets of that philosophy helped science studiers establish the inter-relations of science with society, to question taken-for-granted distinctions between an inside and outside to science, and to establish a more mature view of science as a social practice (see Knorr-Cetina and Mulkay, eds. 1983; Latour 1987; Rouse 1987 and 1993; Pickering, ed. 1992). However, Gross and Levitt—and the science defenders—reduced the science studies alliance with postmodernism to an expression of relativism. Specifically, the science defenders reacted to the aspect of postmodernism that seeks "to valorize "ways of knowing" incompatible with" science (Gross and Levitt 1994/1998, 11).

This position was clarified and restated by the authors several times. The following citations exemplify the view (all from Gross and Levitt 1994/1998):

> "For decades certain assumptions about the epistemological ranking of various fields have prevailed….The recent critiques of science incarnate attempts [*sic*] to regain the high ground, to assert that the methods of social theory and literary analysis are equal in epistemic power to those of science" (12).

> "…the central tenet of the various schools of thought that make up the academic left is one that may be labeled "perspectivist"…. They are at best the expression of local "truths" and "structures" that makes sense only within a certain context of social experience" (38).

> "Outwardly or covertly, [the academic left] insist on supplanting standard science with other "ways of knowing"… (249).

For the science defenders, the science studiers have questioned the privileged epistemology of science. Gross and Levitt highlight the view that science has unique access to truth. Philosopher of science Michael Ruse views the privilege of science

similarly, since "science uniquely transcends culture" (Ruse 1994, 41). Countering uniqueness alone would not be so deplorable, the defenders insist, if the science studiers were not so bold as to question the supremacy accorded by that uniqueness.

The science studiers response to *science-as-different* was exemplified in the *Science Wars* volume of essays, as I discussed earlier (Ross, ed. 1996). Emily Martin's claim that she "has treated scientific forms of knowledge as one strand among many that make up knowledge about the body" may be just the most salient example of deploying the *science-as-same* argument (Martin 1996, 61). In her case, an a priori belief in the value of different forms of knowledge opened up avenues of research into biology and medicine. Martin does not deny the value of science as an epistemology. She just considers other forms of knowledge as valuable and useful. Sociologist Trevor Pinch's view is that "science is no different from other craft activities like pottery, carpentry, and cooking" (Pinch 1996, 16). Likewise, for Richard Levins, an evolutionary ecologist, science is not a unique knowledge-producer (Levins 1996). He begins his own work with the proposition that science is like other modes of learning in that "all knowledge comes from experience and reflection on that experience in the light of previous knowledge" (Levins 1996, 180). Even if his view shows an allegiance to one particular philosophy of science, a science defender would have to enter into an evaluative discussion about whether Levins' approach was "right" or "wrong." But the science warriors were never that subtle.

Analyzing the terms

> We really must get over the absurdity of holding what is cultural to be unreal. After all, acid rain is real, smog is real, the bomb is real. And if ostrich-like we choose to ignore the evils that are our own doing, our ignorance is real (Grene 1987, 74).

Commentators have considered the science wars a response to claims of cultural or social constructivism that supposedly denied scientific realism, to anti-scientific sentiment among cultural critics, to fears of funding cuts resulting from the end of the Cold War, and to shoddy scholarship among leftist postmodernists. Yet, not all who are defending science are natural scientists; and not all who are studying the enterprise of

science are science studiers. Nor can the structure be aligned with political affiliations, since both sides of the debate have claimed allegiance to the "left" (Gross and Levitt 1994, 8-9; Sokal 1996b; MacIlwain 1997; Gieryn 1999, 341). As Segerstråle says, "political allegiances do not seem to have much explanatory power when it comes to the activities of the anti-antiscience warriors [i.e., science defenders]" (Segerstråle 2000, 78). Of course, Gross and Levitt decry the fallacies of the academic left, but they do so to reinvigorate, or reestablish, the political left. And, as I will conclude later, a salient characteristic of the defenders' argument was a call to return to the common notion of a two-culture divide—that is, it was reactionary, and thus perhaps politically conservative (see Heller 1994 and Will 1996).

Certainly, each of these characterizations of an opposition carries some weight, but none has sufficient explanatory power by itself. Each issue is secondary to the main explanatory dichotomy in the science wars between *science-as-different* and *science-as-same*. Another example of this dichotomy comes from Henry Bauer, a natural scientist and science studier. His dissatisfaction with current STS derives from a lost ideal: Bauer "came to science studies…for insights about what is *special* about science, what is *different* about science" (Bauer 2000, 51). Bauer explains how over the past few decades, science studiers have become intent on showing how science is the same as other human activities and by "harping always on human frailties of scientists misses the important points, and the big picture, [amounting] to denigration of science" (Bauer 2000, 52). Similarly, Weinberg protests that "…science *differs* [my emphasis] from political or artistic history [in that] the achievements of science become permanent" (Weinberg 2001, 9-10). On the other hand, science studier Trevor Pinch observes that "…science studies breaks down this cozy relationship [between science and other forms of knowledge]. Rather than treating science as the "exotic other" or just as a different animal, it levels the playing field" (Pinch 2001, 2-7).

Following these characterizations by Pinch, Weinberg, and Bauer, we have to recognize perspective dependency when assessing the sides of the debate. The battles are defined in one way from the side of the science defender, yet differently by science studiers: the two sides are not aligned as mirror images of one another. Thus, interpreting whether or not a study of science is anti-scientific depends on the concept of science one brings to the discussion. Earlier, I suggested representing the two camps of the debate

with a visual metaphor of a pyramid on the side of the science defenders and a level playing field on the side of the science studiers. That relationship is more accurate than the mirror image opposition, especially given the conflict in conceptualizations of science. For Weinberg and Bauer, the different and special epistemic privilege of science explains its rightful position of authority. As Pinch notes, "For many practicing scientists…the hallmark of why scientific knowledge is special…is precisely because science is epistemologically privileged" (Pinch 2001, 2-10). For the contributors to Ross's *Science Wars* volume, science is not uniquely structured, nor different from other modes of learning, or even, for Aronowitz, unlike a community of industrial workers.

