# Antimonies of Science Studies:

# Towards a Critical Theory of Science and Technology

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# Abstract

Science Studies is an interdisciplinary area of scholarship comprising two different traditions, the philosophical History and Philosophy of Science (HPS) and the sociological Science and Technology Studies (STS). The elementary tension between the two is based on their differing scholarly values, one based on philosophy, the other on sociology. This tension has been both animating the field of Science Studies and complicating its internal self-understanding.

This thesis sets out to reconstruct the main episodes in the history of Science Studies that have come to formulate competing constructions of the cultural value and meaning of science and technology. It tells a story of various failed efforts to resolve existing antimonies and suggests that the best way to grapple with the complexity of the issues at stake is to work towards establishing a common ground and dialogue between the rival disciplinary formations: HPS and STS.

First I examine two recent theories in Science Studies, Sociology of Scientific Knowledge (SSK) and Actor-Network Theory (ANT). Both of them are found to be inadequate as they share a distorted view of the HPS-STS divide and both try to colonise the sociology of science with the tools of HPS. The genesis of this colonizing impulse is then traced back to the Science Wars which again is underpinned by a lack of clarity about the HPS-STS relationship. This finding further highlights the responsibility of currently fashionable theories such as ANT that have contributed to this deficit of understanding and dialogue.

This same trend is then traced to the work of Thomas Kuhn. He is credited with moderate achievements but recent re-evaluations of his work point to his culpability in closing the field to critical possibilities, stifling the sociological side and giving rise to a distorted view of the HPS-STS relationship as seen in SSK and ANT. Now that the origins of the confused and politically divided state of Science Studies is understood, there is the urgent task of re-establishing a balance and dialogue between the HPS and the STS sides.

I use two important theoretical threads in critical theory of science and technology to bring clarity to the study of these interrelated yet culturally distinct practices. Firstly I look at the solid line of research established by Andrew Feenberg in the critical theory of technology that uses social constructivism to subvert the embedded values in the technical code and hence democratize technology.

Secondly I look at the work of Jürgen Habermas's formidable Critical Theory of science that sheds light on the basic human interests inside science and technology and establishes both the limits and extent to which social constructivism can be used to study them.

Together Feenberg and Habermas show the way forward for Science Studies, a way to establish a common ground that enables close scholarly dialogue between HPS and STS yet understands and maintains the critical difference between the philosophical and the sociological approaches that prevents them from being collapsed into one indistinguishable entity. Together they can restore the HPS-STS

balance and through their shared emancipatory vision for society facilitate the bringing of science and technology into a democratic societal oversight, correcting the deficits and shortcomings of recent theories in the field of Science Studies.

# Statement

I hereby state that following thesis is entirely my own work and has not been submitted for any other degree at any other university or educational institution. All sources of information used in the thesis have been indicated and due acknowledgement has been given to the work of others.

Signed:

_____

Nikó Antalffy

Date:

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# Introduction

This thesis has grown out of a Critical Theory oriented sociological inquiry into the field of Science Studies and the felt need to resolve the existing theoretical antimonies of the field. It is fuelled by the question of how best to open up science and technology for scrutiny and the felt imperative to work towards their democratisation. Science and technology are fast changing targets to comprehend yet their far reaching societal effects warrant strong critical engagement.

Popular discourse may "black box" science and technology (Misa 2003: 2) and assume they are neutral tools with unimportant technical details, philosophy, history and sociology of science and technology, the disciplinary shards that make up Science Studies, have been working hard on opening that "black box" to analysis and scrutiny. Science Studies has been preoccupied with this task at least since the time of Robert Merton, a famous pioneering sociologist of science, and even more so since the rise of the radical science movement and the rise of social constructivism from the 1960s & '70s onwards. These movements have helped greatly in legitimising the active questioning and critique of developments in science and technology, not only for activists but for Science Studies practitioners too. It is the primary task of Science Studies to reveal the socially constructed and philosophically available contents of the above "black box" in a systematic way and to analyse phenomena that society, and science and technology within it, create together.

Major controversies and success stories mark the peaks of popular preoccupation with science and technology: from Hiroshima and Nagasaki, Bhopal and thalidomide to the more recent waves of developments in biotechnology and nanotechnology and to the politicization of the greenhouse effect as global warming. Although for Science Studies scholars controversies are good rallying points for both engagement with a wider public sphere and for studying and analysing major scientific and technological developments, science and technology are more continuously and imperceptibly present in everyday life. They invisibly shape our assumptions and mark out the background possibilities for decision making all the time. Science Studies theories have been wrestling with the idea of just how much of our social reality is being shaped by technological systems and scientific

rationality and how much these systems and rationality in turn are shaped by social reality. The philosophical dilemma of determining the degrees to which each phenomenon is determined by technological, scientific or more general social forces has gained expression in Science Studies theory as social shaping, social constructivism and technological shaping (Brey 2003:52). Yet it is the whole social-technical aggregate that Science Studies aims to comprehend in order to give answers to questions such as what role expert knowledge could and should play in the shaping of scientific developments, how should policy be formulated, what alternative pathways of technology development are possible and what the consequences will be for a variety of societal interests.

How should Science Studies go about opening the "black box" of science and technology? First of all the field needs the conceptual tools for capturing the internal epistemic logic and values of science so that its unique values can be understood, and its constitution can be opened up and critiqued internally. This traditionally has been the domain of philosophy of science. Secondly, Science Studies needs the conceptual tools to investigate the practices and values of science and technology for a wider societal analysis, appraisal and critique, which in turn can be used to evaluate the wider effects of science and technology, to hold them accountable and to open up a space for democratisation. This second way of opening the "black box" has traditionally been the domain of sociology of science. The philosophical and sociological strands in Science Studies are today reflected in the institutional division of the field, consisting of History and Philosophy of Science (HPS) and Science and Technology Studies (STS). In Chapter 1 I will give a brief history and description of the two sides.

At their best HPS and STS are complementary, they see the value of science and technology from two distinct directions: philosophy of science invests in understanding science in terms of its knowledge, epistemic justification and the logic of its methods, while sociology of science aims to capture science and technology in their societal context and to critique their social effects. HPS and STS share the common project of understanding and articulating what science and technology are and Science Studies as a whole needs their distinct contributions. When the two scholarly sides are open and in dialogue with each other their self-limitations in light of each other's project becomes apparent and HPS and STS can remain complementary rather than in conflict.

When I surveyed the current theories in Science Studies I was surprised to find that there is little awareness of the antimonies of the HPS-STS relationships, the limitations of each side's approach and the necessity of their cooperation. Instead of dialogue and negotiation recent theories seem to facilitate the colonisation of STS by HPS and subsequently the sociological understanding of science and technology is being lost. To compound this I could not find a well developed critical research programme that aims to both capture the cultural values of science and technology and develop a societal critique of their logic and practices. The lack of such a programmatic critical approach led me through the maze of recent Science Studies theories and through the recent reflexive and cultural turns that this field has experienced through the last 30 years in the English-speaking Western world. I wanted to trace the development of recent theories to understand where their lack of self-awareness originated from and how the field of Science Studies got to the stage where it is now.

In order to do this I came to analyse the two most prominent theories of the field in terms of their scholarly constitution and contribution to the field as a whole. Both of these approaches, Sociology of Scientific Knowledge (SSK, in Chapter 2) and Actor-Network Theory (ANT, in Chapter 3) seem to offer radically new directions for the field. They both make use of social constructivism, a broad movement that aims to interrogate science and technology in terms of their social constructedness, an approach that predates both SSK and ANT and underscores the basic rationale for sociology of science. Despite innovations and the scholarly influence of both SSK and ANT, their radicalism proves underwhelming because the approaches they use lack a critical direction and are fraught with inadequacies and limitations. Neither of them is able to articulate the cultural significance of science and technology and both of them end up dominating the STS side with the values and assumptions of the HPS side. This has the double effect of losing the field's internal dialogue and losing the relationship between science and democracy.

The recent Science Wars has done little to draw out the limitations of each side, HPS and STS, or to bring them into an open dialogue where they can gain awareness of each other's limitations. Instead it has exploded some of the underlying tensions that animate the field. I will analyse these in Chapter 4 to show the intellectual structure of Science Studies and to trace the philosophical taxonomy that SSK and ANT have attempted to synthesise with little overall success. In order to uncover the remaining

promise of their social constructivism I go back in time to investigate the scholarship of Thomas Kuhn and find that instead of a radical turn his theory provided an uncritical turn for Science Studies. In Chapter 5 I will show how Kuhn's scientism and internalism in particular are echoed in the later SSK and ANT. Kuhn's work, instead of re-invigorating the field, ended up sowing the seeds for the normative crisis in the shape of the colonisation of STS by HPS.

Finally, because of this disappointing overall scholarly situation, I have come to trace backwards the Critical Theory tradition in the study of science and technology that was neglected in favour of French (ANT) and British (SSK) traditions. The re-discovery and extension of this scholarly tradition is the best way to remedy the field's critical deficiency and normative crisis. I will introduce the Critical Theory work of Andrew Feenberg (Chapter 6) and Jürgen Habermas (Chapter 7) and will discuss their genuinely progressive insights into the constitution and cultural values of science and technology. They offer powerful ways of delivering a democratically responsive critique into the workings of science and technology, and provide direction for how Science Studies can re-interpret its own constitution so that the sociological and philosophical sides can re-establish their dialogue.

Feenberg and Habermas are both able to bring back normativity into their theories: in appraising the cultural values of science and technology by analysing the basic knowledge constitutive interests vested in them, and by making conceptual space for democratic interests so they can gain representation and leverage in and through science and technology. Critical Theory is able to correct both the critical deficiency and the normative crisis in Science Studies and is able to provide a normatively charged point between positivist realism and post-humanist relativism. With the combined effort of Feenberg and Habermas it becomes possible to successfully negotiate the HPS-STS divide so that the two sides remain in a productive dialogue which in turn allows them to appreciate each other's contribution and shed light on their own self-limitations.

