

Chapter One:

Toward a Philosophy of Science and Technology Studies: Meta-Science, Scientific Practice, and the Natural World

A specter haunts American universities or, at least, its faculties: boredom. A generation of professors entered the universities in the middle and wake of the sixties, when campuses crackled with energy; today these teachers are visibly bored, if not demoralized ... This subterranean discontent might surface, reconnecting with public life. Conservatives suspect and fear this; hence they continuously rail against what they imagine as the threat from the universities. I think they are wrong. I hope they are right. (Russell Jacoby The Last Intellectuals: American Culture in the Age of Academe, 1987, xiii)

It is desirable to set up a higher standard of explanation of what scientists are doing than simply to offer interpretations. Why should any particular sociological interpretation be accepted over any other interpretation? If we are just privileging the force of our own rhetoric, or focusing attention on some sets of conditions and ignoring others, the best we can hope is to stay away from intellectuals who do not already agree with us ... we must be able to show why our explanations are better than other explanations. To do this, we need to be more comparative and more systematic. (Randall Collins "Replies and objections" Social Epistemology, 1992, Vol. 6, No. 3, 267.

1.1 General Introduction

In this dissertation I offer a framework for identifying, understanding, and adjudicating among, knowledge claims made about scientific practice and their relationship to propositions about the world. I refer to knowledge claims about scientific practice and their relationship to propositions about the world as 'meta-scientific claims.' I analyze and develop criteria for determining the validity of meta-scientific claims and translating them from their disciplinary origins into a coherent epistemology of scientific practice. Meta-scientific claims are descriptive and normative statements about the conduct of scientific practice, or about how scientific practice ought to be conducted, from various disciplinary, interdisciplinary, and contextual perspectives. I argue that meta-scientific claims are distinct from natural or social scientific claims, therefore the means for determining the validity of these claims is also distinct. If, however, the claims forwarded in science and technology studies (STS) simply reduce to current empirical practices and disciplinary categories, no compelling reason may exist to study science outside traditional disciplinary boundaries. Larry Laudan contends: "If one finds Kuhn's relativism about rival methods of inquiry objectionable ... putting it right will require the repudiation of much of the metaphilosophical apparatus that has been entrenched

in positivism, and in analytic philosophy generally, since the 1920's." (1996, 16) Laudan issues the challenge that this dissertation takes up; namely a re-examination of the roots of the study of science, and establishment of an epistemology which grounds meta-scientific claims.

I argue that social constructivism forms a set of general background assumptions that shape the methodology of STS. In this sense, STS is a form of paradigm-based inquiry. Amplifying a point made by Steve Woolgar (1981), I take social constructivism, in American STS, as a methodological tool which is anticipated by two sources – the land-grant research university and Thomas Kuhn's *The Structure of Scientific Revolutions* (1962).¹

STS theorists, interpreting Thomas Kuhn's position in *The Structure of Scientific Revolutions* as skeptical and relativistic, have characterized science as just another ideology. In addition, STS shifted the locus of Kuhn's neo-Kantian constructivism from the cognitive to the social. Further, social constructivism is presented as a form of naturalism; the world is nothing more than the product of human social interaction. As human beings never encounter the world absent social conventions and relations, constructivists hold that "the social" is "all that is the case." Still, STS is committed to a world view in the Kuhnian sense. Social constructivism is taken to prefigure all forms of STS inquiry, and, by extension, is taken to prefigure all forms of scientific inquiry. Consequently, social constructivism collapses second order, or meta-level, inquiry into object level inquiry about the nature of the social. Meta-scientific knowledge claims became captives of the social constructivist paradigm.

Consistent with the philosophical impetus of social constructivism, I examine the cultural setting in which American STS has developed and, predominantly, resides – the land-grant research institution. STS is, at its core, a reflexive pursuit.² The "reflexive problem" in

¹ I refer to a point made by Schmaus, Segerstrale and Jesseph (*Social Epistemology*, 1992, Vol. 6, No. 3, 248). Many radical reflexive theorists have admitted to, or embraced (Ashmore 1989), the inescapable relativism following the observation that the categories and tools employed by social constructivists could, in themselves, be socially constructed: "The emphasis on social interests certainly has been an important analytical tool. However as Steve Woolgar ... has already pointed out, one could always argue that social interests are socially constructed by historians and sociologists of science just as constructivists say that scientific facts are social constructed in the laboratory." Woolgar's point is well-taken, but incomplete. In this instance I take the "laboratory" for the social construction of social constructivism in American STS to be the land-grant research university. To carry the metaphor a step further, the "laboratory notebook" which provides the instructions for the social constructivist experiment is, accidentally, Thomas Kuhn's *The Structure of Scientific Revolutions* (1962).

² I refer to Steve Woolgar (ed.) *Knowledge and Reflexivity: New Frontiers in the Sociology of Knowledge* (London: Sage Publications, 1988) and Malcolm Ashmore's *The Reflexivity Thesis: Wrioting Sociology of Scientific Knowledge* (Chicago: The University of Chicago Press, 1989) as examples of the reflexive turn in STS. The development of reflexive sociology historically coincides with the early development of the field. The cornerstone of reflexive sociology Alvin Gouldner's *The Coming Crisis in Western Sociology* (New York: Basic Books, 1970) is published just as American STS programs are taking root. I have argued (1993) that the moral emphasis of Gouldner's form of reflexivity was erased by an empty, ultimately harmful, exercise in textual cleverness and irony by reflexive theorists in the sociology of scientific knowledge (SSK).

STS is, predominantly, a product of the British academic (i.e., High Church) establishment.³ Absent from reflexive examination is an historical awareness of the institutional system that sponsors much of American STS. This lack of historical awareness can be explained, in part, to the differences among American, European and Asian STS. Moreover, if STS can be considered a form of paradigm-based inquiry, Steve Fuller's (1992) argument regarding Thomas Kuhn's influence helps explain the absence of a discipline-based historical awareness.⁴ I argue that the Morrill Act of 1862 establishes the conceptions and criticisms of the relationship among science, technology and society by establishing patronage for American STS in land-grant universities. The Morrill Act formalized the relationship among public lands, agricultural production, scientific and technological advancement, consumption, and national prosperity.⁵

³ The primary participants in the debate over David Bloor's (*Knowledge and Social Imagery* London: Routledge and Kegan Paul, 1976) reflexivity tenet in the Strong Programme in the sociology of scientific knowledge are, among others, Barry Barnes (*Scientific Knowledge and Sociological Theory* (London: Routledge and Kegan Paul, 1974), Harry Collins and Trevor Pinch, (eds.) *Frames of Meaning: The Social Construction of Extraordinary Science* (London: Routledge and Kegan Paul, 1982), Michael Mulkey *The Word and the World: Explorations in the Form of Sociological Analysis* (London: Allen and Unwin, 1985) and Jonathan Potter, Peter Stringer and Margaret Wetherall *Social Texts and Contexts* (London: Routledge and Kegan Paul, 1984). The focus on British STS, originating in the Discourse Analysis workshops, was intended, in some manner, to generate the notion that a level of methodological consensus had been reached in the field of STS which would make a reflexive turn possible. I would argue following Diesing (1991) (as quoted in Shadish and Fuller (eds.) *The Social Psychology of Science* New York: Guilford Press, 1994) that the community of reflexive theorists has successfully adapted Kuhn's blueprint in *The Structure of Scientific Revolutions* for the development of a research program. Also imported with the Kuhnian blueprint was an historical blind-spot. The history of the institutions in which STS resides has been typically neglected (the limited exception is the work of Stephen Cutcliffe: "The Emergence of STS as an Academic Field" *Research in Philosophy and Technology*, 9, 287-301, 1989; Science, Technology and Society: An Interdisciplinary Academic Field" *National Forum* 69 (2), 22-25, 1989; "The STS Curriculum: What Have We Learned in Twenty Years?" *Science, Technology and Human Values* 15 (3), 360-372, 1990), or reflected, ironically, through the eyes of individual researchers. As an example of first-person history in the creation of STS see David Edge's "Reinventing the Wheel" *Handbook of Science and Technology Studies* Jasanoff, Markle, Petersen and Pinch (eds.) (Thousand Oaks: Sage, 1995).

⁴ "Being There With Thomas Kuhn: A Parable for Postmodern Times" *History and Theory* Volume 31, No. 3, (1992), 241-275. If Fuller is right, and *Structure* acts as a conceptual blueprint for STS, one could point to the lack of attention of American STS to its own historicity as a symptom of paradigm-based inquiry.