Viewing the debate within the overarching structure of *science-as-different* v. *science-as-same* also helps explain why not all historians, for example, align themselves with the science studies side, or all scientists with the defense (see Lewontin 1995). This view also allows us not to relegate realist arguments only to the science defense. Many of the commentaries about the science wars *have* reduced the dispute to one of realism versus constructivism (Wolpert 1994; Weinberg 1994; Gross, et al. 1995; Dickson 1997; Fuller 2000). The realist concern has some merit, and the grounds for much of the debate have been drawn from an explication of what constructivism is, but the realism-constructivism issue is secondary to the broader structure of participants. Hacking distinguishes between six types of constructionism (his term) as he observes that "the basis of genuine and fundamental disagreement [in the science wars]…can be stated without using elevator words like "fact," "truth," or "reality," and without closely connected notions such as "objectivity" and "relativism"" (Hacking 1999, 33). Of these types, the distinction Hacking makes between the "construction of an idea" and "the construction of an object" and the confusion between the two are most relevant in our case, as does his goal of demonstrating that something can be real and constructed.[47] That is, constructivist accounts of science do not *necessarily* imply anti-realism. Even if they did, the specific *form* of anti-realism would need to be explicated along with the *form* of constructivism. This is the problem of communication that follows from a

[47] The idea/object distinction is also in keeping with Hacking's (1983) more notable theory/entity distinction with respect to types of realism. For discussion about how something can be real and constructed at the same time, see Hacking (1999), esp. chapters 1 and 5, wherein he tries to correct Stanley Fish's (1996) attempt to demonstrate the same thing. I will say here briefly that once we recognize the variety of interactions between the different types of construction, it becomes apparent that some aspects of

perspective-dependent description of the debate: just as the scholars who have debated the issues cannot be relegated to one discipline, the philosophical allegiance of those scholars cannot simply be bifurcated.

The concern over relativism in its many forms—epistemological, ontological, methodological—also finds its source in recognizing what each side is doing, and why. But, like Hacking, at least one scientist has noted that the "disagreement is not (just) over something as abstract as epistemology or metaphysics, nor as vaporous as politics. It goes to the heart of the reasons most scientists feel good about their work, and hence about themselves" (Saulson 2001, 22-5). And the reason people feel good about themselves is because they are contributing something unique.

The perspective-dependent definition of the debate allows asymmetrical arguments to be made, so that science defenders can question science studies literature, while science studiers are excluded from questioning scientific achievements. Likewise, science studiers ply their trade of reflexive analysis throughout the debate so that it becomes difficult to separate primary contributions to the wars from secondary commentaries on those contributions. These comments on the rhetorical approach help establish how the debate has been conducted. The terms used in arguments about the issues are familiar enough: realism, objectivity, relativism (methodological or otherwise). As I alluded to above, these are what Hacking labels "elevator words," since they raise the discussion to a higher philosophical level, although they do not solve problems by virtue of this elevation alone (Hacking 1999, 21). They are related to what is at stake in the science wars, but the terms do not account for the structure of the disagreements. The elevator words are enrolled to demonstrate how important the position of the proponent is, or to show how ludicrous the position of the opponent is.

Much of the substance of the debate has come from how each side treats the qualifiers to their descriptions, and this difficulty persists even in my analysis of that debate. How I qualify the statements "science is different" and "science is the same" will go far in setting my own view onto one side or the other. Is science a different *practice*? Does science have a unique claim to truth, one that other epistemologies do not have? Does it have a unique access to reality? Does science operate with a correspondence

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a "thing" can be constructed while others are "real." As an example, Hacking (1999, 63-99) points to Pickering's *Constructing Quarks*, which is about the construction of the idea, not the object.

theory of realism that grants this privilege? Is science our best form of human knowledge? By no means do we have to answer only "yes" or only "no" to all of these questions. Science is different in practice than other disciplines. But so too is literature different; and religion; and law; and mythology. Science has proven to be more successful than other forms of knowledge in acquiring material ends, in prolonging life, in establishing security and wealth. This has been accomplished by using science as an arm of politics and by organizational strengths that are credited to analytical worldviews, for example—in fact, both of these comments are topics that science studiers need to research. The debaters did not rely on insisting on *practical* similarities between culturally contiguous knowledge producers. All along, the issue of the practice of science (except for its various *methods* of practice) was not enrolled as a point of dispute. And if debaters did observe the non-existence of a unified scientific method, this was intended to highlight the heterogeneity of science, not its lack of novelty.

From the outset, authority and credibility were the most significant issues at stake. Yet, it was the science studier's credibility that was contested, not the scientist's. "Science" was never in danger of losing the science wars, nor would scientific practice be damaged by the outcome of the debate. Gross and Levitt's fears, whether well-founded or not, were targeted at the cultural perception of science and the safeguarding of terms like rationalism and truth. The primary level of disagreement between *science-as-different* and *science-as-same* was bolstered in the crisis phase through asymmetrical argumentation and by reference to an authority-credibility relationship.

Conclusion

Charges of irrelevancy came up several times in the debate. Perhaps the charges that science studiers deny scientific truth—a fair characterization of the defenders' position—were irrelevant all the while, but that point had never been successfully made. Weinberg's use of the philosophy/ornithology analogy claimed that the scholarship of science studiers was irrelevant. But that charge fundamentally misconstrued the purpose of studying science. Maybe these allegations of irrelevancy derived from the heterogeneity of the members of the two sides—there are of course fundamentally divisive differences in approaches to studying science, and in approaches to practicing

science. A more adequate explanation, though, is that the boundary work done by both sides to demarcate relevant critique from extraneous and uninformed commentary derived from the concept of science being utilized by each participant. The science wars have been a debate between those who perceive science as having a privileged access to reality and those who treat science as a knowledge-producing enterprise that is culturally contiguous with other forms of knowledge production. In between these two positions, and on the outer fringes of them, reside a spectrum of beliefs about what science and reason are.