The field of Science Studies in its present state requires a large dose of self-scrutiny to move forward. Critical Theory is a useful partner in this as it can help resolve the field's crisis of self-understanding. With this help Science Studies can restore the healthy dynamic between HPS and STS where there is mutual awareness of strength and self-awareness of limitations. Instead of colonisation the two sides

are bridged: the philosophically charged vision of HPS is complemented by the sociological approach of STS so that both science and technology can be critically interrogated internally and scrutinised in their real life societal effects, offering entry points for critique and alternative pathways of development. A new combined Critical Theory direction makes it possible to understand the full spectrum of values that science and technology stand for, critique them internally and externally, and with the help of a progressive emancipatory critique theorise for alternative human futures.

# Chapter 1

# Academic vessels: STS and HPS

The scholarly and institutional context of contemporary theorizing in relation to science and technology can be best viewed through an examination of the two academic 'vessels' that harbour today's academic thinking: Science and Technology Studies (STS) and History and Philosophy of Science (HPS). These two, and their local variants, are considered to be academic constituents of the broader field of Science Studies. Considering the development and disciplinary positioning of these two scholarly formations will allow me to draw the background for the development of two contentious and politicized contemporary theories of science and technology, namely Sociology of Scientific Knowledge (SSK) and Actor-Network Theory (ANT). This background chapter will also allow for the better understanding of other major disciplinary developments in the broader field of Science Studies that preceded SSK and ANT: Thomas Kuhn's theory of scientific paradigms and the highly politicized and turbulent Science Wars, both of which will receive a chapter each (Chapters 4 and 5). My main focus in looking at STS and HPS as academic vessels then is to provide a background to the present epistemic state of Science Studies and to start exposing the sociological and philosophical underpinnings of the field as contained in the scholarly assumptions and milieu of each: STS being the more sociological and HPS the more philosophical approach. This 'double sidedness' of Science Studies will become highly relevant later in the thesis when I draw together the strings of Science Studies development as elucidated in Chapters 2-5 and provide a new self-understanding for the field as a whole in the Critical

Theory tradition based on the combined insights of Andrew Feenberg and Jürgen Habermas. With the help of their scholarship I will point to a more potent, empirically relevant, but also normatively charged critical approach to science and technology than exists today in an organised form. This chapter 1 then gives a preliminary history of ideas context that becomes the setting for a wider critique towards a renewed understanding of Science Studies.

## Acronyms

The duality of Science Studies is embodied in the fields of STS and HPS. STS stands for Science and Technology Studies, or Science, Technology and Society, and is the more sociologically connected and more recently developed of the two. HPS stands for History and Philosophy of Science, and as the name suggests it is the more philosophically centered, and also older formation. These acronyms may look like pure academic hair-splitting for many science and technology practitioners outside of the university: activists, policy workers, but also for people in the general population who take a deeper interest in science and technology generally. In this chapter I want to show that they are quite different academic creatures with a different story to tell about science and with different implications and applications in the real world. Although both STS and HPS are academic disciplines with little direct responsibility for the consequences of their knowledge making enterprise, there is still a wider democratic constituency that Science Studies theorizing is indirectly responsible to as members of the wider society are the ones who enjoy the benefits or suffer the real life consequences of technoscientific phenomena.

Throughout the thesis this normative interest spurred me on to find the best approach in Science Studies that both help theorise science and technology, and also actively allow for a real life engagement with their consequences.

While the history of HPS is more a rise and succession of theoretical entities, STS is more readily conceptualized in terms of its institutional history. STS was conceived with that acronym in the late 1960s and is considered a truly interdisciplinary project from the beginning, while HPS only gradually acquired such a characteristic 'mingling' of originally entirely independent disciplines and their eventual fusion is harder to demonstrate. Changes in the history of HPS can be attributed more to the rise and fall of theoretical developments in philosophy than the merging of history and philosophy of science. STS too experienced some internal changes in its 40 or so years, however these are more a function of shifting theoretical emphasis than a radical rethink of foundational questions. I will argue that STS and HPS have fundamentally different approaches even though they attempt to answer the same question of how to understand and explain science and technology best. They have been living with this duality since their beginning as they have evolved in either a more sociological (STS) or a more philosophical (HPS) vein. The peculiar mix of tension and co-operation between them relate back to their scholarly differences and similarities: STS and HPS cannot be reduced to each other, yet radically separating them would also deprive both of constructive engagement with the other. With that in mind I now turn to give a brief history of ideas for each.

# HPS

HPS is definitely the older formation with its roots going back to the philosophy of Francis Bacon in the 16th century (Gillies 1993). However, there is historical consensus that the real beginnings of philosophy of science should be placed in the late 19th century when philosophers still had scientific training but science and philosophy have begun to develop independently. However, arguably philosophy of science only began to mature into a distinct entity in the first third of the 20th century when the basic idea of positivism was extended by the Vienna Circle. Consequently, instead of reaching back to Comte and Locke and launching into a long elaboration of pre-20th century philosophy I will follow up the beginnings of HPS from the 1920s onwards. This early 20th century part can be considered the formative years of of later 20-21st century philosophy of science.

In contrast to STS that is easier to characterise in terms of its institutional history, HPS presents a different picture, one of a changing landscape of theoretical developments within less variable institutional units. On the institutional level it presents a much more even and peaceful development, but when its theoretical content is considered a highly contested and colourful terrain is revealed. From the days when the Vienna Circle's empirical positivism flourished to the recent 'science wars' debates over the intelligibility of postmodernist accounts of science, History and Philosophy of Science has been through the most remarkable theoretical changes.

I will attempt to put forward a short history of this (eventually) interdisciplinary formation by recounting the succession of the most formative of theoretical developments that have flown through HPS and to a large extent made it into what it is today. My aim here is to introduce the most characteristic theories and philosophical turns in a chronological order (as far as such an exercise is possible in a linear fashion), the stepping stones in which the aims and the foundational questions of HPS have become crystallised. During this introduction I will also bring to attention the epistemological, methodological and political issues these same theoretical developments brought to the fore, some of which continue to be debated today. I want to keep the focus on the most immediately relevant context of each development and put aside wider contemporary debates on their validity and legacy for later chapters.

## Vienna Circle to Popper

This famous group of philosophers and their activities between 1922 and 1938 had a formative influence on philosophy of science and could be thought of as the first milestone of HPS. The Circle's most well-known members were the mathematician Hans Hahn, the physicist Philip Frank, the social scientist Otto Neurath, the philosophers Moritz Schlick and Rudolf Carnap (Audi (ed) 1995: 836). Their discussions focussed on the formal and physical sciences and took place at regular meetings, while their ideas were publicly expressed in subsequent conferences and

publications[1]. There are several important philosophical developments associated with the Circle, most centred around their views on science and their perspective of logical empiricism (or logical positivism as it also became known).

Empiricism and positivism have roots going back to Locke and Comte respectively and could be considered the methodological and epistemological precursors of logical empiricism (Audi (ed) 1995: 445)[2]. In this regard the Circle was drawing its inspiration from major British and French philosophical developments and recognised science as the prime site of alliance between the two: the repository of definite, certain understanding of the physical world based on empirically observable facts and the laws that govern relationships between them (Williams 1983: 239).

A more immediate precursor to full-blown logical empiricism was logicism that grew out of Bertrand Russell's formal considerations on mathematics and his preoccupation with set theory (Gillies 1993: 11-13). Russell claimed to have established on logical grounds that there were two kinds of truths, logical truth exemplified by mathematics, a kind of 'hollow' truth that amounted to truism, and experience exemplified by science, which was based on observation, the logic of which was essentially inductive. Although for Russell there remained the problem of how such acts of inference could be justified, for now the logic of induction was established as a credible and reliably constant conceptual basis of science's mode of

[1] Their journal, Erkenntnis ('Cognition') was launched in 1930; there were several international congresses and conferences on the unity of science, which was a major theme of the Circle, so much so that an ambitious project was launched to create The Encyclopedia of Unified Science (Hanfling 1996: 194).

operation. The Vienna Circle took these truisms to be pre-given 'protocol statements' that needed no justification beyond simple logic, while science justified its 'truth' via positive empirical means. It was clear that science has gained a strong philosophical justification that has placed it on a firm footing. This was the first modern description of the core operational logic of science and the beginning of a specialist preoccupation with its philosophical attributes, still well within the discipline of philosophy.

Logical empiricism was officially born when the Circle published their 1929 Manifesto of Wissenschaftliche Weltauffassung: Der Wiener Kreis: 'The Scientific Conception of the World: The Vienna Circle' (Gillies 1993: 17). Here logical empiricism surfaced as a coherent perspective maintaining that science was the custodian of the kind of truth that was based on a kind of structured experience. Such a logically devised experience was made meaningful by planned testing of hypotheses through observation and deductive and inductive logical interpretation. This process of empirical verification (a reincarnation of Wittgenstein's 'verification principle' (Hanfling 1996: 195)) was at the core of the scientific method, which, as the allegedly most solid philosophical crux of science, itself became a core consideration for the philosophy of science.

We can now see that early philosophy of science found its subject matter in the core operational logic and principles of natural science that together delineate both the basic methodology and epistemology of natural science.

[2] Comte envisaged sociology, as a natural 'evolutionary' extension of the physical sciences, to be the culmination of positivism; and at this point the epistemological and methodological complexities of

The Circle has also inherited from Wittgenstein the problematic of demarcation between science and metaphysics. The philosophical exercise of separating metaphysics from science was taken aboard and extended, further supporting the status of science and beginning a long preoccupation with demarcation in later HPS[3]. Science was to be strengthened this way from outside, but at the same time it was to be fortified from inside by the reductionist 'unity of science' thesis. The Circle's members maintained that all sciences shared a methodological outlook the foundations of which encompassed realist and positivist elements, uniting the natural, social and cultural sciences. They conceived of a unified mind-independent world that could be interrogated and forced into offering up the parameters and laws of its composition through the method of verification supported by empirical methods. This framework for the scientific method was thought to hold true across all areas of knowing, belonging to different branches of science.

However, as soon as science looked like a unitary, conceptually tangible beast with justifiable lines of demarcation from its conceptual neighbours, contemporary scientific theories manifested a problem that did not easily gain resolution within the framework of logical empiricism as it was formulated. A revolution in physics elicited by the new theories of relativity and quantum mechanics, have posed new questions for the philosophy of science. As Newton's theories have become inadequate, imprecise or incorrect in light of new theories the question arose, how

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the social sciences start to unfold.