⁵ Much of the history of the Morrill Act, and its influences, was written either during World War II and the post-war era, or during the 1970's as university curricula were revised in the wake of 1960's social upheavals. Generally acknowledged to be the best secondary source on the land-grant college movement is Earle D. Ross's *Democracy's College: The Land-Grant College in the Formative Stage* (Ames, IA: Iowa State University Press, 1942). Other World War II-era works of note are Mumford's *The Land Grant College Movement* (Columbia: University of Missouri Press, 1940), Eddy's *Colleges for Our Land and Time: The Land Grant Idea in American Education* (New York: Harper, 1957), Brubacher and Rudy's *Higher Education in Transition: An American History, 1736-1956* (New York: Harper, 1958); Hofstadler and Smith's *American Higher Education: A Documentary History* (Chicago: University of Chicago Press, 1961); Babbidge and Rosenzweig's *The Federal Interest in Higher Education* (New York: McGraw-Hill, 1962); Rudolph's *The American College and University: A History* (Athens, GA: University of Georgia Press, 1962); and Veysey's *The Emergence of the American University* (Chicago: University of Chicago Press, 1965). A reassessment of the "democratic mission" of the land-grant system was made during the 1970's. Books and articles of note are: Anderson's (ed.) *Land-Grant Universities and Their Continuing Challenge* (East Lansing: Michigan State University Press, 1976); Lang's "The People's College, The Mechanics Mutual Protection and the Agricultural College Act" *History of Education Quarterly*, 18, 1978, 295-321; Johnson's "Misconceptions About the Early Land-Grant College" *Journal of Higher Education*, 52 (July/August 1981, 333-351); and Williams' *The Origin of Federal Support for Higher Education: George W. Atherton and the Land-Grant College Movement* (University Park, PA: Penn State University Press, 1991). Scott Key argues ("Economics or Education: The Establishment of American Land-Grant Universities" *Journal of Higher Education*

By constructing the site and conditions for the interplay of American science, technology and military in service to the state, the Morrill Act effectively scripted the forms of radical critique which STS could forward. I argue that as a social construction, American STS is largely a by-product of the mission of the land grant university – service to state government interests. Within the land-grant setting, STS’s function is, in part, to adhere to, and enforce, state and university administrators’, mandates. While the counter-culture movement of the 1960’s may have given rise to STS, the ultimate goal of science values education was to promote state economic growth. Finally, in proposing the land-grant university system as the site at which social constructivism is constructed in American STS, I conclude that the radical critique of science and technology is diffused within a institutional setting which promotes scientific, technical and economic interdependence.

As the land-grant institution is the home of American STS, Thomas Kuhn’s *The Structure of Scientific Revolutions* (1962) is the founding text. I extend Steve Fuller’s argument that the emphasis placed on Kuhn’s supposed form of relativism did have a “conservative” effect on the development of science studies.⁶ Kuhn’s reticence in clearly articulating “the irrationality thesis” (in paradigm selection) and post-Kuhnian, radically relativistic interpretations of science as just another ideology, predominated STS.⁷ Adopting *Structure’s*

March/April 1996, Vol. 67, No. 2, 196-221) that the Morrill Act was more about raising federal revenue than democratizing higher education.

⁶ Fuller’s analysis of Kuhn’s influence on STS is the subject of a forthcoming book *Being There With Thomas Kuhn: A Philosophical History of Our Times* (Chicago: University of Chicago Press, forthcoming). While Kuhn’s presence is felt in Fuller’s early work (*Social Epistemology* Bloomington: University of Indiana Press, 1988), “Being There With Thomas Kuhn: A Parable for Postmodern Times” (*History and Theory* Volume 31, No. 3, (1992), 241-275) lends the basis for the forthcoming book. Fuller’s work on Kuhn includes “Teaching Thomas Kuhn to Teach the Cold War Vision of Science” (*Contention*, Vol. 4, No. 1, 81-106, 1994) and “Kuhnification as Ritualized Political Impotence: The Hidden History of Science Studies” (Chapter 7 in *Being There With Thomas Kuhn: A Philosophical History of Our Times* (Chicago: University of Chicago Press, forthcoming). The beginnings of Fuller’s critique of Kuhn can be found in 1989 (“Philosophy of Science Since Kuhn: Readings on the Revolution That Has Yet To Come” *Choice* 26: 593-603). In addition, Fuller has addressed Kuhn’s influence, particularly on the philosophy of science, in two other books: *Philosophy of Science and Its Discontents* (2nd ed. New York: Guilford Press, 1993) and *Philosophy, Rhetoric and the End of Knowledge: The Coming of Science and Technology Studies* (Madison: University of Wisconsin Press, 1993).

⁷ David Bloor’s (1976, 55-65) interpretation of Kuhn’s relativism, in light of Karl Popper’s neo-positivism, helped anchor the reception of *Structure* in Strong Programme STS. Barry Barnes (*T.S. Kuhn and Social Science* New York: Columbia University Press, 1982) showed, systematically, how Kuhn could be operationalized in research in the sociology of science – a playful rejoinder can be found in Ashmore (1989) 89-92. Kuhnian historiography routinely sponsors much STS research. A philosophical defense of Kuhnian relativism can be found in Gerald Doppelt’s “Kuhn’s Epistemological Relativism: An Interpretation and Defense” *Inquiry* 21, 1978, 33-86; “A Reply to Siegel on Kuhnian Relativism” *Inquiry* 23, 1980, 11-123; and “Relativism and the Reticulational Model of Scientific Rationality” *Synthese* 69, 1986, 225-252. However, in the backlash following the Sokal Affair (see Philip Kitcher “A Plea for Science Studies” *La Recherche Forum* www.larecherche.fr/FOR/SOKAL/kitcher.html) the relativism ascribed to Kuhn has been under attack by critics of STS. Kuhn’s pose as a “reluctant revolutionary”, articulated most notably in Lakatos and Musgrave *Criticism and the Growth of Knowledge* (1970, 231-278), is the basis for a reconsideration of his view by Gross and Levitt (*Higher Superstition* Baltimore: Johns Hopkins University Press, 1994) and Gross, Levitt and Lewis (eds.) *The Flight From Science and Reason* (Baltimore: Johns Hopkins University Press, 1996).

blueprint made STS a form of paradigm-based inquiry. Kuhnian relativism, propagated in STS as social constructivism, inoculated science from the possibilities of meta-level critique.⁸ The effect was to rob the theoretical wing STS of an historical mission, and awareness, outside of serving constructivist interests.⁹ However, the impulse toward developing meta-level evaluative criteria can be found in Kuhn's appeal to the historical, philosophical and social contexts in which science participates.¹⁰

The appeal to "context" in STS opens the door to a form of justification which requires the translation and adjudication of rival meta-scientific claims.¹¹ Epistemological holism

⁸ The basis for this argument is adopted from Israel Scheffler's criticism of Kuhn in *Science and Subjectivity* (Indianapolis: Bobbs-Merrill, 1967).

⁹ I note the split between the "High Church" or theory wing, and the "Low Church" or policy-oriented wing in STS. Fuller makes this distinction in *Philosophy, Rhetoric and the End of Knowledge: The Coming of Science and Technology Studies* University of Wisconsin Press, 1993, xiii-xv. If, as Fuller asserts, the High Church was captured by Thomas Kuhn's *Structure of Scientific Revolutions*, and, subsequently, subjugated to the social constructivist paradigm, STS has yet to develop an integrated purpose. Fuller argues that rhetoric can mesh the theory and practice of STS. I abstract from Fuller's position. Meta-science does not await a discipline informed perspective, rather it needs a unique epistemological basis.

¹⁰ The appeal to context is a way out of the relativism inherent in social constructivism. Kuhn's plea for an historical approach to science was an attempt to offer meta-level critique from a stable (i.e., not leading to infinite regress), second-order (meta-level) platform. The criticism of Kuhn's notion of paradigm-based science misses the placement and province of meta-science. Kuhn's aim was didactic. With a limited social awareness (necessarily according to Brush (1974)), normal science required a critical rationality, supplied by historians to, for instance, contextualize pedagogical falsehoods. Quite speculatively, I suggest that Kuhn's form of developmental psychology, adopted from Piaget and Bruner, posits a "conscience" for science that is historically grounded. Here, I argue for recasting the question of whether criteria for assessing paradigms are external to it, to a question of assessing meta-scientific claims in relation to the practices they purport to interpret or explain. The appeal to context is not, necessarily, paradigm governed. As Harris (*Against Relativism: A Philosophical Defense of Method* LaSalle, IL: Open Court Press, 1992) points out the problem of appeal to external criteria in paradigm assessment results in "... what Wittgenstein would have recognized as an illegitimate totality. To say that two paradigms are incommensurable requires one to assume an intellectual position such that one can 'stand outside' the totality of a single paradigm. The point is one recognized by many philosophers from Plato to Wittgenstein. To develop any general theory about any totality which includes drawing the boundaries or limitation of that totality, one must also include as part of the argument of the general theory something which is outside the totality ... [Rudolph] Carnap recognized, long before Kuhn, that empirical questions are internal to a particular framework and that one's choice of frameworks cannot be empirical in the same manner" (84-85) Harris goes on to describe Kuhn's claim of incommensurability as stronger than Carnap's position. (Harris refers to Carnap's "Empiricism, Semantics and Ontology" in *Meaning and Necessity* Chicago: University of Chicago Press, 1956, 205-221). While Carnap argues for a different form of empiricism at the meta-level (within frameworks), the determination of incommensurability is necessarily anchored, on Kuhn's account, to a paradigm and is self-refuting. From an STS perspective, the interpretation of Kuhnian relativism sidesteps Carnap's criticism, although the social constructivist form of naturalism brings back the problem of circularity. The appeal to context invokes assessing a scientific practice from practitioners outside of a scientific paradigm. Although different kind of philosophical problems (i.e., translation, coherence) follow as a result, the hope of STS remains in overthrowing the social constructivist paradigm and wrestling honestly with the relationship between meta-scientific claims, the practices to which they relate, and the world those practices describe.