The early phases of the science wars were characterized by accusations that science studiers were anti-scientific. This charge was associated with irrationalism, given that what was being potentially unmasked was the sanctity of science's superior foundation. That position of superiority helps us explain the credibility science has for describing the world. As the debate continued and grew in prominence, this relationship between authority and credibility was codified into an authority-credibility-supremacy triumvirate, by which defenders could base their critiques against the science studiers whose own critique was then perceived to be against the public welfare. Since *science-as-different* had already been established, arguing asymmetrically became the means by which the defenders could assert a criticism of science studiers that, in turn, claimed the studiers could not criticize science. Finally, as a consequence of the unique structure of the science wars, the parallel path of resolution (meta-commentary) has merged with the main path of debate over the past few years, wherein representatives from both sides have sought to understand what the other side has to say. But debates do not necessarily end with agreement, and the science wars are no exception.[48] Nonetheless, despite the creation of a small market niche for science wars participants—or in addition to that fact—the resolution has meant that at least some of the debaters have heard each other.

The tone necessary for resolving the differences is exemplified by Peter Saulson, a gravitational wave physicist who had been the subject of some of Collins' earlier work and a critic of science studies. He says, by "discussing these matters [of disagreement] I have learned that science is in fact a much less distinctive activity than it first appears. Deep in my heart, I confess that I still hold the faith that something about it is both

unique and uniquely good. But identifying and explaining that feature also seems to be uniquely hard" (Saulson 2001, 22-5). The projects of science and science studies are not the same. Concerns that the studiers cannot have anything to say about science derive from the perception that the uniqueness of science precludes informed, outside commentary, though if science is culturally contiguous with other knowledge producers, the concern for methodological relativism makes little sense. Furthermore, faith and belief about how science is culturally situated reside at the core of the science wars. The combination of these facets of the debate define the regime where resolution will take place. The means to move beyond the debate are not those of finding a middle ground, of compromising, but rather they are to be found by choosing the terms of the argument on a level above this main structure of debate.

[48] Labinger (2001, 28-1) warns "Let's Not Get Too Agreeable," while Weinberg (2001, 24-1) says that although he agrees largely with the arguments in *The One Culture?*, "perhaps it is still not too late to draw back from the brink of peace.

CHAPTER 3: *THE TWO DEBATES IN COMPARISON*

…a change came over analytic philosophy around the time that philosophers began reading Wittgenstein's *Philosophical Investigations* side by side with Kuhn's *Structure of Scientific Revolutions*…. The result of this collaboration has been the blurring of the lines between the sciences and humanities, and an attempt to make Snow's [two-culture] controversy as quaint as the 19th century debate over the age of the earth.

--Richard Rorty (2000)

Science studies, rather than endorsing the parallelism of the two-culture thesis, asserts that there is *one culture* in the sense that both science and the humanities share the characteristics of being cultures of expertise.

--Trevor Pinch (2001)

This thesis is a work in the history of intellectual debates. In the first chapter, I discussed the main positions of the two-culture debate, with specific attention to the conceptualization of science that Snow used in his thesis. A Cold War context provided the basis for Snow's positivist, hierarchically-defined science; the triumph of the scientific attitude that Snow forwarded led to moral, cognitive, and cultural authority for both science-as-knowledge and scientists-as-citizens (see Hollinger 1995). In the second chapter, I told the story of the science wars and discussed the main positions of that debate, with specific attention to how the two sides predicated their arguments on differing conceptualizations of science. The science defenders relied on the uniqueness of science to justify its superiority; the science studiers treated science as a knowledge-producer, culturally contiguous with other epistemologies, neither unique nor superior by definition. The historical context for the science wars was much different than that for Snow and Leavis, having emerged from the culture wars of the late 1980s. Attacks on the authority of science and technology in the broader society had been the legacy of

1960s and 1970s campus radicalism. But, with Allan Bloom's *The Closing of the American Mind* as exemplar, it was academia itself that came under attack at the end of the Cold War (Bloom 1987). The science defenders sought to debase science studies scholarship that denied tacit epistemic authority for science, a move those defenders thought belied the moral structure of society.

As academic debates go, the two share a common concern for science, its impact, promise, implications, and operation. It is not surprising, then, that many science warriors have viewed their skirmish as evidence for the ubiquity of Snow's construct and as an argument comparable to the Snow-Leavis debate. Many scholars have made the comparison, and the prevailing opinion is that, yes, the two debates are inextricably linked.[49] However, before we agree, we have to note the important differences. Most starkly, given the influence of science studies on the two-culture divide, it seems curious and somehow misplaced to allow the science wars to be considered a modern two-culture debate. The contexts and the structures of the debates are different. In this final chapter, I will compare and contrast the two debates, concluding that although they share many practical similarities, the significant differences between the two are more important.

Since the debates are open to interpretation, and will be for a long time to come, it might not seem important to define their meaning in stone, or to disclaim their similarities. However, just as it will be an important move for science studies to redefine itself after the truce of the science wars, so too will it be important to recognize the relationships of science studies to both science and the humanities. This redefinition too may seem mundane, but it is because of science studiers' unique attention to the two cultures that the inter-discipline needs to be understood in light of its relationship to the cultural split. Claiming that the science wars are a recurrence of a two-culture debate indicates that the very meaning of the interdisciplinary approach has been negated, in a sense. That is, in one significant way, while the two-culture debate dealt with which side of the divide was 'better,' the science wars debate was based on whether or not scholars should adhere to a two-culture divide. When we compare the two debates we thus relegate science studies to continued misunderstanding. If science studies scholars do not understand this point, then the science wars battles were for naught.