[3] 'Boundary work' is now considered a sub-field of both STS and HPS. It focuses on the separation (or not) of science from non-science. Practically all through the history of Science Studies (either in STS, HPS or pre-STS sociology of science) there has been interest in demarcation. Early examples are the post-Vienna Circle rejection of Psychoanalysis and Marxism on the grounds of impossibility of falsification by Popper and several instances of extreme relativism in theorising such as Feyerabend's 'anything goes' principle. Some of the recent 'Science Wars' debates also focus on issues of what counts as credible scholarship in HPS and what does not and where such demarcation positions postmodern accounts.

was it possible to objectively overthrow previous knowledge when surely the same scientific method was utilised earlier? Does this mean that scientific knowledge is not universal or true for all time or that scientific methods are not completely objective? How was the ensuing scientific change of guard to be accounted for? This revolution in physics that was born out of Einstein's, Heisenberg's and others work was not explained by verificationism alone (Gillies 1993: 20-21). Such considerations have opened up two related developments within philosophy of science. One concerns a conceptual split between considerations given to the context of theory development and the context of justification. This development eventually opened up a theoretical crack for non-realist interpretations of scientific knowledge. The other development is the increasing importance of historical evidence in accounting for scientific development, foreshadowing the future role of history in an interdisciplinary HPS. These two developments have started nudging philosophy of science away from hard realism rooted in presently available evidence and towards a more relativistic and historicist pathway. Here we see the very development of contemporary scientific theories pushing philosophy of science further along its own development as philosophers of science come face-to-face with the philosophical ramifications of a radically new physics.

However, the decline of the Vienna Circle was not a result of slow theoretical obsolescence (or a fast gestalt-like switch in collective thinking) but the political developments in Germany. Members of the Vienna Circle were forced to leave Austria for racial and political reasons as the Third Reich strengthened its grip on power[4]. But by now they collectively have not only laid the future foundations of

[4] Schlick was shot in 1938 by a Nazi student; others fled mainly to Britain and the USA and exerted great influence on the English speaking world most notably through the work of Quine and Ayer.

philosophy of science but also helped unleash considerations that still keep swirling today. The rigour with which they debated their ideas gained dignified followers in their lifetime and beyond (and many severe critics) and strongly invigorated philosophy of science. Today the Circle's philosophy of logical positivism is considered archaic, abandoned or justly criticised; very few scholars would admit to holding on to it in its original form. However, positivism, empiricism and reductionism are still often in favour in different guises and the Circle's conceptual framework is still evidently useful for many scholars today (Hanfling 1996: 194).

There were direct offshoots from the Vienna Circle, the most notable of them being Karl Popper's work. His most praised insights pertain to the kernel of the scientific method. The Vienna Circle's verification principle, whereby new theories gained currency in the scientific community by passing confirmative empirical tests, was turned around to become the principle of falsification, the process of testing hypotheses to see whether empirical observations could 'falsify' the theories from which they were projected. Inductivism is replaced by deductive logic. This new falsification principle means that theories are now only thought to be valid for the time being and can always be proven invalid at a later point when contradictory evidence comes to the fore, so absolute truth gives way to cumulative growth of knowledge and gradual approximation of correspondence to the laws of reality.

Popper's emphasis on falsification has been attributed to his early critical turn against his short Marxist phase in 1919, his psychologically bent observations of Einstein's reasoning and exposure to British liberalism (Jacobs 1991). Popper, according to his autobiographical writing, was quickly disillusioned by socialist and

communist ideals as they contributed to bloody political change and social turmoil. A critical stance towards perceived extreme lines of thought, political or otherwise, seemed to be in order. Popper's early studies in association psychology have led him to make psychological observations upon Einstein's remarks on potential empirical tests that were they to eventuate, would make the general theory of relativity 'untenable' (Jacobs 1991:168). The gestalt switch from verification to falsification was prepared. In the end, Jacobs traces the concept of fallibility to Mill's *On Liberty*, in which criticism is appraised as the instrument of defence against human fallibility.

*The Logic of Scientific Discovery* was Popper's main work on the scientific method in which he describes in great detail the procession of conjectures and refutations through which scientific theorising advances. The principle of falsification also becomes the yard stick by which the demarcation between science and non-science is further clarified: what cannot be potentially falsified does not qualify as science. Famously, according to Popper, psychoanalysis and Marxism are two examples of non-science on the basis of their unfalsifiability. Progressing toward higher degrees of falsifiability within what has been deemed science, results in higher levels of universality and precision (Jacobs 1991: 173), qualities that science epitomises. These same scientific qualities ensure that scientific knowledge will approximate, and eventually (perhaps in infinity) correspond to objective truth. According to Popper's doctrine of verisimilitude this is the ideal endpoint of scientific inquiry, where falsity-content is minimal and truth-content is maximal. The only problem is that when objective truth is allegedly reached the chances of falsification are zero,

therefore a theory that corresponds to objective truth is logically unfalsifiable[5]. Falsification can never achieve a positive conclusion.

The practical implication of Popper's account of scientific progress changed the image of science into the custodian of provisional truth that is permanently fallible. But instead of marking science as weak such high level of rigour and precision elevated science in the game of being critical, and therefore contributed to its image as highly truthful by relegating the subjective elements of intuition to the production of viable conjectures. Even the choice between rival hypotheses to be put to test is to be based on objective arbitration, the criterion of which is the demonstrable level of falsifiability. The same falsifiability (testability) criterion is to be used in decisions between new theories: the more novel predictions one of them can make beyond subsuming predictions of old theories and potentially falsifying them, the more value that new theory possesses (Jacobs 1991: 178). To underscore his logical system, Popper used historical examples (Newton, Galileo and Kepler; the still favoured triumvirate in HPS), arguably an *a posteriori* justification of why and how previous scientific 'progress' came about. Nevertheless, by using historical evidence to aid philosophical reasoning, Popper has amplified the role of history in philosophy of science.

Popper's meta-science has brought together analytical philosophy, contemporarily available philosophy of science and British liberalism. In his thought the Vienna Circle's empiricism and objectivism were fortified by critical and logical elements from the other two influences. After Popper, the world of science was safely

[5] Vicious counter-critics may want to point to the unfalsifiability of Popper's own contentions, however later theories, especially Kuhn's may be marshalled to the defence of Popper on this point.

retained within a realist perspective and its leitmotif remained as instrumental as ever. Therefore, epistemologically Popper was in agreement with the empirical positivism of the Vienna Circle and in order to strengthen his positivism he tried to do away with conventionalism (Duhem, Poincare, Schlick and Neurath (Jacobs 1991: 177)) that linked theory selection with convention based, and therefore potentially subjective, criteria[6]. Methodologically he further extended logicism which in turn helped him expand on the central methodology of science itself. Politically Popper stayed on the right, evidence of this being his later major work of 'Open Society and Its Enemies'[7].

From these early years philosophy of science has developed into a mature discipline with a variety of debates and research directions. From Popper onwards it has also taken on the history of science as a central element in its way of interrogating science. Later chapters on Kuhn and the Science Wars will elaborate further on how social-historical considerations have become so important for philosophy of science and how the discipline got entangled in a complex set of epistemological debates that have brought about both strong scholarly infighting and healthy questioning of the foundational attributes of HPS itself.

However, the most important foundational issues of philosophy of science can already be clearly seen here with the Vienna Circle and the work of Popper, and contemporary textbooks re-formulate these points energetically as a foundational guide to understanding the basic subject matter of the discipline. Philosophy of

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[6] Contention over the ontology of criteria, not to mention all kinds of other constitutive and modifying 'contextual' effects, continues and conventionalism finds a worthy descendant in social constructivism that is partly based on the underdetermination (or Duhem-Quine) thesis.

science is preoccupied with the questions of the ultimate aim and logical processes of scientific knowledge formation, with the conceptual formation of scientific meaning and validity, with logical justifications and processes, with the logical details of scientific description, explanation, prediction, causality, laws and so on (Klemke et al 1998:20-23). It aims to provide logical explanations of the conceptual building blocks of science by careful analysis of its abstract processes using a specialised philosophical metalanguage that extracts higher levels of meaning from the language of the sciences themselves (ibid.). Consequently philosophy of science provides very particular types of conceptual resources to the understanding of science as a human activity such as the logical analysis of its concepts, methods and arguments and its underlying principles of operation. From its early beginnings HPS clearly shows its later epistemological colours. These are distinctly different from the sociological colours of STS as I will show in the next section.

## STS reconstructions: early years and influences

The other disciplinary vessel of Science Studies is STS: Science and Technology Studies or Science, Technology and Society. STS developed later than HPS and is the more decidedly sociological of the two. It too wants to understand and explain science, but does it with sociological tools and a sociological outlook, using empirical methods next to interpretation and always considers science as part of a larger societal setting. In this section I will give an account of the early years of STS and the scholarly influences that shaped its development.

[7] Foundationalism coupled with right-wing political views remains a recognised 'flavour' within HPS.

The setting for the earliest appearance of STS was the post WWII political climate in the United States education system. This was the early Cold War era with sky-rocketing spending figures associated with scientific and technological projects. The 1950s and 1960s were undoubtedly the era of Big Science with the formation and ascendance of US agencies overseeing large science-related industrial projects, many of which continue to be highly influential today. The US Department of Energy started putting large sums of money into huge scientific projects often with national defense significance[8], and NASA the US space agency was to put the first human on the Moon. On the more publicly visible front science and technology were strong allies with industry; new branches of manufacturing were mushrooming. These years are still referred to as 'the golden age of science', a time of fermentation for the 'military-industrial complex' and also a time of fermentation for sociological thought on the very same subject.