¹¹ 'Context' is used numerous ways in STS. Generally, 'context' is a term paired with a discipline or field of study – a "rhetorical context" for example. For a survey of the manner in which 'context' is invoked the *Handbook of Science and Technology Studies* (Jasanoff et al. (eds.) Thousand Oaks: Sage, 1995) serves a guide. The question of accounting for the historical context in which the history of science is given is the basis for debate between Mario Biagioli ("From Relativism to Contingentism" *The Disunity of Science: Boundaries, Contexts, and Power* Galison and Stump (eds.) Stanford, CA: Stanford University Press, 1996, 189-206) and Simon Schaffer ("Contextualizing the Canon" *The Disunity of Science: Boundaries, Contexts, and Power* Galison and Stump (eds.) Stanford, CA: Stanford University Press, 1996, 207-230). Helen Longino (*Science as*

accompanies analyzing science in context.¹² The consequence of holism is that groups of beliefs can be tested within larger contexts. In order to stop an infinite regress (i.e., the appeal to ever larger and more complex contexts), constructivists assign, or bracket, specific contexts in which science participates. Appealing to an economic context, for example, brackets a given constructivist account by postulating the existence of certain entities with which one can explain, or interpret, cause and effect relationships. While constructivists are relativists regarding the epistemic value of different contexts, the appeal to holism, generally, and to context, specifically, necessarily implies a logic of justification. For example, if one posits that contextual beliefs about gender influence scientific judgment, one initially accepts that a context exists in which gender categories are understood, socially, and affect the outcome of scientific practice. The context of gender is taken as uniquely explanatory. The researcher takes the appeal to gender, and not, say, rhetoric, as justified under certain conditions. As a result, the STS practitioner has a necessary set of conditions, and an implied justification, under which an appeal to context explains a given scientific practice. If, from a social constructivist perspective, the conditions under which a gender-based explanation of scientific practice are transitive, no reason exists to designate any one context as opposed to any other. On this reading, a context becomes a simple placeholder – rhetoric, economics, politics, history – any context would offer as valid an explanation as gender. The appeal to context, then, is an attempt to designate second-order, or meta-level, explanatory and evaluative criteria of a

Social Knowledge: Values and Objectivity in Scientific Inquiry Princeton, NJ: Princeton University Press, 1990) attempts to develop a theory of scientific objectivity which gives an explanation of the role contextual values play in science. Curd and Cover's textbook (*Philosophy of Science: The Central Issues* New York: W.W. Norton, 1998, 210-253) offers a detailed commentary on Longino's work in light of Kuhn's influence.

¹² The definition of epistemological holism I employ is: "A family of doctrines whose common core is the notion that an individual element in a complex whole has the properties it does only insofar as it stands in certain relations to other, similar elements ... [I]n epistemology, proponents of coherence theories of justification insist that a particular belief is justified only if it coheres with a large number of similar beliefs." (Curd and Cover (eds.) *Philosophy of Science: The Central Issues* New York: W.W. Norton, 1998, 1298). The appeal to context, I will argue, entails epistemological holism, which entails a coherence notion of justification. However, I argue in order to determine if a context-based claim is true, it must cohere with a specific set of statements that we hold about an identified scientific practice. Additionally, the statements that we hold about an identified scientific practice must cohere to a set of statements we hold about the world. For example (I offer a version of standpoint feminism), one could claim that if science was done by women, from the standpoint of women, then we would have a more objective picture of the world. Initially, one would have to determine, given designated, although not mutually exclusive, contexts, what characteristics women possess which would be both necessary and sufficient to produce a more objective picture of the world. Those characteristics would need to cohere with scientific practices which embody them. In addition, those practices would need to be shown to produce a more objective picture of the world. I take each of these claims to be empirical: 1) The context-based claim that a "woman's standpoint" exists; 2) The meta-scientific claim that a woman's standpoint entails a certain scientific practice; and 3) The epistemological claim that these certain scientific practices yield a "more" objective knowledge about the world. If any one of these claims cannot be shown, coherence is threatened.

scientific practice which cannot be reduced to social constructivism. Moreover, the justification for accepting a context-based account turns on a coherence theory of truth.

A context, then, entails a scheme of justification. That one can identify a context implies a necessary set of ontological relationships. In order to avoid infinite regress, one must argue that a designated context stops the automatic appeals to other contexts. That a context stands in an identifiable relation to scientific practice and the world that practice describes entails a form of coherence. If the world, the scientific practice and the context in which that practice occurs are just social constructions, then we have no rational basis to choose among differing interpretations or explanations.¹³

1.2 Argument Summary

This chapter examines the current state of philosophical affairs in science and technology studies (STS). The Messianic burden of STS is to lay bare the true nature of the relationship among science, technology and society to the lay public. Social constructivist doctrine supplies STS practitioners with the critical reflective faculties to grasp what goes on behind the sciences in the production of scientific knowledge.¹⁴ Science, venerated for three centuries as producing objective knowledge about the world, is, as it turns out, just another social institution in which human foibles are played out and reproduced. This chapter outlines the approach of the dissertation. Social constructivism is examined on its own terms. If science is socially constructed, then, of course, STS is socially constructed. I examine the fundamental historical, sociological and philosophical elements of the social construction of STS. First, I analyze the mission of the institution in which American STS is primarily housed – land-grant

¹³ Harvey Siegel (*Relativism Refuted: A Critique of Contemporary Epistemological Relativism* Dordrecht: Reidel, 1987, 153-154) offers a similar argument to refute Nelson Goodman's appeal to an individually unique meta-theory to determine the "rightness of worlds." I argue that the act of choosing a context yields to criteria for its rightness in explaining or interpreting a scientific practice. If the appeal to context does not yield to implied justification, the account which follows is a *reductio ad absurdum* – criteria for rightness are completely relative on the meta-theoretic level. However, if the rightness of a context-based account is asserted, its coherence to the practices which are being interpreted or explained can be shown.

¹⁴ I refer to the type of social constructivism most commonly associated with the Strong Programme in the sociology of science. The Strong Programme proposes to study science scientifically by "... tracing the psychological and sociological causes of scientific beliefs and decisions especially decisions to accept or reject theories ... [and insists] that all scientific beliefs whether true or false, rational or irrational, should be explained in the same sort of way in terms of social and cultural factors" (Curd and Cover (eds.) *Philosophy of Science: The Central Issues* New York: W.W. Norton, 1998, 1308). Social constructivism is defined as the view that "... the subject matter of scientific research is wholly or partly constructed by the background theoretical assumptions of the scientific community and thus, is not, as realists claim, largely independent of our thoughts and theoretical commitments" (Boyd, Gasper and Trout (eds.) *The Philosophy of Science* Cambridge, MA: MIT Press, 1991)

research universities. I argue that if STS is, largely, a social construction produced by American research universities, its criticism of science is captive to (or constructed by) the historical relationship among the agricultural research and technological developments, and state, federal and military economic interests. Second, I analyze the effect of the founding text of STS – Thomas S. Kuhn’s *The Structure of Scientific Revolutions* on STS. Again, if STS is, largely, a social construction produced by the reception of Kuhnianism, its criticism of science is anticipated by the ambiguity and weight of the social and intellectual framework found in *Structure*. Third, I analyze a philosophical move made by social constructivists to ground their work against thorough-going relativism – the appeal to context. I argue that the treatment of context as, essentially, a form of meta-scientific realism allows STS practitioners to slip the strangle-hold of social constructivism. While constructivists see the appeal to context in keeping with a form of epistemological holism, I argue that contexts necessarily imply a logic of justification in which one can determine criteria for adjudicating among claims about the nature of scientific practice. Further, I argue that contextualism entails a coherence theory which connects meta-scientific claims, scientific practice, and the world that practice describes. In closing I offer a set of proposals for a unique philosophy of STS.