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[49] See note 1, page 3 of the present thesis for citations.

Given that one side of the science wars was composed of scholars who studied science—as a cognitive, practical, rhetorical, theoretical enterprise—that science studies side would seem to have a keen advantage in the debate. After all, debates about "what is science" are at the center of every study of science. And, more pointedly, controversy studies are at the core of constructivist topics of research (see Collins and Pinch 1993/1998; Martin and Richards 1995). For example, in the previous chapter I discussed the perspective-dependent nature of the debate. That was another way to say that both sides can look at the same situation and see two different things. Perspective-dependency explained the justification for the asymmetry used in the science wars arguments. So, Gross and Levitt refer to the debates in Andrew Pickering's *Science as Practice and Culture* as "internecine wars [which] suggest that practitioners of this subdiscipline [i.e., science studies] disagree, and misunderstand one another…" (Gross and Levitt 1994/1998, 290; see Pickering, ed. 1992). But science studiers recognize the debates in the Pickering collection as integral to the science studies program. What is an "internecine war" to the science defenders is standard fare to the science studiers. It seems like an obvious observation to make, but the focus of science studies is the enterprise of science, just one of the two cultures in Snow's thesis.

In one sense, the science wars were waged by science defenders to argue that answering the question "what is science" must involve the scientist's views as well as the science studiers (see Labinger 1995; Bauer 2000). Rarely, though, were the defenders that subtle or understanding. It was only in retrospect, as with Bauer, or while attempting to resolve the debate *in medias res*, as with Labinger, that the point of including the scientists' views was salient. For the most part, the defenders' position was to exclude science studiers as mere humanists or social scientists. By virtue of their non-scientific status, the science studiers were located across a cultural divide that could not communicate with the natural sciences. Snow decried that communication gap; the science defenders wanted to reassert it.

How much has changed in the interval?

Steve Fuller, in his review of *Higher Superstition*, states that "the one didactic advantage afforded by [Gross's and Levitt's] monolithic portrayal of the natural sciences is that it licenses us to revisit the 'Two Cultures' controversy that C.P. Snow sparked….How much has changed in the interval?" (Fuller 1995, 117) However, Fuller neglects to follow through with his suggestion or to clarify the direction of his query. Though he speaks briefly of political changes, he says nothing of how the two-culture construct has changed. We are left to wonder *how* and *why* the science wars license "us to revisit the 'Two Cultures' controversy"? How much of *what* has changed? Fuller exemplifies the tendency to compare the two debates, citing the Two Cultures as a precedent for the science wars in at least four publications.[50] Other scholars make similar comments, but mostly for the pop cultural significance of referencing what has become a common example of an inability to communicate with academics outside one's chosen field.

There are two distinct levels on which to compare the science wars with the two-culture debate. On the first level, scholars note that the two cultures are still unable to speak to one another, as evidenced by the retorts of science defenders. On one conceptual level higher, the comparison is between the actual debate between Snow and his opponents (most notably, Leavis) and that between science defenders and science studiers. Two-culture revisits are so rampant, and have been ever since 1959, that it was inevitable for the science wars to draw comparison.[51] Doing so allows a writer to circumvent the root causes of the disagreement, ignore historical context, and easily enroll allies. But, these factors are generally applicable to the first, pop culture, level of comparison. On that rudimentary level, the distinctions between the cultures are easy to recognize, because they are visible in their practical appearances and from mundane activities. By all means, scientists and humanists reside in different places across an academic campus and live in different professional cultures. Even if they both conduct

[50] Most overtly, Fuller (1995a) titles a contribution to the 1995 European Society for the Study of Science and Technology meeting, "Two Cultures II: Science Studies Goes Public." The others: Fuller (1995b) 117; Fuller (1996) 29-60; and Fuller (2000) 185-190. This last source is an attempt to show how the two debates are different, though the disparity is not brought clearly to light. Fuller's account rests on noting that "If the Science Wars are a Manichean struggle between "The Arts" and "The Sciences," then all humanists and social scientists should feel under threat. But they do not" (Fuller 2000, 185). While I agree with this assessment, I find it lacking in explanatory power.

[51] See Appendix 1 for a compendium of recent "Two Cultures Revisited" examples.

research, one is performed in the laboratory, or out in the field, while the other is done in the library or in a study. Scientists have their own distinct publication outlets, professional organizations, and acceptable styles. Grades are usually assigned numerically in chemistry courses, while humanities professors generally give letter grades. All this is just to say that there were legitimate practical differences between Snow's two cultures fifty years ago, and there are still practical differences today. However, the argument in this thesis, and this chapter specifically, is not directed against that proposition. And even if it were, I would have to ignore two facts: that the practical differences given above exist between any two academic disciplines and individual personalities, and that issues of academic specialization have a significant role in creating more and more distinctions.[52]

The argument in this chapter is addressed at the conceptual level and how "things have changed" over the past forty years. Rather than filling in the thick description of forty years of academic history, though, I am providing a two-point comparison between the early 1960s and the mid-1990s. The broader issues of epistemic authority, credibility, and educational implications have recurred with the science wars. However, the efforts of interdisciplinary science studies have repositioned the divide between natural science and the humanities, first, conceptually, by describing science as culturally embedded and without a superior epistemological foundation, and second, methodologically, by combining divergent approaches to viewing the divide. In the years since Snow, some disciplinary efforts tried to bridge *two* cultures, some tried to blur them into *one* culture, and some tried to deny the divide, prescribing *three* cultures or more.