By the 1960s the student movement was also in full swing as part of a larger social fermentation at the time, and students demanded education to demonstrably be in dialogue with civic concerns. One large concern was the use of science and technology in war and in peace with special reference to controversial and tragic instances of environmental and human destruction, intended or otherwise, 'accidents' such as the Long Island nuclear incident, and the guiding values behind

[8] The DoE was instrumental in the establishment of a number of large agencies that are still powerful and influential in the science and technology policy landscape in the US: it developed commercial atomic energy and nuclear medicine (at this stage it was called the Atomic Energy Commission, or AEC, before it become DoE later), the Office of Scientific and Technical Information, a system of National Laboratories that grew out of WWII war-related research activities etc. Today DoE remains a very significant sponsor of basic scientific research and together with the NIH (National Institute of Health) mapped the human genome in the 1990s (Warnick 2001).

scientific and technological projects. The bombing of Hiroshima and the Manhattan Project were icons of past science projects that demanded answers.

STS was partially an Establishment response to these concerns, both from the Government's and the universities' perspective. STS is often recounted as having an anti-technology if not anti-establishment tone at the beginning as reflected in its literature (Cutcliffe 1990: 362). Other scholars investigating the history of STS squarely see it as a development aiming to subsume or even appropriate anti-establishment voices. This, however, was not necessarily an always conscious subterfuge. If anything, it was a gradual development with a highly rational and pragmatic outlook. It is a highly debated point within the STS community whether this 'appropriation' has pre-empted or swallowed up more radical intentions in the community or has given them an appropriately dignified place in the pantheon of the Academe from which more substantial political victories can be fought out, or at least those same radical voices can be clearly heard. It is a largely conceded historical point that anti-science ideas of activists from the freshly forming environmental and civil rights movements of those early days did inform the STS agenda fuelling it to take a stand against an overly science and technology-dominated society.

A similar story at Penn State University is recounted in a rather mild tone by Roy Rustum, the then STS director and later editor of the Bulletin of *Science, Technology and Society*:

> In 1968, when student activism at Penn State was at a peak, the same faculty entered into a series of dialogues with students about the character of society in the United States. Out of this came recognition of a large gap in the curriculum, and a need for courses on how science and technology -- the defining features of our culture -- have been, and are, related to all aspects of society. The first STS courses were offered in 1972 (Rustum 2000a).

1968, of course, was the year of student movements, which is why the faculty at Penn State was 'entering into a series of dialogues' with students. The concerns they were voicing were directly related to and shared by other social movements of the times. One very important aspect of these was a quasi anti-scientific stand vis-à-vis the Establishment. Their intellectual sources of anti-science and anti-technology sentiment were the dystopian theories of Lewis Mumford and Jacques Ellul. They both strongly shaped the ideas of the disenchanted students and soon their works started to prominently feature in early STS curricula. It would be foolish to assume a causal relationship here, early STS courses did not take direct 'orders' from the students' movement, but those same influences were definitely reverberating within the early circles of STS scholars and their disenchanted students.

Other influences, however, are much less anti-establishment: C.P. Snow's 1959 Rede lecture (and subsequent lectures at several universities) is considered to be a conceptual milestone on the basis of its formative concept of the 'two cultures' of science and humanities (Leslie 1999: 273), a division STS meant to bridge with its interdisciplinarity. Snow warned about the growing gap between the sciences and the humanities, their 'mutual incomprehension' and the importance of remedying

that chasm through education. He wasn't alone in his concern for future generations of engineers and physicists whose predecessors have worked as scientists behind the scenes of the second World War, including the Manhattan Project. A decade earlier the United States' Committee on General Education has already established a plan to 'humanize' tertiary science education by injecting perspectives on the social dimensions of science into their curricula (Leslie 1999: 273-5). Several universities, including MIT, have started to employ social scientists and historians within their science and engineering departments and by the early 1960s antecedents of subsequent STS subjects have started out.

There were other influences too: populist science writers such as Alvin Toffler and Theodore Roszak were not unambiguously negative in their intent and impact either. Even though both of them helped to problematise the value-free image of science, at the same time they popularised scientific achievements and projected a bright and fascinating future delivered by luminous extensions of science and technology. A fear of future scientists practicing without ethical concerns and without the 'values of a good citizen' was somewhat paradoxically coupled with a deep fascination with the assumedly immense possibilities those same scientists may deliver in the not too distant future.

The initial push for STS bore the mark of all these conceptual precursors and therefore was bound to be a mix of criticism and awe, with a formidable tension between the two that is arguably still present today. STS was partially 'riding on the back' of the 'golden age of science' while also becoming its first institutionally established and credited critic. The very first STS-type subjects were taught to

engineering students as part of their ‘liberal training’. It was often viewed as a kind of general education that would equip future engineers and scientists with ethical thinking adding to their civically responsible professionalism (Leslie 1999). Subsequent STS courses were taught to a wider spectrum of students with the double aim of giving science literacy to humanities students and teaching a humanist perspective to science and engineering students; a composite of humanizing science and scientising the humanities. Appreciation and critique of science have both become formative perspectives for the very framework of early STS teaching.

Early STS courses at universities in the United States often changed faculty location and composition of academics from different disciplines. The history of such internal politics is well documented in Leslie (1999) and other articles of the Bulletin of Science, Technology & Society, a core STS journal today.

Because the STS approach was so engaged and so ‘close’ to science, often including scientists in the teaching, it was much harder to disregard or discredit their work as the babble of otherwise scientifically illiterate academics from the humanities. The actual STS programs were often conceived of by academics from different disciplines and were taught by a similarly diverse mix of scholars from physics, engineering, religious studies, sociology, history, etc. The dominant intention was to create interdisciplinary or multidisciplinary teaching units that would showcase different perspectives on science and technology. Scholars primarily trained and versed in STS were a later product of these new interdisciplinary departments. There were, and still are, considerable differences between STS departments, even within the United States, in disciplinary composition and exact aim of teaching. However,

the introductory description from the STS school of Penn State University is worth quoting here as a general example as theirs was one of the first academic units to be involved in STS teaching. It aptly summerises the position of most other STS schools.

> Science, Technology, and Society (STS) is an interdisciplinary approach which reflects the widespread realization that in order to meet the increasing demands of a technical society education must integrate across disciplines. Understanding the relationships among political systems, social traditions, and human values, and learning how those relationships are influenced by science and technology, is an essential part of contemporary education.
>
> **STS** provides a bridge between the sciences and the liberal arts.
> **STS** encourages communication between diverse disciplines, so students may better appreciate the many complex ways in which science, technology, and society interact.
> In an increasingly interconnected and technological world, it is essential we understand that decisions have consequences.
> **STS** critically examines issues such as genetic engineering, the environment, emergent diseases, computers and the Internet, applied ethics, nuclear waste, and international agriculture.
> **STS** provides students with the foundations for responsible citizenship, and the skills necessary to succeed in a highly competitive and constantly changing future workplace (STS at Penn State University 2000).

As an inter- and trans-disciplinary academic field STS could be characterized as an alloy of several approaches that were already present in early curricula. STS schools are still around despite the dissipation of some of the original financial and political support that was a definite aspect of its conception. The earliest American STS departments seem to flourish especially (MIT, Cornell, Ranssalaer, Penn State, Stanford, Virginia Tech) with many of them continuously pursuing projects that go beyond the university walls and most sustaining vigorous academic and extra-academic connections that demonstrate interest in social engagement on technoscientific issues.

Through the thirty plus year history of STS, both in the United States and in other countries, its resident scholars have effectively combined disciplines from science, social science and humanities by maintaining a balance between different approaches and theories. STS teaching has tended to reflect relevant empirical research from its constituent disciplinary areas as well as theoretical developments in its own more and more independent academic field of 'Science Studies'. Curricula often consisted of several strains, often along the lines of the constituent disciplines and the scientific/technological fields that provided the study material. In terms of theoretical leaning through the 1980s the teaching material of STS included Sociology of Scientific Knowledge (SSK will be discussed in Chapter 2) which was the most prominent theoretical development of those years. In the 1990s, Actor Network Theory (ANT, the subject of Chapter 3) has become an integral part of the theoretical teachings of many STS departments. In terms of actual areas of science to be explored STS had an especially sharp focus on the nuclear industry in the 1970s. That focus has later shifted to other controversies and most recently it often

centres around topical areas of study such as biotechnology and nanotechnology, coinciding with activist and general community concerns over these same areas.

## Two subcultures in STS united by sociological episteme

STS scholars have always been attuned to the teaching of scientific controversies, not only because they are such ideal sites where conceptual differences and actual power clashes are so highly demonstrable, but also because STS has always contained a strong social movement or activist element. It is somewhat ironic that STS was supposed to bridge the 'two cultures' of science and the humanities while also somehow reproducing a different kind of subcultural division in its midst: the activist and the 'academic'. Waks (1993) has analysed these two subcultures that according to him have until quite recently misunderstood or failed to engage with each other, the 'academic' side considering the activists to be naïve realists and 'epistemic naives', while they in turn regarding the 'academics' as publicly useless elitists of a kind who are unprepared to and uninterested in making a commitment beyond embracing a default relativism.

The two subcultures have always existed as STS itself has a dual conceptual and political origin: one aims to critique science and the other to understand it. One is directly employing a normative stance and strives towards meliorist goals, to achieve change in the community and the environment: to stop wood chipping,

impose moratoria on certain types of experiments, set up community-based fora as part of policy making etc. The other concentrates on strictly academic goals and sees the fulfilment of its mission in clarification, interpretation and understanding: to shed light on the privileged knowledge making and justification processes of science, to understand the effects of technology, to investigate economic, political and social mechanisms behind the functioning of scientific projects. Fuller (1996) has even called these sides the 'Low Church', the activist side that favours 'citizen science', and the 'High Church' which would correspond to the ivory tower 'academics' who foster a 'professional science' outlook. The separation of these two sides could never have been as sharp as the two subcultures argument favours, nevertheless they have been distinct enough developments within STS since its beginning. Some of the lingering oppositional sentiments could be traced to the relative isolation of scholars in the two subcultures, as activists are often found outside the university system in high school teaching, research and sites of activism.

However, even these two subcultures share a larger epistemological umbrella created by a common sociological framework. This uniting epistemological cover is their shared perspective of social constructivism, according to which science and technology are the result of social processes and are always deeply embedded in a wider social context. This is one of the major tenets of STS whose basic scholarly rationale rest on this constructivist premise: it is worthwhile to focus on the social context of science and technology only if this social context is an important, if not primary, determining force in how science and technology develop and change. This is exactly what the constructivist premise maintains and so both subcultures firmly maintain a broadly sociological outlook.