In section 1.2 I provide the general structure for the dissertation and link historical, sociological and philosophical approaches to an analysis of STS development. Section 1.3 begins by comparing the religious imagery found in David Edge’s opening chapter (“Reinventing the Wheel”) in the *Handbook of Science and Technology Studies* (Thousand Oaks, CA: Sage, 1995) and Mircea Eliade’s (*The Sacred and the Profane* San Diego: Harcourt Brace Jovanovich, 1959) description of the Christian concept of historical revelation. The purpose of this rhetorical comparison is to illustrate the way in which social constructivism is the matter of faith which sustains the STS crusade against science. Philip Kitcher (“A Plea for Science Studies”) also notes the pervasive influence of constructivist dogma and bemoans the possible coming of the “Planck effect” in STS in which the truths of “social acceptance” become simple axioms to a new generation of scholars. Section 1.4 looks at the effects of social constructivism, born out of an interpretation of *Structure*, on STS. I suggest that constructivism is a kind of “philosophical agnosticism” in which no commitments are made to the basic elements of philosophical inquiry except for constructivism itself. Recently, the positivist legacy has been reconsidered in light of what Larry Laudan describes as the failure of post-positivism. I attribute the absence of a progressive line of research in STS to the inability to distinguish whether context-based claims about scientific practice are true. However, in the wake of the “Sokal Affair”, the so-called “science wars”, the publication of numerous critiques by scientists

(Gross and Levitt 1994 being the most notable), recent books describing programmatic compendia (Jasanoff et. al. 1995, Hess 1997), and the cultural atmosphere surrounding the end of the millennium, STS stands at a critical nexus. The comfortable cynicism of social constructivism must be abandoned for an honest attempt to understand the relationship of the claims we make about science to each other, to the nature of scientific practice, and to the nature of the world.

1.3 STS Orthodoxy

Perhaps the foretold "coming of science and technology studies" (STS) hangs, like Christian faith, on historical revelation – the promise that divine incarnation, in historical time, “guarantees the validity” of sacred symbols.¹⁵ For the Christian apologists, natural occurrences, with their attendant representations and rituals, established the presence of the sacred. Since natural symbols pre-dated religious orthodoxy, Christianity afforded a context into which new meanings were revealed. Believers held that history, while adding new meaning, could not destroy a symbol’s archaic structure. Moreover, the deepest meaning of natural symbolism awaited expression in Christian faith. The revelations brought about by faith affirmed the believers’ convictions; historical knowledge deepened their commitment.¹⁶

¹⁵ The initial quoted phrase refers to the subtitle of Fuller's book *Philosophy, Rhetoric and the End of Knowledge: The Coming of Science and Technology Studies* (Madison: University of Wisconsin Press, 1993). In the first chapter of the book Fuller seeks to recapture the lost rhetorical sense of "nineteenth-century theorists of science" (3). These theorists, Fuller suggests, supplied the normative contribution of "... isolating a lingua franca, a procedural language that would enable all the science to develop toward a greater methodological unity and, hence, greater public accountability" (5). Through the "sociological dressing down of science," STS practitioners retrieved the sense of a public science which Comte and subsequent positivists lost. The positivists' mistake came in using "demarcationist rhetoric" by speaking of science as uniquely pursuing "hypothesis generation," 'theory testing,' and 'falsifiability'..." (10) The historical revelation (I refer to Mircea Eliade's *The Sacred and the Profane* (San Diego: Harcourt Brace Jovanovich, 1959, 136-138) Fuller offers rests with the sociological presumption that science shares, with all institutions, the universal quality of being social. If, according to Randall Collins, "...we want to understand how a discovering science [discovers something about the world] is possible, we need sociology to ground it." (Collins *Social Epistemology* Vol. 6, No 3, 270) This macro-social appeal is, commonly, a first step of constructivist analyses of science; an article of unfashioned disciplinary faith. Intoning the "coming of science and technology studies", Fuller's rhetorical pose is reminiscent of Christian apologists and equally unconvincing.

¹⁶ Mircea Eliade *The Sacred and the Profane: The Nature of Religion* (Willard R. Trask, trans. New York: Harcourt Brace Jovanovich, 1959, 111-113) describes the valorization of history in Christianity. Eliade also mentions Hegel's adoption of the "... Judaeo-Christian ideology and applies it to universal history in its totality: the universal spirit continually manifests itself in historical events and manifests itself only in historical events" (original emphasis, 112). STS practitioners valorize history as a means of revealing the nature of science. Appealing to a form of holism, STS practitioners also invoke history in its totality. However, extrapolating from Hegel's formulation, STS practitioners locate the material and the spiritual conditions of history within the practices and means of social construction. Assuming that science is a social construction, the past is a set of material conditions which "could have turned out otherwise." Consequently, the winners and losers in scientific debates were determined by historical happenstance and not overwhelming empirical evidence. Hegel's "World-Spirit", the ultimate result of history, in the STS formulation, is found in social contexts in which science participates and is interpreted as shaping scientific practices.

For science studies practitioners, dubbed critical self-reflective prophets¹⁷, scientific practices, with their attendant representations and rituals, established the presence of “extra-scientific” influences. Locating scientific symbols within discipline-based contexts, including, but not limited to, history, sociology and philosophy, STS researchers sought the structure meaning and significance of science. Believers held that the contexts in which scientific practice took place would not destroy empirical results, rather they would reveal new meanings regarding their production and use. Given the apparent misapprehension of science at the positivists’ hands, scientific symbols awaited the “... fulfillment of [their] deepest meaning through the new values contributed by [STS].” (Eliade 137). The revelations brought about by faith in social constructivism affirmed STS practitioners’ convictions; revealing the contexts would deepen their commitment.¹⁸

According to dogma, the arrival of STS will reconcile scientific practice with public interest. Moreover, STS practitioners when analyzing “... science – the source of accredited knowledge – [are asked] to wield not a plowshare but a sword. And those who live by it should be prepared to die by it. For the conventional ideologies and myths that STS scholars challenge

¹⁷ David Edge’s (“Reinventing the Wheel” *Handbook of Science and Technology Studies* Jasanoff, Markle, Petersen and Pinch (eds.) Thousand Oaks: Sage, 1995) use of religious metaphor, and reference to STS practitioners as prophets, reveals the messianic nature of STS. As challengers to traditional scientific orthodoxy, STS practitioners are threats to entrenched to the “old” institutional values supported by positivistic science (18-20). The truths that STS knows, and must reveal, are found through reflection on the contingent social nature of knowledge.

¹⁸ I refer to Eliade’s formulation of Christian faith throughout this paragraph which mirrors Edge’s description of belief in STS. Both the correspondence between Eliade’s reference to the nature of religion and Edge’s reference to the nature of STS turn on the role of interpreting and revealing the true nature of historical symbols. From Eliade: “Certain fathers of the primitive Church had seen the value of the correspondence between the symbols advanced by Christianity and the symbols that are the common property of mankind ... For the Christian apologists, symbols were pregnant with messages; they showed the sacred through the cosmic rhythms. The revelation brought by the faith did not destroy the pre-Christian meaning of symbols; it simply added value to them ... it could even be said [a] ... symbol awaited the fulfillment of its deepest meaning through the new values contributed by Christianity. The Christian faith hangs upon a historical revelation; it is the incarnation of God in historical time that, in the Christian view, guarantees the validity of symbols ... In other words: History cannot basically modify the structure of an archaic symbolism. History constantly adds new meanings, but they do not destroy the structure of the symbol” (136-137). From Edge: “The challenge by critical STS scholarship to the old set of beliefs could thus erode the credibility and validity of ... the legal profession and of their institutional forms and practices ... Through the vicissitudes of historical contingency, the old image of science has become firmly embedded in the educational subconscious of modern industrialized societies. This is precisely why STS insights are ... ‘wantonly neglected’ and STS courses are constantly under threat when times are hard ... No one can deny that the subject matter of STS studies is of central concern to humankind. STS analysis points to all the ‘higher’ aspects of human endeavor – truth and power and justice and equality and democracy – and asks how these can be conserved and consolidated in modern society ... ‘for the relief of man’s estate’” (19). Both Eliade and Edge suggest that human symbols, of religion and science respectively, await proper historical interpretation. Only through the proper set of beliefs can the true nature of these symbols be understood. For Eliade, Christianity supplies the values necessary for the meaning of archaic symbols to be revealed despite historical changes in our understanding. For Edge, STS supplies the values necessary for the meaning of science to be revealed even though “old” (positivist) images have an historical foothold. In both instances the proper meaning of humanity’s symbols will be revealed through true faith.

are the very myths that justify and legitimate current practices in [science]”¹⁹ Presumably at stake in the battle over science’s manifest image is the public welfare. Duped by the image promoted in textbooks and research articles, a trusting public continues to invest in the promise of unabated scientific and technological progress. Steeled by the resolve that scientism will yield to humankind’s better angels, STS practitioners await a public reckoning.²⁰ Prodded by science critics, modern society, initially seduced by powerfully entrenched economic interests, will grow weary of scientific and technological oppression. Awakened from historical slumber, alerted to social contingency, and motivated by political necessity, society will slowly seek the truth about scientific practice. In light of a renewed sense of democratic participation and equity, scientists who, in Dudley Shapere’s (1987) words, “learn to learn” about the world, will release their white-knuckle grip on positivist mythology.²¹ Deciphering the symbols of the postpositivist consensus, science studies practitioners will ultimately make known what basic historical interpretation could not: science is fundamentally an expression of subjective interests and perspectives. Conceding to public demand, scientists will reveal the true structure of science and admit to the epistemic, methodological and linguistic relativism of their practices. The validity of the postpositivist consensus, reconceived in STS categories – contexts, controversies, literary forms, networks, practices - will be supported by the new scientific image. Despite the sacred intervention of STS, however, the battle for science’s soul may rest with one profane irony – in Steve Woolgar’s truest sense. The heralded disclosures coming from science and

¹⁹ David Edge “Reinventing the Wheel” *Handbook of Science and Technology Studies* Jasanoff, Markle, Petersen and Pinch (eds.) (Thousand Oaks: Sage, 1995, 19).