In the first chapter, I discussed the role of the history of science in the first half of the century. George Sarton, Charles Singer, and Herbert Butterfield cast the history of science as a bridge between the arts and sciences, accepting the proposition that there were two distinct regimes of intellectual activity. Another group of disciplines that spoke to the two-culture construct was the social sciences. Snow did not mention sociology or anthropology in his first version of *The Two Cultures*, but hastened to add that the social

[52] See Bauer (1990), who makes the point that cross-disciplinary differences are present well beyond a polar distinction of science and humanities. Also, around the time of Snow, Michael Polanyi argued that such differences were inherent in the division of labor between any two cultures, and not simply the dichotomized science and humanities (Polanyi 1969).

sciences might be a third culture in his *Second Look* of 1963 (Snow 1993, 71). Clifford Geertz, for one, denied that the social sciences could be relegated to either side of the divide, calling them the "'Third Culture' Snow forgot" (Geertz 1983, 158). In the years since the Snow-Leavis debate, several works have taken the view of Geertz, denying the limiting either/or choice of a two-culture construct (see Lepenies 1985; Furlow, ed., forthcoming). A third science studies approach that has direct relevance to a two-culture construct is the broader study of rhetoric. Rhetorical studies of science work across the two-culture divide, even in name, concentrating on the study of science writing.[53] From this view, both literature and science are forms of knowledge that derive from one common culture. The approaches to studying literature and science therefore blur the divide between cultures (in a hierarchical fashion) and invoke a pluralistic, contextual approach (Levine 1987; Bazerman 1988; Prelli 1989; Peterfreund 1990; Dear 1991; Slade 1991). The two means by which science studies reposition Snow's divide—conceptual and methodological—work together to forward a description of science as local and contingent. Thus, the science-as-same argument derives from the boundary definitions of science that result from the combined approaches of various members of interdisciplinary science studies.

Changes in the historiography of science since Snow's day highlight this concept of science as local and bounded. In Chapter 1, I discussed the birth of the history of science at Cambridge was described in terms of Butterfield's guidance towards context-specific histories and away from retelling the stories of scientists that scientists tell themselves. As such, the bridging mechanism so loudly trumpeted for its moralizing effects in the first half of the century began to deteriorate just as historians of science established academic autonomy. Paul Forman has commented on the history of science's bridging function, observing that the "…divergence between science and the humanistic world views has traditionally been of the greatest import for the history of science. Bridging the gap was the special cultural function claimed by historians of science from

[53] Various approaches to studying the writing of science are worthy of elaboration and discussion. The rhetoric of scientific writing, discourse analysis, and studies of literature that have scientific themes fit within this broad category. However, I focus on the field of Literature and Science, both for the sake of clarity and because "Literature" and "Science" fit neatly into the history of the two-culture thesis. The efforts of the Society for Literature and Science, founded in 1986, whose journal, *Configurations*, was founded in 1993, have been central in this recent history.

the mid-eighteenth to the mid-twentieth century" (Forman 1991, 84). Of pertinence here is I.B. Cohen's claim, in 1961, that he was getting "weary" of this bridging purpose, a comment that supported Forman's dating of the end of the historian's "special cultural function" around the time of Snow's thesis.[54]

When we consider that interdisciplinary science studies include divergent approaches to studying science like the history of science, sociology, philosophy, and literature and science, the viability of a simple two-culture opposition no longer makes sense. An elaborated understanding of science, such as that provided in science studies scholarship, repositions and subsumes Snow's articulation. In sum, the hagiography of hegemonic science prominent in the positivist spirit of Snow's generation has given way to contextual, localized, boundary definitions of the scientific enterprise among science studiers. From the science studies perspective, it goes without saying that these concepts of science say nothing *against* the success and influence of scientific achievement and opportunity. In fact, it might seem that these definitions enhance the authority of science, providing richer accounts of its history.[55] But, given past instances of miscommunication, the point does need to be stressed; and given conflations of science studies with post-modernism, and furthermore of post-modernism with delegitimizing power structures, we should consider Dear's neologism "epistemography" (methodological relativism about beliefs) as a useful way to accurately represent the core of science studies.

Of course, we cannot define all of science studies of a piece, but we can define the terms of the science wars as an argument between those who perceive *science-as-different* and those that see *science-as-same*.[56] The notion of *science-as-same* is given foundation by the ideas of local knowledge (Geertz 1983), scientific knowledge as always rooted in local, practical know-how (Rouse 1987 and 1993; and Kuhn 1962/1996 before him), boundary definitions (Gieryn 1983 and 1999), or nodes in an actor-network (Callon 1983; Latour 1987). Understanding this difference in scientific exegesis helps to

[54] Cohen's observations that "the slogan of the bridge still haunts us" and that he was "weary of being considered a bridge between disparate groups" were intended to serve as a call for a higher purpose for the history of science as an academic discipline (quoted in Crombie 1961, 773).
[55] Shapin is quoted in *Nature* as saying that "sociologists of science are 'doing scientists an honor by showing that science is a much richer, more complex, and heroic activity' than some rationalist explanations imply" (Dickson 1997, 334).

explain why the science wars debate differs fundamentally from the two-culture debate. With boundary work, there are many fields of knowledge vying for credibility and far more than two cultures. Ultimately, intellectual cultures are innumerable when the demarcation between them is no longer simply a negation, that is, when the humanities are not just the opposite of the sciences.