The two subcultures do use this sociological framework for different ends though. The ‘academics’ can be reassured in being able to amend or reconsider their previous knowledge concerning the contextually described nature of science and technology that can add to rational debate and perhaps inform wider societal choices by presenting rational and well-researched knowledge; although the focus remains on understanding and interpretation. The ‘activists’ on the other hand consider the determinant social factors to be sites of possible action that is orchestrated or incited to directly serve the actual interests of a wider community. Both share a generally critical stance towards the workings and functions of science and technology (Fuller 1997), but draw somewhat different conclusions based on a partially diverging interest base.

There is some debate about whether these differing viewpoints of the two subcultures within STS are incompatible or complementary and this remains an important disagreement for the academic/non-academic divide (Waks 1993). It is possible to find evidence of both continuous feuding and attempts at reconciliation, often within the same article (Fuller 2000a) signalling that such apparent contradictions are often regarded as internal fomentation or the signs of a vigorous but friendly quasi-pluralist intellectual climate. Yet, when smaller disagreements are settled it is quite obvious that all the above positions within STS share the same general social constructivist outlook that informed the early STS curricula. This outlook is fundamentally sociological and takes science and technology as human endeavours that can and should be studied within their societal context using sociological research tools and understanding. The High Church and Low Church

interpretation of the ultimate goals of STS research can diverge in that one sees its ultimate aim as critical and scholarly and the other as activist. Yet, their shared understanding of science and technology as fundamentally social phenomena unites them under a common epistemic umbrella.

## STS and HPS

This shared epistemic umbrella that unites STS approaches within a broadly sociological outlook also sets apart the whole of STS from the epistemic world of HPS that looks for logical rules within the epistemological framework of science, investigating constructs such as truth, validity, rationality and justification. Their different epistemological framework also goes with differing methodology: while HPS uses philosophical analysis and interpretation STS scholars reach for sociological tools of investigation. They share an elementary interest and general subject matter: studying science in order to explain better what it is, what it does and how it works. Yet they diverge on how scholarly knowledge of science is to be arrived at and the framework that informs their epistemological outlook. For HPS science is an essentially knowledge-based enterprise that aims to ascertain valid claims about the nature of natural reality, while for STS science is a largely socially constructed human endeavour that can only be understood and accounted for in its social context. The early development of HPS and STS reflect their differing outlook and show the scholarly and societal influences on their pathway of development.

However, it is after these early days that the pathways of HPS and STS become more intertwined as new theoretical developments appear on the Science Studies stage that muddy and question their separation by combining hitherto separate epistemological and methodological frameworks. Instead of understanding and respecting the separate descriptions of the value of science that HPS and STS offer these new theoretical developments attempt to assimilate one into the other. By doing this they end up distorting the contribution of both sides and lose sight of the dialogue between the two distinct views on science that HPS and STS represent. Chapters 2-5 will discuss three important developments in Science Studies that brought novel perspectives but also contributed to the above epistemological confusion: Sociology of Scientific Knowledge (SSK), Actor-Network Theory (ANT) and Thomas Kuhn's theory of scientific revolutions that heralded this epistemological confusion in Science Studies. As I will show in the next two chapters both SSK and ANT opened up radically new ways of looking at the tension between HPS and STS but unfortunately both decided to do away with the divide altogether and appropriate the vision of STS into the framework of HPS, suppressing the sociological side altogether. This resulted in the scholarly loss of the distinct visions of science offered by the two sides and with them their dialogue that could have continued to shed light on the limitations of each and how they can continue to complement each other for a full evaluation of the cultural values of science and technology.

Chapter 5 will show that the work of Thomas Kuhn too achieved new insights into the tasks and methods of Science Studies but again HPS is assumed to be the sole scholarly driving force that is used to appropriate and therefore distort the

sociological heritage of STS. This results in the same loss of the sociological vision of science that later SSK and ANT perpetuate. I will also discuss the so-called Science Wars that raged through Science Studies through the 1990s and sparked some of the most interesting scholarly debates of this combined interdisciplinary area. These debates pose some of the most interesting foundational questions for Science Studies that need to be critically explored and resolved if scholarship in this area is to successfully re-configure itself. One of the most important foundational tasks for Science Studies remains the nature of the HPS-STS division and how this productive tension can be used to bring them into a productive dialogue that acknowledges their common aims and epistemological differences.

# Chapter 2

# SSK - scientism as empirical relativism

The Sociology of Scientific Knowledge (SSK) is one of the two more prominent contemporary Science Studies theories that I will discuss. I have chosen SSK and Actor-Network Theory (ANT) as suitable examples because they have both come up with radically new interdisciplinary formations that have shaken up Science Studies and have reached to the foundational issue of the field: how to constructively re-negotiate the HPS-STS division and how to productively bring together their insights towards a future Science Studies. Both theories have been popular and ANT is approaching the kind of popularity that could cement it as the standard approach in Science Studies. SSK did very well in its own right.

SSK was a self-styled formation during the 1970s in Edinburgh University's Science Studies Unit with their original 'Strong Programme'[9] and for a while Science Studies scholars discussed it as having a real potential for becoming a favoured alternative to old-style positivism. SSK practitioners have proposed a radically new methodological and epistemological blend derived from both HPS and STS that has intellectually enlivened and enriched the field of Science Studies. Through the 1980s SSK practitioners have roused disciplinary debates and have questioned the HPS-STS connection and so Bloor's contention is true: that the 'terms of the debate' are rightly judged to have been altered by the combined efforts of SSK practitioners (Bloor 1991: x; Rouse 1992 etc.).

My aim in this chapter then is to provide an overview of the history of SSK, show and discuss the scholarly basis of the SSK movement, to uncover where its constituting elements have come from and to appraise SSK's contribution to the foundational issue of the HPS-STS divide: how to understand and negotiate the differing orientation and values of the philosophical and the sociological sides of Science Studies.

## Brief history and scholarly origins

Members of the SSK first identified themselves as such in the early 1970s when they started referring to themselves as the 'Edinburgh school'. This happened at the Science Studies Unit at the University of Edinburgh. It was around this time that the boundaries of SSK theory started to consolidate (Collins (ed) 1982: ix). The most famous of them all, David Bloor, arrived to the Science Studies Unit in 1967 (Bloor 1997: 373) while others have joined in the following years. Bloor arrived with a degree in experimental psychology and with a scientific outlook that he retained throughout. This, as I will discuss soon, he later incorporated into the initial formulation of the 'Strong Programme' of SSK.

SSK's original members have come from a wide variety of scholarly backgrounds contributing to its interesting and mixed epistemological and methodological tenets. Some have previously been working within the walls of departments such as history

[9] The 'Strong Programme' of SSK is most often linked to the name of David Bloor, however, it was partly the result of collaboration and was understood to function as a collective mantle.

(Henry James), medicine, mathematics and physics (Trevor Pinch). They have brought not only their areas of research interest but also their general scholarly outlook to be amalgamated into SSK. Beyond a varied natural science and HPS type background disciplines many members did also possess STS type degrees of sociology and philosophy or have been oscillating between official disciplinary locations before arriving to the openly interdisciplinary setting of the Science Studies Unit at Edinburgh. The effects of a diverse collective disciplinary history can be traced in the epistemological and methodological commitments inherent in the core tenets of SSK. These combine sociological, philosophical and scientistic elements and a healthy dose of historicism.

The original and most potent formulation of SSK was the 'Strong Programme' that spelt out SSK's basic tenets with an intellectual vehemence and formulaic determination not unlike a manifesto. The 'Strong Programme' was put forward in a decidedly programmatic and fervent fashion and its adherents clearly identified themselves with SSK and defended its original tenets, which I will outline in the next section.

The 'Strong Programme' was followed by an upsurge of studies attempting to apply the basic tenets in a variety of science and technology related areas. By the 1980s there had been sufficient internal and external criticism of SSK to bring about divisions among followers. However, the eventual scattering of foundational members was probably as much an effect of academic dilution and change of staff than the direct effect of the theory's dissipation at Edinburgh.

The Bath constructivist-relativist approach was an SSK spin-off that managed to temporarily stake out a territory and cherish the SSK flame in an openly relativist and strongly programmatic way. Other fragments of SSK were eventually driven through a 'reflexive turn' in which epistemological and methodological shifts signalled a more defensive and less self-assured position. The dissipation of SSK finally gave way to new foundational debates around Actor-Network Theory (or ANT) mostly on French soil, and various 'cultural turn' approaches that are often grouped as cultural studies of science. These include some feminist science studies, anthropological, historical and literary approaches, all that have fed into the Science Wars of the 1990s (more on this in Chapter 4).

Both ANT and cultural studies of science are now considered to be separate developments, but have undoubtedly come to being with the help of SSK. Both are sometimes considered to be partially harbouring answers to some of the perceived failings of SSK's philosophy and practice. On the other hand, SSK itself has diversified with original members and newer affiliates espousing differing shades of philosophical and political viewpoints and sometimes publicly pitting themselves against each other. It seems though that by the turn of the 21st century SSK has fought out most of its battles in Science Studies journals and the field has moved on to Actor-Network Theory and other popular current approaches. Yet SSK is still worth discussing here for at least two reasons. One is that SSK is now often considered to be a forbearer of ANT (Latour 1999a:281) and as such is a direct contributor to how Science Studies scholarship looks is today. Secondly, and most importantly for this chapter, SSK brings up the issue of how to think about and what to do about the double-sided nature of the field of Science Studies. The

philosophical HPS side and the sociological STS side possess different orientations and harbour different scholarly values, HPS captures the logical methods and epistemological significance of science while STS critically looks at the societal effects of science and technology, holding science accountable and evaluating the everyday effects for technology in order to aid the future planning. SSK fails to understand the cultural distinction between the two sides and is unable to recognise their limitations and complementary nature. Instead SSK attempts to subsume the sociological constructivist side under the scientistic philosophical one, colonising STS with the tools and framework of HPS. This move shows that SSK's originally bold creative vision is in fact flawed in its conception. Because SSK fails to recognise the foundational qualities of Science Studies inherent in the two sides it is unable to provide a workable theoretical solution for the field.