²⁰ David Edge “Reinventing the Wheel” *Handbook of Science and Technology Studies* Jasanoff, Markle, Petersen and Pinch (eds.) (Thousand Oaks: Sage, 1995, 19).

²¹ Edge concludes his overview to the *Handbook of Science and Technology Studies* (Jasanoff, Markle, Petersen and Pinch (eds.) Thousand Oaks: Sage, 1995) by mouthing an STS catechism: “... the ‘old,’ positivistic image of science, as an abstract, timeless search for irrefutable facts – ending the pain of uncertainty, the burden of dilemma and choice, separable from ‘society,’ and leading inexorably to technological innovations for the good of all – exhibits an apparently puzzling tenacity.” (18). Edge explains the resilience of the twentieth-century scientific image as a matter of political expediency. As scientists know where their research bread is buttered, they cleverly maintain the “old picture” of science to deceive politicians and tax-payers. Now part of the policy-making consciousness, the “old” image of science lends scientists “... access to the political arena and the resources that they need.” (18). While characteristically provocative, Edge seemingly ignores the pervasive effect, posited in much STS analysis, of political and social exigency on science and STS. The caricature of scientists “...hold[ing] fast to the old picture...” (18) insists on a flexible notion of the positivist influence. Depending on a given STS account, scientists either know little about the tenets of positivism, (see Michael Mulkey and Nigel Gilbert "Putting Philosophy to Work: Karl Popper's Influence on Scientific Practice" *Philosophy of Social Science* Vol. 11, 1981, 389-407), or, according to Edge, masterfully deploying the positivist image to deceive policy-makers. Further, the positivist image makes scientists victims of their own success in making it “...difficult to come to terms with any public admission that they, too, have to reconcile observations and values in reaching their judgment.” (18). The need for STS survives, in part, on reigning in the uncontrolled rhetorical use of positivism. Scientists must be protected from deceiving themselves, deceiving policy-makers, and deceiving the public. Apparently, scientists fail to be clever enough to silence their STS critics. Unless, of course, having STS practitioners chase down the effects of positivist ideology is also the scientists’ intent.

technology studies are rooted in, and anticipated by, science itself. Despite the seeming revelations born of STS criticism, what we discover about scientific practice may reflect nothing more than our degree of faith in it.

1.4 Philosophical Agnosticism

While deriding philosophy of science's earnest attempts to understand the epistemological, justificational, structure of science, SSK seems itself, however, in danger of dissolving from one intellectual fashion to the next. While the case studies remain persuasive, the multiplicity of contesting analytic frameworks suggests a certain intellectual disarray.
(Longino 1992, 281)

Science and technology studies (STS) lies trapped in the amber of philosophical agnosticism.²² Consigned to study science like any social practice, science studies practitioners ceaselessly reinvent standard objections to the epistemological values deemed constitutive of science. Interpretations of scientific practice born of sociological and anthropological case studies, and propagated within disciplinary contexts, either mistakenly substitute as explanations, or are posed as “interesting” just-so stories.²³ Scientific explanations about the world, and meta-scientific interpretations of scientific practice are collapsed into constructivist categories and treated as epistemic equivalents.

²² By way of an introduction to an issue an *Social Epistemology* dedicated to the “social epistemology of science studies”, Fuller (Vol 6., No., 3, 241) explains that “... science studies arose from debates between philosophers and sociologists over whether knowledge production could be adequately explained or justified in terms ... of philosophical ‘truth’, ‘reality’, and ‘rationality’ ... which applied to science alone ...” The result of this debate, Fuller claims, was a “methodological commitment” on behalf of science studies practitioners to remain “agnostic” about science and scientists account of their practices. Schmaus, Segerstrale and Jesseph (*Social Epistemology* Vol 6., No., 3, 243-265) argue that the philosophical agnosticism of research programs in the sociology of scientific knowledge (SSK) leads to explanations of scientific practices built on reified sociological categories, and “mutually contradictory assumptions.” Absent any “hard” philosophical commitments, sociological accounts of scientific knowledge “... spread amoeba-like from one philosophical commitment to another.” Laudan’s (1981) renowned critique of Bloor’s “Strong Program” sociology grounds much of Schamus et al.’s formulation of the “Hard Program” alternative.

²³ Helen Longino (“Hard, soft or satisfying” *Social Epistemology* Vol. 6, No. 3, 1992, 281-287) counters: “On the basis of a series of varied and provocative case studies, ranging from the Pasteur-Pouchet debate regarding spontaneous generation to theoretical developments in elementary particle physics, practitioners of the family of analyses called social studies of science, or sociology of scientific knowledge (SSK) have challenged orthodox views about the growth and development of science ... One interpretation of the case studies is that at least in those cases ... the cognitive or epistemological values that are commonly deemed constitutive of science were displaced by other values – social, personal, political – and that the acceptance of a hypothesis or closure of a debate was determined not by the epistemic merits of the case, but by factors in some sense external to it. Of course, if such factors were correctly invoked in a sufficient number of cases, one could not longer call them external to science” (281). Longino correctly points out the “illegitimate totality” resulting from the general explanatory role of “the social” in science employed by SSK practitioners. I argue that the social constructivist paradigm in STS is partly responsible. Further, the validity of meta-scientific claims that posit social explanations of the outcome of scientific debates, for example, must be adjudicated within STS and external to science.

Collapsing the relationship of scientific explanations of the natural world into constructivist categories, the unique structure of meta-scientific claims remains epistemologically undifferentiated within contexts. Consequently, Fuller's naturalistic admonition that: "Science should be studied as one would any other social phenomenon, which is to say, scientifically ..." ²⁴ carries a dual burden of evidence – to show science as equivalent in the terms of all social phenomena, and to show that science is only tractable to social scientific study.

Examining the positivist program's failures leads one back to the original questions asked by philosophers of science in the early to mid-twentieth century. But perhaps more importantly for STS, the questions raised, and largely unanswered, by the positivists still lie at the philosophical heart of meta-scientific claims.²⁵ The problems the positivists identified in trying to achieve a unity of science, the commensurability of rival frameworks, the means for verifying meaningful sentences, the problems of translation, and the need for a neutral observation language, are amplified more profoundly in the study of science. Generally STS practitioners, much like logical empiricists, have failed to enunciate "... a metaphilosophy that would dignify those preferences [regarding the aims of science] by acknowledging that they had any cognitive significance" (Laudan 1996, 16). Metaphilosophical relativism, a

²⁴ Steve Fuller, *Philosophy, Rhetoric and the End of Knowledge: The Coming of Science and Technology Studies* (Madison: University of Wisconsin Press, 1993, 14). Fuller's mandate distills approaches to the study of science found in strong programme sociology credited to Barry Barnes (1974) and David Bloor (1976). The reliance on sociology as the engine in scientifically studying science is, Fuller argues, a result of Thomas Kuhn's unwitting dismantling of the history and philosophy of science. By arguing that the history of science proceeds in ways other than presented in "...the classics and ... in the textbooks from which each new scientific generation learns to practice its trade ..." (Kuhn 1970, 1), Kuhn "relativized" any conclusions one could make about scientific progress. The accuracy and direction of "great man" internal history thus eliminated, Kuhn (to his chagrin) would serve to legitimate all context-based approaches to science studies. While Fuller admits that Kuhn "...betrayed little knowledge of sociology in *Structure* ..." (9) sociologists came to question the need to refer to traditional philosophical categories – objectivity, truth, rationality – as anything other than the product of social interaction. To advance Fuller's thesis, "Kuhn's plague" – the thoroughgoing relativism espoused by sociologists of science (knowingly in the case of reflexive theorists) – threatens to unravel science and technology studies and its "fundamental mandate." If science studies is "scientific" in a way similar to the science described in *Structure*, then the narrative which gave birth to the study of science also contains the seeds of its destruction.