To be sure, the contrast is not a simple one. For example, the hybridization of an interdisciplinary approach attacks the two-culture distinction—by introducing social, humanistic elements to science—while trying to legitimize it—by studying science scientifically, for example, or by remaining in the schools of the humanities. Also, consider the following points of similarity (beyond the views of practical differences I have already excluded). (1) From the science defenders' point of view, the science wars are premised on the notion that science, as a distinct and superior way of knowing, has been attacked by outsiders, by non-scientists. The science defenders use the cultural divide as a rhetorical strategy to defend their positions and reassert their credibility. This strategy retains the scientists' authority and power as knowledge providers. This is consonant with the Snow-Leavis dispute. (2) Given this approach, it is not surprising that the science warriors have used language similar to Snow and Leavis. Gross and Levitt describe the "Scientists" and the "Academic Left" in their confrontation with verbiage similar to that used in the two-culture debate. The academic left, as Gross and Levitt have it, is turgid, full of perverse theories, ideological, and reliant upon metaphor. Science is objective, reliable, and self-correcting, resting on sound methodology.[57] The academic left (science studies) is described in *Higher Superstition* with the same antagonism that Leavis had described Snow.[58] And (3), Leavis rebuked Snow's thesis, by not granting science the same position of authority and moral guidance that Snow wanted for it. Likewise, the science defenders reproached science studiers' scholarship. Those defenders did not accept the notion that science was *not* a superior, objective, and privileged knowledge-producer. All of these points of comparison are viable, but only at a superficial level.

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[56] Let me reiterate that this 'same-difference' formulation is aimed at the conceptual level.
[57] See Gieryn (1999) 354, for an elaborated listing of the verbiage used in *Higher Superstition*.
[58] Note, though, that the direction of the charges are reversed: Leavis the *humanist* decried Snow the *scientist*; but Gross and Levitt the *scientists* decry the science studies *humanists* (and social scientists).

"The fox knows many things, but the hedgehog knows one big thing"

Isaiah Berlin used this verse about the hedgehog and the fox to differentiate between those thinkers who seek to uncover the infinity variety of things (foxes) and those who relate everything to one all-embracing vision (hedgehogs) (Berlin 1953). Of course, his thesis was an exposition of Tolstoy's view of history, which admitted of a more psychological "take" on how one may perceive the world. But the construct is useful. The advantage of the metaphor is that foxes may be pluralistic (a term Berlin uses), but they are not necessarily relativistic with respect to truth. They may be in search of diverse accounts of life, but they are also after reality; both foxes and hedgehogs are realists. Hedgehogs, in turn, are not *necessarily* reductionist, though they likely are.

There is a sense in which we can view the two-culture debate as one between two hedgehogs. Snow and Leavis were both opposed to pluralism, and both espoused unifying principles of life. Reviewing the debate twenty-five years after, Neil Annan, a friend of Snow's and target of ridicule by Leavis, observed that the two-culture affair was an argument between two monists. Both Snow and Leavis "saw reality as a set of huge blocks that could be comprehended in a single vision" (Annan 1987, 5). The fox-hedgehog split helps to explain why some thinkers say there is only one culture, from which science and the humanities derive, while some prefer to say there are hundreds of cultures, each uniquely identifiable. We can also recognize a sense in which the reality that the Snow and Leavis sought carried different moral manifestations. For Leavis and literature, personal relationships to the world—individual experiences—were superior for establishing a moral existence. For Snow and science, the moral call was for science to save the world—to feed the hungry, make the poor wealthy, alleviate international tension. Society would be irresponsible otherwise. As discussed in Chapter 1, Leavis thus fits into a progress-morality divide that had been recurrent in British society for many generations. The divide that Snow addressed, though not explicitly, was one of

morality contra irresponsibility. That is, the moral thing to do is to act as a responsible citizen of the world by utilizing science; we would be irresponsible if we did not take Snow's view.

In contrast, the science wars might be seen as a debate between hedgehogs and foxes. The science defenders embrace a vision of science as all-encompassing: science and reason will guide humanity to a better future, and, in fact, the only future. To question this is to be irrational. Their call is, in this sense, reactionary, because the defenders are demanding that we base our scholarship on the same morality-irresponsibility divide that Snow invoked. It is, in fact, a demand that we return to the two-culture construct that Snow decried, to a time when the communication between cultures was strained because the humanities could not understand the superior epistemology of science. Snow lamented this chasm of communication; the science defenders demand it.

Science studiers seek more complex explanations of those very notions of reason and scientific rationality, taking on the role of the foxes. Segerstråle discusses in her synopsis of perceived anti-scientific sentiment that one persistent facet of the science wars was to use rationality and scientific rationality synonymously, to the exclusion of more nuanced ideas about rationality (Segerstråle 2000, 114-115). Only by opening up the assumptions of science-as-epistemology and scientists-as-practitioners can we see the infinite diversity and, many say, beauty, of scientific reason. Science studiers have certainly been persistent about opening up black-boxes and questioning the taken-for-granted notions of its subjects. In doing so, they have had to resort to metaphors of intricacy, such as webs, networks (be they actor- or diacritical-), and interdependency, and so on. Berlin helps here as well, commenting on history, just as science studiers comment on science:

> [History is] a thick, opaque, inextricable complex web of events, objects, characteristics, connected…[and] divided by literally innumerable unidentifiable links—and gaps and discontinuities too, visible and invisible. It is a view that makes all clear, logical and scientific constructions—the well-defined, symmetrical patterns of human reason—seem smooth, thin, empty, 'abstract'… (Berlin 1953, 63).

Reading this, one thinks of Shapin's depiction of science as a web of material, social, and literary technologies in which the "working of each depends upon and incorporates the others" (Shapin 1984, 507). The more we look into the doings of science, the less likely it is that a monistic view can be maintained.[59]

Structural Comparison

When we recall the structure of the science wars as a debate between those who conceptualized science as superior and unique and those who conceptualized it as culturally contiguous with other forms of knowledge, it is easy to contrast that debate with the two-culture controversy. The main issues at stake in the "wars," authority and credibility, were argued through the expression of several subsidiary points. Those points were (1) scientific uniqueness, (2) asymmetrical argumentation, and (3) reflexive analysis. The conceptual disagreement over scientific uniqueness accounts for the other subordinate issues and is the most all-encompassing structural element of the debate. However, the terms of the debate intermingle so readily that it is difficult to unweave the threads without losing the fabric. That is, the science defenders conceive of science as a unique, superior, hegemonically-situated knowledge-producer, thereby justifying their claim to authority in matters of societal concern, their debasing of perceived attacks against that authority, and their denunciation of science studiers' methodology.