SSK's scholarly antecedents are quite varied. Bloor himself explicitly points to a number of influences: Mannheim, Merton, Kuhn and Wittgenstein were among the most prominent, but he also gestures to Durkheim and Weber demonstrating sociological influences. Bloor's publications and research, apart from core SSK interests and contributions to debates, have focussed on the Kuhn/Popper debate and Wittgenstein's philosophy. Bloor claims that SSK's basic tenets 'represent an amalgam of the more optimistic and scientistic strains to be found in Durkheim (1938), Mannheim (1936) and Znaniecki (1965)' (Bloor 1991: 7) and that '[t]he cause of the hesitation to bring science within the scope of a thorough-going sociological scrutiny [has been] lack of nerve and will' (ibid: 4). However, the problem with 'bringing' science directly into sociology is less about a 'lack of nerve and will' and more about the elementary differences between HPS and STS and

their differing vision of science. It is also about sociology having its own epistemological and methodological commitments and justification of these in relation to their differing subject matter. SSK ignores this elementary difference that exists between the two constitutive sides of Science Studies.

SSK is proclaimed to be the natural and radical successor to the 1930s German-dominated field of sociology of knowledge in that it uses a more evolved version of the original Mannheimian framework with the intention and subsequent achievement of 'pushing further and deeper' into its subject matter and thereby attaining a more thorough study of science. This proclaimed aim shows the elementary orientation of SSK towards the HPS-STS divide: taking some elements from both traditions but instead of establishing a bridging dialogue between them, collapsing the sociology of science into the philosophy of science. Instead of a radically new amalgam SSK ends up with a scientistic ideology that proclaims the values of the natural sciences to be superior to that of the social sciences. This produces a disorientation of the separate scholarly legacies rather than a bridging of the divide. What would be necessary instead are recognition of both the values and the scholarly limitation of each side, coupled with an understanding of their distinct contributions to the common task of understanding the cultural values of science and technology.

SSK's basic approach also received some of its impetus from the felt need to 'oppose the arguments of rationalist philosophers who wished to treat science as a unique form of human activity, one which required no empirical understanding other than that implied by describing it as rational' (Barnes et al (eds) 1996: xii). This

description would seem to capture the majority of empirical positivists and pre-SSK philosophers of science treating science as a box of conceptual entities to be elaborated purely by non-empirical, sociologically 'untainted' thought-investigations. Today the 'dragon of positivism' is thought to be dead, or at least thought to be safely out of self-respecting mainstream HPS and STS. But in the early 1970s social constructivism in the Anglo-Saxon Western world was still fighting that battle and SSK was one of its strongest pillars within Science Studies. In this sense then SSK was both bringing natural science to STS and sociology to the reigning empirical positivism of HPS. In other words SSK did start out with a mediating role of sorts even if it was unconscious and ultimately unproductive in bridging the sides; SSK managed to invigorate the attention of sociologists towards science and it held onto social constructivism in the face of traditional scientific realism. Thereby early SSK could be seen as a mediating theory between HPS and STS, but on closer observation SSK's real motives were not to bridge the divide but to present a theory with a radically new mix of constitutive elements. This it has managed, but in the process it has produced disorientation rather than a re-orientation of Science Studies.

This new kind of interdisciplinary cross-fertilisation between HPS and STS seems to offer the radical promise of bridging positivist philosophy of science and classical sociology of science, resulting in a potent new Science Studies movement. On the one hand traditional British philosophers of science are described as not having gone far enough in studying science as they kept treating it as a unique case that possessed a certain authority not to be challenged[10]. On the other hand, the same

[10] In agreement with positivist scientists on that point who also refused social constructivist attempts at explaining science based on 'external factors'.

philosophers are considered inadequate on grounds of using the 'wrong type' of understanding that lacked a crucial empirical component based on sociological research into everyday science. SSK was set up to correct these mistakes by closing the gap on science, methodologically, epistemologically and also in taking the most sociologically neglected branch of science, mathematics, under investigation, as the ultimate Wittgenstein-inspired explanandum. Such a move would be an elegant demonstration of how SSK was to connect the natural sciences to HPS and then on to STS.

In a way, SSK's programme represented a courageous 'third way' forward at the time. An approach going beyond positivist realist 'armchair' philosophizing that was perceived to be justifying and legitimizing science through the edification of its cognitive aspects. SSK's programme also wanted to go beyond the Mannheimian and Mertonian sociological alternatives of the past that were viewed as partially successful but not nearly radical enough. They were viewed as a good first step towards understanding the inner workings of science in that they articulated the social values embodied by the institution of science and working scientists, but remained conservative as they avoided a radical confrontation with the social constructedness of the very fabric of scientific knowledge. Therefore, SSK definitely attempted to negotiate the HPS-STS divide by trying to push both beyond logical positivism and older sociological alternatives to the study of science, and break through to a radically new approach that could study science from an amalgamated Science Studies perspective.

However, it's difficult to see the fulfilment of SSK's promise to break with old-style philosophy of science as SSK's scholarly orientation bears the powerful influence of British empirical positivism and the natural sciences[11]. Bloor reached back to the hard sciences for inspiration on how to deliver a strong methodology. He took the general orientation and some basic building blocks of scientific methodology and attempted to supplant them into an STS type study of science. However, he did this not in the way American empirical sociology has done so, that is by taking scientific methods and tools as they are and using them for the study of humans in societies producing large scale empirical data to be used in social policy and planning. Rather, Bloor brought in scientism via a general naturalistic stance and empirically conceived methods that stay at a more reduced (even reductionist) scale resulting in the study of localised details.

Apart from this scientism the unique SSK formula also contains two other elements that will be defined and discussed in the following section: social constructivism and a relativistic methodology. As will be seen, both aspects have often been regarded as incongruent with the above scientism and therefore the SSK 'formula' has been considered as being of curious composition rather than a surprisingly progressive and useful mix of theory. In fact, I will argue later in this chapter, that the resulting mix is a disappointingly unproductive one that, instead of engaging both the STS and the HPS tradition in a dialogue that recognises their differing strength and aspirations, ends up collapsing the sociological side into the scientistically tweaked philosophical one resulting only in a confusion of their relationship.

[11] Bloor's own heritage of experimental psychology may have pushed him towards a naïve scientism.

To shed some light on how this particular scholarly mix animates the inner workings of SSK as a theory a more detailed elaboration follows outlining SSK's aims, basic philosophical underpinnings, the Strong Programme's 'basic tenets' and how SSK theorists see their approach fitting into the Science Studies landscape.

## SSK's tenets and philosophical underpinnings: problems of hybridity

SSK started out at a time when there already existed both an opening for social constructivist approaches and a sizeable literature on scholarly possibilities within Science Studies generally. So to present something radically new SSK theorists had to reach for a new configuration of forces. The 'shell of objectivity' had been broken by earlier social constructivists, classical sociologists of science such as Merton and Mannheim, and the extreme relativism of Paul Feyerabend in HPS. SSK strongly built on social constructivism in that the aim was still to explain scientific phenomena on the basis of their socially determined nature. What is radically new is that SSK reaches for particularly challenging targets such as explaining mathematical knowledge sociologically in order to demonstrate its radical new agenda and it proposes to mix up two insofar rather separate logical traditions: empiricism and relativism.

So mathematical knowledge becomes the ultimate social constructivist challenge for Bloor and he sets out to negotiate this with a hitherto unseen combination of methodological and epistemological choices. Traditionally scientific knowledge has been the object of study for philosophy of science, not for the sociologically minded scholar, with the important exception of Mannheim whose study of scientific knowledge could be considered one of the progenitors of SSK. Beyond him, sociologists who studied scientific knowledge stayed with its organisational or distributional features, not its actual content. That task was supposed to belong to traditional analytic philosophy of science which was realist in conception but un-sociological it its methods of inquiry and style of analysis. Mannheim on the other hand was advancing a social constructivist agenda, with his own epistemological variation of 'relationalism' that was deliberately formed 'away' from scientific realism, if not in reaction to its foundationalist tenets. Bloor, linking himself to both of these earlier pathways, sets out to pursue a unique epistemological and methodological combination: a scientific realist world-view, a relativist epistemology, a social constructivist agenda and an empirical methodology. The primary goal was to fully account for the 'very essence' of science, the content of its knowledge-base, via social phenomena, using natural scientific methodological devices: empirical positivism turned back on science itself. This was not considered an attack on science, but a scientific way of studying science, using its own logic. SSK has set itself a rather interesting if difficult task: going further than any social constructivist theory in Science Studies has done and pursuing this new target with a new combination of methods.

Within SSK's main aim of investigating and explaining the very content and nature of scientific knowledge was the supposedly progressive impulse of growing beyond classical sociologists of science who 'voluntarily limit the scope of their own inquiry [and commit] a betrayal of their disciplinary standpoint' (Bloor 1991: 3) by focussing their efforts exclusively on matters of institutional framework (followers of Merton) and factors 'external' to science. SSK, unhesitatingly and with conviction, was to throw itself into the study of scientific knowledge, which was taken as consisting of those beliefs which scientists confidently and collectively endorse (ibid.: 5). This was to be carried out using the scientific tools of 'locating regularities and generating principles or processes which appear to be at work within the field of […] data' then 'to build theories to explain these regularities […], theories which explain the beliefs which are in fact found, regardless of how the investigator evaluates them' (ibid.). The aim, in short, was to arrive at causal explanations of scientific knowledge that are objective in that they are untainted by any effect originating in the investigator. And so the idea of empirical relativism was born.

## The hybrid agenda of SSK and its confusion over the HPS-STS divide

SSK's above discussed aims and scholarly origins set it on a hybrid path that encompasses both STS and HPS-type scholarship. First of all in this section I will focus on the philosophical positions SSK occupies and how it attempts to negotiate

the STS-HPS divide. This discussion will include SSK's particular mix of social constructivism, scientific realism and its position of scientism that connects the two and demonstrates where SSK goes wrong in its attempt, failing to acknowledge the differing legacies of STS and HPS and collapsing its sociological impulses into a scientistic outlook. Secondly, I will discuss SSK's 4 main tenets that also strongly align it with natural scientific thinking and further show a gap between SSK's social constructivist impulse and its scientism. The last of these 4 tenets warns of a possible pathway to the infinite regression of reflexivity which later becomes a very real pitfall for SSK theorists when some of its members go through a 'reflexive turn'.