²⁵ The questions to which I refer are not raised with respect to the relationship between meta-science, scientific practice and the world. Kuhn's interpretation of Goodman's answer to the riddle of induction (originally presented in *Fact, Fiction and Forecast* Cambridge, MA: 1955) is the original source of social constructivism in STS. As a result, social constructivism wiped out a consideration of meta-scientific realism. The question of whether the theoretical terms invoked by constructivists – the existence of Latourian "networks", the existence of intentional acts of "social construction" (recruiting allies, mounting rhetorical strategies), for example – exist independently of our theorizing about them has been ignored. Generally, however, social constructivists treat these entities as real and causal. The significance, for STS, of work done toward the end of the positivist era (Carl Hempel's *Aspects of Scientific Explanation*, Free Press, 1965; Rudolph Carnap's "Empiricism, Semantics and Ontology" in *Meaning and Necessity* Chicago: University of Chicago Press, 1956, 205-221; Quine's "Natural Kinds" in *Ontological Relativity and Other Essays* New York: Columbia University Press, 1969, 114-138; and Hilary Putnam's "Explanation and Reference" in *Conceptual Change* Pearce and Maynard (eds.) Dordrecht: Reidel, 1973, 199-221) was trampled under the enthusiasm for Kuhn's work.

creation of the positivists, has reasserted itself in the contextual relativism of the constructivists. Like the positivists, constructivists hold that the aims and methods of science are matters of taste and practitioners' preferences. Coupled with the problem of incommensurability, metaphilosophical relativism supports constructivist accounts of scientific practice.

1.5 Regarding Post-Positivism and STS

The first to receive international notice for taking up the sword against science's myth makers, and their positivist co-conspirators, was the accidental revolutionary Thomas Kuhn.²⁶ Kuhn, who denied many of the later implications attributed to his work, admitted to benignly identifying science as both historically and socially situated. Sociologists of scientific knowledge, among others, seized on the Kuhnian model, attempted to operationalize its elements, and mounted a meta-historical critique of science based on the findings in *The Structure of Scientific Revolutions*.²⁷ While some critics of *Structure* chided Kuhn for a lack of sensitivity to his own historicity,²⁸ advocates readily accepted, and extrapolated, the

²⁶ Alan Musgrave in *Paradigms and Revolutions* ed. Gary Gutting (Notre Dame, IN., 1979, 51) offers a quote – used by Steve Fuller to open his lengthy deconstruction of the Kuhnian myth “Being There With Thomas Kuhn: A Parable for Postmodern Times” (*History and Theory* Vol. 31, Number 3, 1992) – which reads: “Perhaps the revolutionary never existed – but then it was necessary to invent him.” Kuhn denied the radical implications of his work (in the most sustained form in “Reflections on My Critics,” in *Criticism and the Growth of Knowledge*, Lakatos and Musgrave (eds.) (Cambridge: 1970, 231-278), and was quoted by John Horgan (“Profile: Reluctant Revolutionary – Thomas S. Kuhn Unleashed ‘Paradigm’ on the World,” *Scientific American* May, 1991, 40) as saying “I’ve often said I’m much fonder of my critics than my fans.”

²⁷ Diana Crane in “An Exploratory Study of Kuhnian Paradigms in Theoretical High Energy Physics” (*Social Studies of Science* Vol. 10, No. 1, (1980), 23-54) attempts to show the function of Kuhnian paradigms in the practice of physics. See also the debate between Crane and Pickering in *Social Studies of Science* Vol. 10, (1980), 497-502, 502-506, 507-508. Meta-historical critiques of science, and of Kuhn’s portrayal of the noncumulative nature of incommensurable traditions (Kuhn loss) can be found in Imre Lakatos’, *Methodology of Scientific Research Programmes* (Cambridge: Cambridge University Press, 1979). As well, Malcolm Ashmore in *The Reflexive Thesis: Wrighting Sociology of Scientific Knowledge* (Chicago: The University of Chicago Press, 1989, 89-92) offers a methodological critique of assessments and applications (e.g., Barry Barnes *T.S. Kuhn and Social Science* London: Macmillan, 1982) of Kuhnian historiography. Ashmore rightly asserts the ease with which observers, historians, sociologists and philosophers, assert their privileged access to the contexts affecting science, while scientists remain unaware of social influences, by necessity according to Kuhn, given the nature of paradigm-based inquiry. I note the emphasis reflexive practitioners place on individual reflexivity especially evident in the use of new literary forms. If the *Handbook of Science and Technology Studies* (Jasanoff et. al. (eds.) Thousand Oaks, CA, Sage 1995) serves as an example of historical reflexivity, STS begins with David Edge getting off the train at Waverley Station in Edinburgh on March 1, 1966. The recent spate of books announcing the “arrival” of STS (Fuller 1993, Jasanoff et. al. (eds.) 1995, and David Hess *Science Studies: An Advanced Introduction* New York: New York University Press, 1997) fail to lend any form of sophisticated history to the development of STS. Fuller (1993, 9-10), in particular, gives a “great man” overview of the development of STS with little attention to institutional history.

²⁸ This charge is leveled by Steve Fuller (“Being There With Thomas Kuhn: A Parable for Postmodern Times” *History and Theory* Vol. 31, Number 3, 1992) and is repeated by Sal Restivo (“The Theory Landscape in Science Studies: Sociological Traditions” *The Handbook of Science and Technology Studies* Jasanoff et. al. eds.

epistemic privilege gained from placing science in context. By positing the advantages of scientists' Orwellian sense of their history, Kuhn inadvertently opened the door for all context-based criticisms of science.²⁹

Published in 1995, *The Handbook of Science and Technology Studies* chronicles “the coming of age in STS” over the last twenty-five years (according to Gary Bowden 1995, 64). Accordingly, STS now projects a distinct “adult” personality beyond its methodological conflicts. The story of STS begins with unmasking the myths of scientific universality and technological autonomy: a feat first attributed to its accidental founder, Thomas Kuhn. Supporting his theory on the normative function of scientific paradigms, Kuhn's historically-based arguments seemed not only to sound positivism's death knell, but to set the ontological table for new epistemological perspectives. The ripening consensus over the virtues of Kuhn's account in *The Structure of Scientific Revolutions* was identified as a call to study science, technology and society's complex interrelations. Beyond the immediate need to align perspectives on the history and philosophy of science, STS examined science and technology as value-laden social constructs. STS practitioners interpreted *Structure* as an argument for generating causes external to science as a necessary condition for accurately understanding scientific practice. Moreover the science, technology, society conjunction entailed perpetual cultural, political and theoretical questions. To capture adequately how scientific and technological practices shape, and are shaped by, social processes, STS asserted the further necessity of studying all contexts in which science and technology occur.

On the surface, the need to “know more” about a given subject, to gain a holistic understanding of complex institutions, especially science, is difficult to dispute. And the standard prescription for knowing more about a subject is through (or derived from) direct experience. However, central to STS epistemology is the claim that one can come to “know” (or

Thousand Oaks, CA: Sage, 1995, 95-110) and David Hess (*Science Studies: An Advanced Introduction* New York: New York University Press, 1997).

²⁹ Steve Fuller (“Being There With Thomas Kuhn: A Parable for Postmodern Times” *History and Theory* Vol. 31, Number 3, 1992) states: “But once Kuhn became a proficient instructor the ... more Piagetian style predominated, which focused the student's attention only on salient aspects of scientific episodes that were necessary for recognizing and resolving some paradigmatic tension. Here we find the Orwellian historical perspective that enabled student's in Kuhn's course to acquire the kind of ‘understanding’ of science that [James Bryant] Conant sought” (273-274). In this passage from 1984 (New York: Signet, 1949) Fuller's notion of Kuhn's Orwellian sense of history is illustrated in the control and use of history, in science, for particular social ends. Kuhn refers to this phenomenon in the writing of textbook science: “The Party said that Oceania had never been in alliance with Eurasia. He, Winston Smith, knew that Oceania had been in alliance with Eurasia as short a time as four years ago. But where did the knowledge exist? Only in his own consciousness, which in any case must soon be annihilated. And if all others accepted the lie which the Party imposed – if all records told the same tale – then the lie passed into history and became truth. ‘Who controls the past,’ ran the Party slogan, ‘controls the future: who controls the present controls the past’” (32).

“know about”) science indirectly; by studying the economic, historical, political and social contexts (among others) in which it takes place.³⁰ Still, the efficacy of contextual analyses regarding and characterizing the practices associated with “doing science” (analyzing laboratory research, for example) has been the subject of recent, celebrated debate.

I agree with Larry Laudan’s most recent diagnosis, in the opening chapter of *Beyond Positivism and Relativism* (1996), on the current state of the philosophy adopted by science studies practitioners. Here, Laudan echoes a sentiment he first articulated in attacking the tenets of David Bloor’s strong program:³¹

... Postpositivism is an intellectual failure. The arguments on its behalf are dubious and question-begging. Still worse, it has sustained virtually no positive program of research. While attracting a few noisy adherents ... postpositivism has exerted no perceptible impact on any of those natural sciences whose philosophy it purports to provide. (5)

Pace Laudan, the argument above could have been mouthed by a postpositivist simply substituting the word ‘positivism’ for ‘postpositivism’: However, his point is well taken. The study of science has stalled. Ironically, given its linguistic sensibilities, science studies has become rhetorical “red meat” for scientists defending their projects before a capricious tax-paying public, and for conservative pundits calling for education reform by attacking the “liberal elite.” Science studies has become a parody of itself, in part, by failing to develop a serious philosophical foundation for its unique brand of inquiry.³² The philosophy of science

³⁰ Fuller makes the argument that one does not need to be a scientist in order to critique science in Chapter One of *Philosophy, Rhetoric and the End of Knowledge: The Coming of Science and Technology Studies* (Madison: University of Wisconsin Press, 1993)

³¹ Laudan (“The Pseudo-Science of Science?” *Philosophy of the Social Sciences* Vol. 11, 1981, 173-98) offers the most salient philosophical critique of Bloor’s Strong Programme. Recent criticisms of STS (i.e., Philip Kitcher’s “A Plea for Science Studies” *La Recherche Forum* www.larecherche.fr/FOR/SOKAL/kitcher.html) bear a striking resemblance arguments, and their structure, Laudan gave more the fifteen years ago.