The question of authority is economic, political, and moral (see Forman 1999; Dear 2001). The equations by the science defenders of irrationalism and fleeing "from reason" with immorality laid the foundation for almost all the accusations against the science studiers, whether implicit or explicit. That is, the defenders equated anti-scientific attitudes with irrationalism; and they labeled science studies as anti-science. Then,

[59] The danger, perhaps, for science studies was that these interconnections came too close to post-modernist concepts for the likes of Gross and Levitt and their science defenders. David Mermin, though, who had quarreled with Collins and Pinch in *Physics Today* over *The Golem*, exemplifies the resolution phase of the debate by recognizing the fault in misusing metaphors, or in appropriating the same metaphor for different purposes. Thus, he invokes a tapestry metaphor, woven with multiple threads (perhaps, social, literary, and material ones), and says of the previous disagreement: "I suspect the major remaining bone of contention is not the weakness of many of the threads nor the strength of the tapestry-rope, but the uniqueness of the weaving, which…becomes…more and more constrained, as more and more strands need to be added" (Mermin 2001, 7-10).

instead of directly labeling the science studiers immoral, the defenders posed their critique against irrationalism. In this, they ignored Michael Polanyi's criticism of Snow's trust in the moral guidance of science almost forty years earlier. Polanyi had scrutinized Snow, claiming that "the naturalistic explanation of morality [denies] the very existence of human responsibility" (Polanyi 1959, 62). Thus, the defenders did no more than restate Snow's line, accepting the connection between morality and science but forgoing the ideals of responsibility that accompanied such an equation.

Asymmetry accounts for the perspective-dependent definition of the conflict. It also helps us explain why the defenders' reference to Snow's moral prescription cannot enable us to define the science wars as a two-culture recurrence. From the science defenders' perspective, science studiers do not have the right to analyze or critique scientific activity. From the other side, science studiers do not acknowledge a gap between science and humanities for the purpose of their research and thus are unconcerned with the defenders' charge. The asymmetry reinforces the authority question in a second way, because science defenders deny the outsiders access to scientific critique, but they themselves engage in non-scientific pronouncements. For science defenders, the scholarship is a one-way road, moving out from science to the broader world.

Reflexive analysis allowed the science wars to become a research topic for the science studiers at the same time the "wars" were a resource. That is, from the earliest days of disagreement there have been articles *about* the science wars that were aimed at outside commentary, not active participation. As I mentioned earlier, this is not surprising, since science studiers have been able to use the disagreements about their work further to define science and scientists and their own verbiage, and to continue their own research protocol without missing a beat. But at the same time, just as many defenders engaged in the science wars have noted that most scientists do not know what the debate is, so too have many science studiers been disengaged from the fray. This too is not surprising, since science studiers have been largely involved in internal debates about the merits and varieties of their own STS scholarship since its earliest days. This seems to be part and parcel of an interdisciplinary academic program.

Authority and credibility were also at stake in the two-culture debate. However, each of the secondary issues I have delineated for the science wars was expressed differently

for Snow and Leavis. First, Snow's hierarchically-defined concept of science was balanced by Leavis's hegemonic concept of literary humanities. Both men argued for one point: which was better in its moral promise, science or the humanities? However, in contrast, the science warriors argued two different points. The defenders argued that there was a split between science and the humanities; the science studiers argued that the study of science did not depend on drawing such a distinction. That is, the battle lines were drawn between 'there is a two-culture divide' and 'there is not a two-culture divide'. Second, but integrally-related to the first, is that not only was science a unique cultural enterprise for Snow and Leavis, but so too were the humanities. If Leavis was to propose a one-culture construct (as he did in later essays), it was a culture in which the literary humanities were elevated and superior. Just as with Matthew Arnold in the 1880s and the participants in the "neglect-of-science" debates in the 1910s, Leavis recommended that the teaching of science be subservient to humanities-based educational structures. In the two-culture debate, a hierarchical structure remained on both sides of the two-culture divide.[60] Snow and Leavis conceived of their positions as being both morally and intellectually high-minded. Because of the boundary definitions advanced by science studies, one-culture pronouncements do not have the same meaning in the science wars. For me to posit a common cultural foundation on top of which rests science and the humanities, for example, would disavow the hierarchical stature of either one. Thus, the conceptual disagreement of the two-culture debate was not revisited with the science wars, and the symmetrical arguments of Snow and Leavis lose all coherency once the hierarchy of knowledge-production is brought into question with the scholarship of science studies.

Just as there are numerous, but superficial, practical similarities, there are numerous dissimilarities. For example, Snow and Leavis were arguing about fields of knowledge, and which could serve society better. With the science wars, the only field of knowledge in question was science, and how it served society. Also, the field of science studies has a foundational relationship to science, as its topic of research. This meta-scientific

[60] It is interesting that sociobiologist E.O. Wilson, who often speaks of two-culture concerns and found favor with the science defenders, also seeks to close the gap between the two cultures with his idea of *Consilience* (Wilson 1998). However, in his construct Wilson's closed gap is guided by science. He offers

stance, deriving from science studies' very inception, might explain much of the confusion or assumed subordination of science studies to scientific pronouncements by science defenders. Noting this relationship, though, carries little explanatory power, except to highlight the defenders' wishes for a return to the hagiography of the positivist era. And even so, the science wars, as I have demonstrated, cannot be defined as an argument between scientists and science studies scholars, *tout court*, so this difference would simply ignore the structural analysis I provided in chapter two. Another example of dissimilarity between the debates is the science and anti-science claims. Leavis was surely anti-science, since his opposition of morality to material progress was clearly of paramount concern. The fact that science defenders claim that science studiers are anti-science only serves to justify their asymmetrical claims. But, I think it has been sufficiently established that a wholesale charge of anti-scientificity is inappropriate.