Although towards the end of this section I will show just how close SSK is to scientific realism, its stated imperative of explaining the very content of science based on social effects is in fact very much an STS-type idea in that it reaches to the social context of science for explanations. The idea of negotiating a new pathway between these differing forces is commendable and could theoretically contribute to a renewed understanding of where the field of Science Studies as a whole is going. However, what SSK ends up doing instead is taking the traditionally philosophical investigation of accounting for the very content of mathematical knowledge which has been taken to be 'pure' and untinged by the 'context of science' and then taking a sociological approach in trying to explain that same mathematical knowledge in terms of its social context. The original sociological imperative and SSK's scientistic leaning do not end up neatly connected in the SSK framework, but rather the former is subsumed under the latter without a dialogue or an acknowledgement of what these differing traditions represent. SSK ignores the orientation of HPS, its

impulse to examine science in terms of its epistemological claims and to understand its value in terms of science's logic and justification. It also ignores the distinct contribution of STS that sees science as a socially constructed human endeavour that has to be studied within its social context.

SSK's unique yet arguably haphazard combination of scholarly forces does not result in a thoughtful dialogue between the sociological, the philosophical and the scientific ingredients as there is no recognition of their differing legacies and there is no conscious effort in carefully selecting and combining methodologies and scholarly frameworks. This is a real loss as Science Studies needs to establish a constructive dialogue between STS and HPS and needs to establish their values in relation to each other. Unfortunately SSK ends up subsuming its sociological inquiry under a scientistic empirical framework and its attempt to merge realism with relativism is not convincing. Instead of thoughtful negotiation and dialogue SSK only contributes to a confusion of the tasks and values of the original constitutive disciplines of Science Studies: freely mixing the evaluation of epistemological claims in mathematics with the more sociological task of societal critique and the evaluation of science as a cultural force in society.

SSK's social constructivism can be traced back to the finitism of its practitioners. Finitism proclaims that 'the meaning of any term or concept, be it scientific or otherwise, is a matter of contingent interpretation or situated judgment' (Miller 1997: 22). Such finitism is closely linked to the theory of underdetermination, also called the Duhem-Quine thesis, and is consequently allied with social constructivism. If the reality of science, its concepts, theories and decisions cannot

be theoretically deducted from all existing *a priori* information (whether such an exercise is actually feasible or not), or in other words these factors constitute a finite field of phenomena inadequate in fully accounting for outcomes (hence 'finitism') then the course of science is underdetermined by such factors. . If this is the case social constructivism needs to seek explanations within the actual current context of science or science itself, including its human agents who forge scientific knowledge. The underdetermination thesis turns into social constructivism when SSK pledges to use historical and sociological data to account for the very content of scientific knowledge.

However, there is a strong twist to SSK's social constructivism, one that plunges it right back into the territory of HPS proper and creates a collision where social constructivism ends up being the victim. SSK dictates that sociological explanation has to be generated in the idiom of science and has to be arrived at using natural scientific methods conceived in a natural scientific philosophical framework. In this sense SSK can be characterised as naturalistic, inasmuch as it advocates, endorses and practices an approach 'according to which methods of the social sciences should correspond closely to those of the natural sciences' (Audi (gen. ed) 1995: 615). This is supported by many SSK statements, such as: 'We see the sociology of scientific knowledge as part of the project of science itself, an attempt to understand science in the idiom of science. […] We ourselves honour science by imitation: in our study of science we try to emulate its own matter-of-fact, non-evaluative approach' (Barnes et al 1996: ix). Although the quote implies that SSK strives for being completely value free, in effect it chooses to assume some of the values of the natural sciences.

This stance goes to the heart of the philosophy of the social science ruffling foundational feathers as evident from vigorous philosophical debates that ensued from the writings of SSK theorists (most recent: Bloor 1999a, 1999b, Latour 1999a). These often address basic methodological and epistemological questions and could be considered a contemporary re-run of the original 'Methodenstreit'. These debates recapture some foundational issues in the philosophy of the social sciences: such as whether the social sciences are unique, what their organising principles and logic are, what values guide their scholarly orientation, where to draw their boundaries from the natural sciences, and how to negotiate the object-subject boundary between Society and Nature. Although Bloor keeps re-stating his social constructivist agenda[12] he keeps siding with science in negotiating problem orientation and methodology, and maintains that SSK remains a causal, naturalistic explanatory programme in the idiom of the natural sciences (Bloor 1999a: 92). When it comes to the actual negotiation of the STS-HPS divide SSK ends up subsuming sociological, STS-type scholarship under a philosophical, HPS-type one that looks to natural science for methods and epistemology.

So in the case of SSK a natural scientific philosophical framework is allied with a scientific realist outlook. They together subsume a relationally more relativistic social constructivism even though this is traditionally thought to be in contradiction with the above perspective. Again, social constructivism maintains that because the underdetermination thesis is valid science is well and truly a social enterprise with the usual appendages that can and should be studied sociologically. In this sense

[12] Also, importantly, Bloor maintains that the conceptual separation of natural and social actors is important (as is the one between Nature and Society), in stark opposition to Latour who actively wants to do away with such pesky acts of differentiation (Bloor 1999a: 95-96).

social constructivism is often thought of as being in partial or full contradiction with natural scientific realism and is often categorised as anti-realist (meaning anti-natural scientific realist) (Rouse 1996: 18). Natural scientific realism on the other hand, in its most robust form entails a subscription to the idea that phenomena can and should be explained in terms of scientific laws that make use of references to natural phenomena and arrive at an approximation of truth which is as objective a description of the universe as possible at the time. There is a diversity of positions within scientific realism, ranging from logical positivism, Popperian falsificationism, historical rationalism and so on, but they all converge on one basic perspective. According to this science is predominantly a scientific enterprise whose practices and content are based on scientific rules that in turn are used to interrogate reality in its own idiom in order to arrive at a scientific understanding of the world. SSK's views partially correspond to a sociological STS-type perspective inasmuch as science is looked upon as a social enterprise with norms and traditions that will be reflected in its content. In this regard SSK can be characterised as constructivist in its preliminary intentions and outlook. On the other hand, the explanations to be reached have to be fashioned in a scientific way. This shows that SSK's position is paradoxical and unworkable in that it tries to bring together the critical framework of social constructivism and the epistemological claims of scientific realism.

Bloor's manifesto prescribes four basic tenets for SSK type research:

These are **Causality**, **impartiality**, **symmetricality** and **reflexivity**. All four tenets of SSK are said to be derived from other scientific disciplines and are supposed to give a backbone to any SSK-inspired research programme. These 4 tenets together

only deepen SSK's inner contradiction and point to a definite oversight in its conception in relation to the HPS-STS divide.

The rule of **causality** means that SSK is to be 'concerned with the conditions which bring about belief or states of knowledge' (Bloor 1991: 7). This value choice is in full agreement with the natural sciences, however, both sides of the explanation can be social. It is acknowledged that social causes may not be the only plausible and useful ones, preparing to leave some conceptual space open for one possible way of achieving reconciliation between social constructivism and scientific realism.

**Impartiality** means that SSK is to study science while being 'impartial with respect to truth and falsity, rationality or irrationality, success or failure. Both sides of these dichotomies will require explanation' (ibid.). This tenet is meant to correspond to natural scientific objectivity and value-freedom. Depending on further specifications of how this is to be put into practice such impartiality may actually mean several things from neutrality to no bias, or even full scale relativism. SSK practitioners have taken it up in different ways making this tenet a rather ambiguous one despite its scientific flavour. This ambiguity has provided an opening for criticisms but also for misinterpretations as SSK theorists themselves see it. This situation is further compounded by the fact that SSK's epistemological and methodological tenets have been slightly shifting over the years effectively making them shifting targets for critics. Sympathetic observers may perceive this as dynamism, but critics have deemed the resulting scholarly constellation as contradiction, inconsistency or inaccuracy/vagueness. In any case, it is reasonably clear that impartiality was to give SSK both an objective stance and methodological neutrality.

The third tenet, **symmetricality**, directly flows from the second and dictates a symmetrical style of explanation given to both sides of SSK's subject material. Impartiality was going to give the same attention to both sides of a controversy or statement, now symmetricality grants them the same methodological treatment. **Reflexivity** is probably the odd one out of the four tenets. It means that the 'patterns of explanation would have to be applicable to sociology itself. Like the requirement of symmetry this is a response to the need to seek out general explanations. It is an obvious requirement of principle because otherwise 'sociology would be a standing refutation of its own theories' (ibid.). Conceptually reflexivity may appear as a humanistic ingredient that allows re-evaluation. If it is trapped in a formula with either very limited or limitless criteria for application, then the result will either be a token gesture or an endlessly regressing relativism. The latter is what SSK seems to have descended into in its later loosely allied manifestations such as Collins' EPOR or empirical programme of relativism and the Bath reflexivist strand of SSK. Both of these have taken the reflexivity tenet towards relativism and ended up fighting it out in journal debates that quickly lost the interest of Science Studies scholarship at large.

The 4 tenets present an unsettling hybridity resulting from the unlikely combination of social constructivism and scientific realism in which scientism is not so much a mediating device but one that ensures that an STS-style sociological perspective is completely sidelined by an HPS-style scientistic outlook. As there is little knowing engagement with the original strengths and function of these legacies or how their relationship could be negotiated for a future Science Studies SSK's hybridity ends up revealing very little about how the HPS-STS divide could be understood or how

their insights and strengths could be productively brought together within a shared framework. What is lost is an understanding of the value of science in the two distinct traditions: science as a human enterprise that operates with a valid epistemological framework and therefore continues to yield reliable rational knowledge, and the sociological understanding of science where it is seen as a societal subsystem with an instrumental technical outlook that has a significant effects on the lives of everyday people and whose societal effects need to be scrutinised.