³² Philip Kitcher “A Plea for Science Studies” *La Recherche Forum* www.larecherche.fr/FOR/SOKAL/kitcher.html) makes the point with a vengeance: “How can Science Studies be liberated from the asymmetrical treatment of society and nature achieved in the early phase of the sociology of scientific knowledge? How can Science Studies be applied to Science Studies itself? Wait! There are new fashions announced in Gallic Haute Culture Let us mix in some Lacan, some Lyotard, a dash of Deleuze. Let us play with Derrida. Let us have some actor-networks, mangles of practice, emergent dialectical surface, multivocalized polygendered postphallogocentric transcategorically sensitive discourses. Let us have solutions to problems that nobody has even thought of posing about science before; indeed, let us forget about science entirely in our deprivileging of canonical texts and our evaluation of context. Like Lear on the heath, we shall do such things/We know not what they are but they shall be/The terror of the earth” (printout 13). Kitcher rightly sees STS as engaged in a discourse closed off from science itself and seeks to simplify STS inquiry by going back to the themes raised in history, sociology and philosophy. For effect, I contrast Kitcher’s critique with a series of provocative points made by Daryl Chubin five years earlier (“The Elusive Second ‘S’ In ‘STS’: Who’s Zoomin’ Who?” *Technoscience* Vol. 5, No. 3 (1992) 12-13): “To become content with one set of claims while arguing vigorously for the existence of others is to disavow one’s relativism and reflexivity. Yet STS scholars assert that others must embrace the “socially constructed” character of all

studies comes either from a curious admixture of realism and relativism, or comes ready-made from a given disciplinary perspective (e.g., sociology, history, psychology).

Laudan further notes: “The central epistemological problem in the philosophy of science, simply put, is this: Confronted with rival claims about the world ... and a certain body of evidence, how do we use the evidence to make rational choices between those rivals?” (1996, 6-7). While not all philosophers of science agree with the programmatic aspects of Laudan’s assertion, it underscores a critical problem in STS: **Confronted with rival claims about the nature and practice of science from numerous disciplinary contexts, what criteria do we have for choosing among rival accounts based on distinct epistemic and ontological categories?** The positivists regarded this problem as one of translation and postulated an observational language which spelled out truth conditions for expressions given their native theoretical language. Translating theoretical expressions into a neutral observation language was an attempt to establish observational, and empirical, equivalence among statements from rival theories. In supporting versions of the “unity of science” movement, Popper and Carnap, for example, were committed to collapsing the natural sciences into the language of physics. In part, the positivist program rested on two notions: that each theory had a (unique) language which could be translated into that of a rival, and that the “rational choice” among theories necessarily entailed the availability of a neutral observation language.

As Sellars (1963) and, earlier, Duhem (1906, reprinted 1954), argued, a neutral observation language, even a “common sense language”, incorporated theoretical frameworks and a world view. No “neutral” observation language was possible. Moreover, in conceding the

knowledge. Excuse me, but doesn't this reduce relativistic and reflexive principles to the status and practice of knee-jerk positivism? ... STS practitioners who decry the notion of a definitive reality and champion the notion of a socially constructed world should welcome alternative interpretations that derive from different approaches to and data on science and technology. An interpretation that is arguably a distortion or caricature should have as much initial credibility as any other – and then prompt further study to determine the validity of the "caricature" claim. But sadly, this is not the case (1992, p. 12). The promise of emancipation from naive scientific realism by SSK does preclude the participation of scientists, among others, in constructing an understanding of science. Again, Chubin notes: “So who is promoting public understanding of science? Or, for that matter, scientists' understanding of science? Not the STS community. It is still bedeviled by internalist questions, enveloped by specialist jargon, and feeding an archive of mounting irrelevance. The turning away from the second 'S' (society) is strongly correlated with a turning inward to the rewards of a profession that has been captured by academic politics. The very tendencies STS sought to repudiate now shield the leading lights – its scholarly role models – from the issues of society, polity and the lay culture. Their work, however erudite, grows sterile” (1992, 13). If STS can be considered a form of paradigm-based inquiry, then we have been in a crisis stage for the last decade. Kitcher and Chubin, separated by five years, note the same response. STS has circled the sociological wagons and turned inward. In so doing, the level of obscurity has dramatically increased exposing the theoretical flanks of STS to attack by the scientific community. The sociological trend which is most disturbing, noted by both Kitcher and Chubin, is the role the “leading lights” play in continuing to promote their own agenda. STS, at times, resembles factions engaged in a cult of personality. Where I hold out hope that the next generation of STS scholars will go back to promoting a broadly defined understanding of science, Kitcher’s prediction is that constructivist dogma will rule the day with newly trained STS practitioners (see Kitcher’s note 41).

incommensurability of rival theoretical claims, the possibility of scientific rationality became even more distant. The choice of rival scientific theories, then, became a matter of historical happenstance or social contrivance. Finally, the incommensurability problem seemingly yielded to an inevitable form of cognitive relativism.

Solving the problem of incommensurability twisted the postpositivist critics (like Donald Davidson) in numerous directions from denying the possibility of translation, to denying the existence of rival conceptual schemes. Laudan (1996) claims that postpositivism remains wedded to the same assumptions and presuppositions as positivism. In addition, he suggests, logical empiricism provided the very fodder, translatability among rival theories, used for attack on the cognitive authority of science, the incommensurability thesis. For Laudan: “The positivists’ squeamishly subjectivist meta-epistemology leads to Kuhn’s theories that scientific disputes that depend on methodological differences cannot be rationally solved” (24). The additional irony, Laudan notes, is that: “The positivists’ insistence on the radical underdetermination of theories points toward the indeterminacy of translation and the attendant relativist thesis that evidence is wholly or largely irrelevant to the evaluation of theories” (24). The weak meta-philosophical stance taken by the positivists cast theory choice as a local, ethical matter which translated into the constructivist strains found of STS. Empirical evidence is largely irrelevant to the evaluation of claims describing scientific practice.

The development of STS has spawned a number of contextual approaches to the study of science; in theory, the number of these approaches are limitless. Moreover, the study of science takes as a *necessary* condition knowledge of the contexts in which science occurs. While knowledge of the science being studied is a *sufficient* condition for studying its practices, it is not, according to STS dogma, a necessary condition. Many STS practitioners conflate the epistemological status of claims regarding the “study of” science with scientific knowledge. To eliminate the distinction between natural and meta- scientific claims, radical constructivists proclaim all objects of natural and social scientific study as socially constructed. While constructivists proclaim science as just another social activity, Latour adds that the scientific literature is “... so hard to read and analyze ... because it is *more* social than so-called normal social ties” (1987, 62 original emphasis).³³ For constructivists, then, a given scientific practice

³³ Latour’s assumption that science is socially constructed makes the success of science an extraordinary feat of social engineering. If one makes a fairly safe assumption that science has successfully progressed, and further assumes, as do constructivists, science is just another ideology, then the success of science is an unparalleled exercise in social, intellectual engineering.

can be both more or less social than itself – although the comparative basis for institutions and practices being “just as” or “more” social remains undefined. As a result of the thorough ambiguity about the definition and explanatory function of “the social”, the study of science proceeds from a series of undifferentiated philosophical assumptions. The need to revisit the philosophical foundations of STS became quite apparent as the “Sokal hoax” was played out on an international stage. While constructivists and reflexive practitioners delight in postmodern ambiguity (and publicity), the study of science is, consequently, perceived by scientists, and some policy makers, as yet another intellectual fad.³⁴

Since the “study of” science can be conducted from any disciplinary perspective, the number of knowledge claims about scientific practice generated by these approaches is potentially infinite. Still, implied in arguments for interdisciplinary approaches to the study of science is that knowledge which is “consciously contextualized” provides a more complete (or accurate) picture of a given event. Typically lacking in this commonsense argument is whether the epistemological and ontological categories offered by given contextual approaches supply either relevant or appropriate knowledge of scientific practice. Moreover, the absence of an integrated, shared epistemic and ontological perspective within STS allows incommensurate disciplinary categories, and the entities posited by them, to be the basis for describing and rendering normative judgments on scientific practice. No basis for adjudicating the validity of meta-scientific knowledge claims exists. Additionally, no basis for determining the efficacy of certain contextual or disciplinary approach to science studies exists; what follows is (to borrow from Collins) is a “contextualists’ regress.”