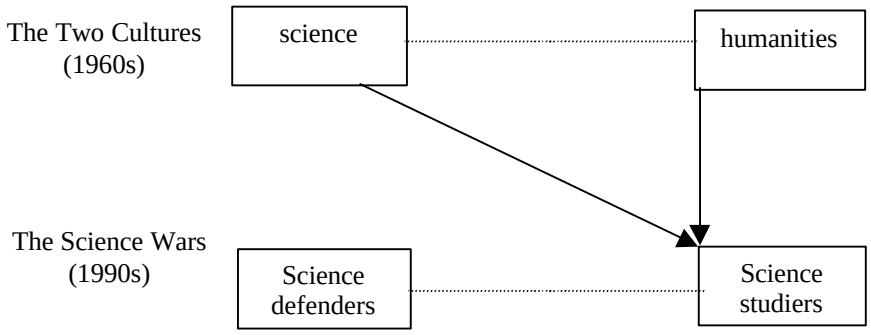


Figure 3. From the two cultures to the science wars. The science defenders place themselves as a descendant of Snow's construct; but the science studiers subsume the two-culture divide for the basis of their research.

My larger point with the asymmetry example is that science defenders have sought to reestablish the line of argument that Snow used. In Figure 3, I represent this aspect of the differences. The schematic shows why the two debates have taken on so much comparison. They can both be aligned with science on one side, and some form of non-scientific epistemology on the other. The figure also illustrates the nature of the differences, most pointedly the perspective-dependency of the science wars. If we remove the arrows that connect the boxes (the participants in the debate) there appears to

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to unify the "two cultures" of literature and science under reductionist scientific laws once and forever, as

be a direct lineage from “science” to “science defenders” and from “humanities” to “science studiers.” The science defenders take Snow’s argument as an historical precedent. They also view the science studiers as humanities scholars in the spirit of Leavis. However, when we reinstate the arrows connecting the two debates together (as shown in the figure), we recognize that the science studiers view both sides of the two-culture gap as their predecessors. In this sense, Snow’s metaphor of “two cultures” is itself a precursor to the program of science studies, shaping the discourse of the field, a point that longtime STS scholar Stephen Cutcliffe also argues (Cutcliffe 2000, 7). If we look to the history of the disciplines that combined to form an interdisciplinary science studies discourse—history of science, sociology, literature and science—the point that science studies found its genesis in relation to both sides of the two-culture divide is strengthened.

The science wars cannot be traced in the same fashion as the two-culture debate: the relationship between the two ‘sides’ is not the same; the rhetorical structure, though similar in places, is on the whole different; the conceptual levels of the debates are not consistent; and the diversity amongst participants is far more complex. Furthermore, aligning individuals in the science wars is more difficult than with Snow, Leavis, and their respective supporters. Aligning published works—editorials, monographs, journal articles and replies, book reviews— instead of individual actors is more appropriate in the science wars, especially since co-authoring has been commonplace. So, although I sought parallel argumentation in the first two parts of this thesis, this final chapter has pointed out the flaws in that approach.

The core issues for Snow and Leavis were ones of credibility, education, and epistemic authority. The science wars of the 1990s reintroduced concerns over those issues, and thus evoked comparisons to the earlier controversy. The two debates did share practical similarities, such as isolating science from other domains of knowledge and decrying the encroachment of a competitive intellectual culture. Snow saw a divide between the progressive promise of science and the retrospection of humanities, while

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"the way to renew the crumbling structure of the liberal arts" (Wilson 1998, 12).

Leavis questioned this perspective, reversing the hierarchy. However, the science wars differ significantly from the two-culture debate on the issues of greater relevance to academia and society. On one side of the science wars, the science defenders argue for a divide between science and those who study science (i.e., science critics, like art critics). On the other side, the science studies scholars attempt to disavow a divide, by bridging, blurring, or denying it. The contemporary debate had its roots in the arrogance and fears of postmodernity of the science defenders. Both of these were fueled by the science defenders' fear of the loss of cultural privilege. When compared to the two-culture debate though, the science wars were predicated on whether or not we need a divide.

Conclusion

The impetus for this thesis was the notion that Snow's articulation rested on a particular view of science that has been elaborated and superseded by recent science studies scholarship. The enterprise of studying science has changed the concept of Snow's intellectual divide by reevaluating what science is and how it works, and by reexamining the very premise of two sorts of intellectual inquiry. The two-culture construct makes sense as a rhetorical strategy and from the point of view of recognizable practices. As a conceptual and epistemological distinction, though, the divide cannot hold up under a revised (science studies) notion of science. Science studies have a prime position vis-à-vis the two cultures - as a blend of history, sociology, and philosophy of science, and as a descendant of Kuhn. They have the best opportunity to understand the implications and epistemological foundations for such a distinction, and as an interdisciplinary methodology science studies both deny the divide *and* reproduce it. The concern over two intellectual cultures has been, and remains, *who* has the credibility to say *what* about the world we live in.

APPENDIX A: THE TWO CULTURES REVISITED IN PRINT

NOTE: The works below were compiled as a bibliography for accessible published works on the topic of "The Two Cultures Reconsidered." Criteria for inclusion is this appendix was based on the degree to which the titles (and contents) of the works approximated the theme of reconsidering the Two Culture thesis. Unpublished works such as class syllabi are not included. Web site addresses are current as of May 2001.

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