Implied generally by arguments for the necessity of contextual analysis in studying science is a dual form of ontological and epistemological holism. While a necessary condition for a picture of scientific practice is to be drawn through the context of a larger system of observations and analyses, that picture is *always* underdetermined. Any account of scientific practice can be trumped as incomplete given that the conditions which might affect practice (social, historical, economical, rhetorical, anthropological, medical, *ad infinitum*) can only be mapped partially. The complexity of scientific practice, then, can either be described only partially, or multiply, by whatever disciplinary perspective(s) are employed. Still, as science studies’ ontological holism implies, the sum total of all accounts of scientific practice, even if contradictory, has the same epistemic status (according to the symmetry principle). Any and

³⁴ Many STS practitioners hold the derivative adolescent fantasy that the publicity generated by the Sokal Hoax and heated attacks by Gross, Levitt, Steven Weinberg and Lewis Wolpert (among others) means that the criticisms leveled against science are hitting too close to home.

all claims are potentially valid, but can never be resolved as such – especially given a constructivist ontology. Also, the possibility of sorting meta-scientific claims through meta-analysis is short-circuited by constructivism. The “contextualists regress” of science studies forces researchers to embrace forms of “... classical skepticism [or] speculative metaphysics” (Fuller 1996, 171). Whereas the problem of rival yet incommensurable claims led studies practitioners to proclaim the irrationality of scientific theory choice, the rationality for (even) postulating and accepting meta-scientific knowledge claims in STS is either reformulated as another problem (e.g., irony, reflexivity), deemed impossible (Woolgar 1988), or ignored.

Even if one assumes the constructivist position, knowledge of the contexts in which science occurs has been elevated in STS as lending a unique epistemic consideration of scientific practice. In fact, the basis for including multi-disciplinary perspectives on science is to get “the big picture.” Entailed in the argument for contextualism is an implied notion of accuracy; the bigger the picture the more accurate our knowledge of science. This insight is taken to be unavailable to scientists given the structure (as revealed by Kuhn) of their practice. Here, science studies practitioners adopt a variation to the solution Marx offered to problems of false-consciousness; retreating to meta-level analyses to describe the origins of scientific knowledge. The bedrock of scientific research, then, is historical happenstance. The existence of entities postulated by social and natural scientific theories is the product of social negotiation. But the difference between scientists and their STS counterparts is that science studies practitioners *know* (and have access to) the mechanisms making scientific knowledge possible. In the same vein, given constructivist reductionism (i.e., all knowledge is the product of social negotiation), a case could be made that knowledge about scientific practice is “just” an extension of traditional social science approaches to epistemology. However, STS practitioners contend that meta-scientific claims are a unique form of knowledge not necessarily anchored to traditional epistemological categories.

Collins and Yearly’s “Epistemological Chicken” argument (in Pickering (ed.) *Science as Practice and Culture* Chicago: University of Chicago Press, 1992, 301-326) garnered much attention and seems to have put “the question of philosophy” back on the table in STS; even Latour and Woolgar have both advocated a “return to philosophy” (see Fuller 1996, 171). Moreover, Fuller’s announcement of STS’ arrival in *Philosophy, Rhetoric and the End of Knowledge: The Coming of Science and Technology Studies* (1993) requires critical evaluation. Larry Laudan’s sustained attacks on science studies over the last fifteen years (in *Beyond Relativism and Positivism*, 1996), and calls for an examination of the positivist legacy, suggest

the possibility of a metaphilosophy developed in STS. Here, some of the traditional questions raised by positivists – theory choice, translation and incommensurability – can be newly addressed. By examining the absence of a metaphilosophical position by the positivists, and proposing its articulation in the context of STS, the role of philosophy, in relation to science, comes into question. Moreover, the constructivists have taken wholesale the positivists' philosophical entanglements. For example, constructivists and positivists agree that with no relevant “facts of the matter” no means exist for adjudicating among rival claims about the aims, methods, and practice of science.

Beginning with Kuhn, the problem of translation, as it relates to incommensurability, has been a central epistemological concern in STS. Kuhn's conception of bilingualism, alternating between theoretical languages rather than translating between them, has inspired similar models of inter- cultural and disciplinary exchange. Collins and Yearly (1992) support the idea that sociologists and anthropologists have a tacit propensity toward “meta-alteration” – the ability to understand an alien practice by adopting the native's standpoint, yet return to the researcher's intellectual and disciplinary home to provide an explanation of the differences. Apparently meta-alteration also applies to the philosophical positions one takes, realist or constructivist, regarding entities postulated by the social sciences or the natural sciences. Donald McCloskey (1991) and Peter Galison's (1992) conceptions of the “trading zone” offer a practice-based conception of translation in tracing the development of “trade” or creole language developed by physicists working on large scale research projects. Here, the location of translation is shifted from the positivists *a priori* legislation to the historical development of trial, error, and bootstrap-contrived conceptual languages. Finally, Fuller (1993) offers the most sustained attempt in addressing the translation problem in STS. He proposes a place for rhetorically-minded science studies practitioners to “interpenetrate” discourse communities, write new texts, and establish “terms for negotiation” among audiences affected by science and technology (1996).

1.6 Conclusion

Whatever its faults, Science Studies is not a house built on sand. It is better conceived as a colony strung out on a difficult, but strategically important, seashore. Some of the buildings gross and gaudy in self-advertisement stand on pathetically slender foundations; it hardly needs a tsunami to wash them away, the merest ripple will do. Other are a curious mixture of craftsmanlike work and jerry-building, often with a folly or vast unscoured stable attached. A few, more modest, sneered at or ignored by the most ambitious builders, are

constructed to last ... What is needed is slum clearance and urban renewal, a project in which historians, philosophers, sociologists and scientists should all be invited to join.

(Philip Kitcher "A Plea for Science Studies" *La Recherche Forum*
www.larecherche.fr/FOR/SOKAL/kitcher.html)

Social constructivism has become STS orthodoxy. As Philip Kitcher suggests in identifying the Four Dogmas (Chapter Five below) of STS thought:

The thoughtful reader, taking up a book such as Latour's *We Have Never Been Modern* or Pickering's *The Mangle of Practice* can only wonder at the height to which the seas of Science Studies have risen. Science seems no longer to be the principle subject (pride of place now being given to Science Studies itself), but, instead, we have entered a discourse as closed off from the phenomena that were once central to the field as some philosophical investigations of the 1950s, with their exclusive obsessions with the blackness of ravens.

In order to connect STS back to science, I argue that we need to examine the institutional and intellectual foundations in which we find ourselves. Kitcher's metaphor of urban renewal is particularly apt. I am inclined, however, to see what we can do with the structure first before called in outside contractors; although one might equate my proposal with rearranging deck chairs on the Titanic. My goal is to deal with the philosophical raw materials we have been given by social constructivism. Current discourse in STS suggests the field has entered a stage, as Kitcher suggests, which is decidedly unreflexive. Constructivism has become axiomatic with recently trained practitioners in STS. Moreover, Kitcher admits that his criticism will likely fall on deaf ears as much of constructivist rhetoric smacks of religious acceptance. In asking: What are the origins of social constructivism in American STS? I want to reveal the false prophets (perhaps of the kind Edge mentions) of social constructivism. The main points I have outlined in this chapter and will pursue in the next chapters are these:

- Social constructivism is taken to prefigure all forms of STS inquiry, and, by extension, is taken to prefigure all forms of scientific inquiry. In this sense, STS is a paradigm-bound form of inquiry;

- Assuming, on the basis of philosophical consistency, the origins of social constructivism are socially constructed, two consequences follow:

1. Infinite regress;
2. Contextual realism.

While radical reflexive theorists celebrate infinite regress, one can always trump the reflexive inadequacies of their accounts. Many constructivists, in order to ground their accounts,

take as given context-based perspectives (historical, sociologic, economic, rhetorical and the like) and take as given the ontological stability of the relationships bracketed by that designated relationship. The reliance on context offers two possibilities for reform with the accompanying examples as possible consequences;

1. One can contextualize social constructivism in American STS. In so doing, I examine the socio-historic setting, intellectual foundations and philosophical implications of a constructivist, American STS with the following consequences:

- Within the historical context of Americana land-grant institutions, STS can be shown as existing only insofar as it contributes to the social order prefigured by the Morrill Act of 1862;

- Within the sociological context of its founding text, STS can be seen as a form of paradigm-based inquiry that was scripted by Thomas Kuhn's *The Structure of Scientific Revolutions*;

- Within the philosophical context of social constructivism, and the social constructivist interpretation of *Structure*, the appeal to context suggests an anomaly in the paradigm. Constructivist accounts depend on a form of meta-scientific realism in which the elements of a context-based account of science necessarily depend on a set of ontological relationships, a logic of justification, a form of coherence, and, therefore, a basis for adjudication;

2. One can articulate the possibility for a philosophy of STS in which meta-scientific claims exist in a logical relationship to scientific practice and the world that practice describes.