On top of the above confusion there is another contradiction to add which becomes important during the Science Wars of the 1990s. Social constructivism and natural scientific realism become thought of as being on politically opposing sides in relation to the legitimation of science: the former as disruptive and challenging and the latter as supportive. Ironically SSK's hybrid framework was set up to be politically neutral in the sense of neither aiming to discredit nor attempting to prop up the authority of science. However, instead of neutrality or peace in Science Studies SSK has sparked confusion and misunderstanding. This is reflected in an ironic state of affairs where on the one hand SSK's scientism dominates its sociological impulse, while on the other SSK's relativist descendants end up being portrayed in the Science Wars as 'enemies of science'!

In the end it is a disappointment that SSK came to add to a disciplinary confusion in Science Studies rather than help resolve it, as SSK has shown early promise in creatively re-thinking foundational issues in the field through a radically new approach. Unfortunately for the field SSK failed to productively negotiate the HPS-

STS divide exactly because its scholars failed to perceive and acknowledge where the two constitutive sides have come from, what their separate functions and strength were and so they failed to conceptualise the task as one of understanding, negotiation and dialogue.

In Chapter 3 I'm turning to the other, even more famous and arguably successful, recent interdisciplinary theory that has offered a radical shake-up of the field and offered a new direction for the future of Science Studies: Actor-Network Theory.

# Chapter 3

# Latour and Actor-Network-Theory

Like SSK, Actor-Network Theory is part of the social constructivist turn in Science Studies. In fact, it's become one of the most recognisable and fashionable theories in the humanities and social sciences, especially among researchers who study science and technology. ANT too was conceived as a radical new theory in STS but unlike SSK it has a French scholarly background and is still an active research strain that is spreading from STS onto new areas of social science. Since the beginning of the writing of this thesis ANT has become very popular in Academia generally. On the surface SSK and ANT share features such as the use of relativism and symmetry and these features hide deeper similarities as I will show in this chapter: they both creatively mix HPS and STS-type aims and explanations and both possess the avant-garde aim to create a radically new direction for the field of Science Studies.

In this chapter I want to comprehend and explain the reasons why ANT, and its progenitor Bruno Latour, have become so influential in Science Studies. Even more importantly I want to look at whether the Latourean mix of scholarly elements that have been freely borrowed from HPS and STS manages to hold onto the shared ground between these two while also further developing their legacy of creating valid knowledge claims about science and technology. Firstly I will look at the beginnings of ANT within a famous early lab study by Bruno Latour and Steve Woolgar. The initial promise of their approach heralds their later success and shows the roots of the later ANT program. An interesting set of influences can be found

here from both STS and HPS albeit without much sense of why and how these were embraced. Then I work through the conceptual layers of the more mature ANT project, mostly through the scholarship of Latour but also using other theorists whose work has been accepted as affiliated with ANT at the time of their writing (Callon, John Law). I want to tease ANT apart and show how HPS and STS-type explanations are mixed together to form a new Science Studies framework that is both radical and ambitious in outlook and freely mixes philosophical and sociological approaches with little regard to their original aims and function. Because ANT ends up disregarding and outright rejecting the distinct goals and methodologies of both HPS and STS it is left with a confusion of objectives rather than a creative and radical amalgamation of the two constitutive sides of Science Studies.

As ANT's inner structure unfolds there are more and more manifestations of scholarly inadequacies and immanent contradictions. Some of these bear a close resemblance to basic problems that plague the relativist framework of many postmodern and post-structuralist theories generally such as performative contradictions, circularity and other logical inconsistencies. Other problems can be directly linked back to ANT's dismissal of the separate normativities at stake in HPS and STS, and its resulting mixing of the two that leads to a normative confusion. ANT refuses to appreciate the collective norms of scholarly clarity and openness that is common to both sides of Science Studies and instead ends up with a dogmatic rejection of both HPS and STS legacies.

I will show how this normative deficit and related dogmaticism prevent ANT from maintaining a meaningful conception of science in democracy and make it unable to engage with the real-life political reality of the very phenomena it studies. All of these shortcomings together make ANT a poor candidate for a masthead theory for Science Studies and indicates the need to turn the field towards a more critical direction that is both able to relate to the normative legacies of HPS and STS, and is able to make use of their shared commitment towards articulating, understanding and critically evaluating today's scientific enterprise.

## ANTecedents in a famous lab study: social constructivism, anthropological fieldwork and agnosticism

The 1970s saw the beginnings of a new approach within Science Studies: Bruno Latour and Steve Woolgar have embarked on their ethnographic study of laboratory life to discover how scientific facts are constructed in the day-to-day activity of a scientific site[13]. They wanted to go beyond the existing internal accounts of science given by scientists about their own work. As Latour recalls in an interview later: 'When we started writing twenty-five years ago there was a great need for descriptions of scientific activity since there was none independent of the scientists' own descriptions' (Crease et al 2003: 20). So these two researchers responded with their lab study to a felt need to produce a new account of science from outside of it,

an imperative shared with STS as a whole around the same time as discussed in Chapter 1.

This lab study, undertaken by these two scholars, one at the time calling himself an anthropologist and the other a philosopher, was first considered to be 'scholarly muckraking' from the natural scientific point of view as proudly judged by the authors themselves (Latour & Woolgar 1986: 21). However, it eventually proved to be a major milestone in Science Studies and led Latour to Actor-Network Theory that is now widely used in Sociology, Science Studies and Cultural Studies. ANT's eminence is demonstrated in a recent collection titled 'Actor-Network Theory and After' (Law and Hassard (ed) 1999) that calls ANT 'one of the most influential approaches to social theory to have emerged in recent years' (ibid.: blurb on back cover). ANT is undoubtedly an influential approach to social theory as it has lent itself to a variety of scholarly uses and has radically shifted the scholarly goalposts for a whole field of study.

The original research dilemmas were canvassed in the first edition of 'Laboratory Life - The Social Construction of Scientific Facts' (Latour & Woolgar 1979), the book that was born out of Woolgar and Latour's lab study. Many of the underlying ideas in this book were conceived in opposition to the then existing scholarly practice within both HPS and the very young STS. From the authors' point of view both of these fields looked at science as a monolithic historical undertaking to be approached with reverence. They thought that previous studies only explored science only at the macro level as a grand knowledge-making institution. In

[13] The lab was at the Salk Institute in California (Webster 1991: 23).

opposition to such traditional ways of considering science Woolgar and Latour directed their focus to study scientific facts, the building blocks of scientific knowledge as they are 'assembled' in a science lab. Their way of looking at science was very far from Merton's traditional sociology of knowledge framework, an approach that may have used such empirical material to search for the normative interests of scientists, or even more so would have left the everyday empirical details to scientists themselves. Latour and Woolgar explicitly wanted to define their study in opposition to existing macro-analyses, grand historical studies and what they labeled as 'the sociology of scientists' (with explicit reference to Merton). Their thinking was very much in line with the direction of postmodern theorists of the time in that they too explicitly wanted to find meaning in small-scale empirical details in ways that could not amount to an 'oppressive grand narrative'. Lab Life took as its primary focus the easily accessible everyday facts of scientific practice: the multitude of 'technical' details, exchanges and actions that constitute the everyday culture of a lab, small scale details that can be used to capture the mundane 'construction' of science or 'science-in-the-making' (Latour 1999b: 15).

In terms of an epistemological framework Woolgar and Latour were extending the basic social constructivist premise. Their lab study went on to break with previous positivist studies in HPS that largely considered 'social factors' as hindrance to scientific method rather than elementary parts of it (Latour & Woolgar 1986: 22). A social constructivist framework in Science Studies holds the assumption that the 'scientific realm' is at least partially socially constructed and therefore is not immune to sociological explanation. Science therefore is a fully legitimate analytic 'playground' for the investigation of social scientists (ibid: 23). This basic social

constructivist outlook lays down the validity for entering the lab with the intention of doing detailed 'internal' empirical fieldwork. Lab Life went against classical historical and social studies into the working of natural science in that it opted for anthropological and ethnomethodological methods which zoomed in on the most mundane and technical aspects of scientific work, on the minutiae of scientific activity. But the lineage from sociology of scientific knowledge was not entirely cut: the authors explain that their main concern is 'with the *social* construction of scientific knowledge in so far as this draws attention to the *process* by which scientists make sense of their observations' (ibid: 32; italics original).[14]

The result is an anthropology of everyday science filled with empirical details: the authors present their accumulated empirical material, show how they carried out their ethnographic investigations on scientists in the lab, including participant observation, and enlist their careful observations of the details of everyday scientific activity. Latour carried out some clerical work in the lab while also acting as an observer, thereby ensuring his presence while partly 'going native'. Woolgar and Latour wanted to find out how the messy details of scientific activity are transformed into a tidy, systematic organisation of knowledge. For this they looked at scientists as a special kind of tribe strongly defined by its practice of knowledge construction which is bound to scientific practices situated within a material milieu of related objects and spaces. Throughout their study the authors aimed to bracket the original familiarity with their object of study, they decided to disregard whatever lay ideas they possessed in relation to science and scientists. They also aimed to

[14] Interestingly the second edition (1986) omitted the word 'social' from its title, leaving 'construction' as a generic phrase. This foreshadows the approach of the mature ANT project to sociology as a modernist hallowed-out centre of the status quo to be side-stepped and discarded, and opens the door to a full-scale post-disciplinary, post-humanist post-structuralism.

deliberately ignore the exoticism of unknown technical details. For Woolgar and Latour a critical stance meant treating the activities of scientists as strange. They decided that all observed activities require a measured explanation no matter how much they have already been accounted for in another framework or how much such traditional explanations were accepted as valid or appropriate.

This 'critical' stance, they emphasize, is not intended as an attack on the natural sciences, more like a kind of 'agnosticism' (Latour & Woolgar 1986: 31). Similarly to SSK, science is only the target as an object of inquiry, not as a political one. In a consciously funny tone Latour remarked many years later expressing the same sentiment (with a definite non-anthropocentric touch that will become relevant later): 'That we are studying a subject matter does not mean that we are attacking it. Are biologists anti-life, astronomers anti-stars, immunologists anti-antibodies? (Latour 1999b: 2)' Similarly the irreverence of Lab Life towards science was not to be read as lack of respect, but as the sign of a measured study that aims to uncover the processes of construction in a neutral, value-free fashion. They consciously avoid the word 'objectivity, Woolgar and Latour want to call their stance critical and reflexive, sowing the seeds for heightened reflexivity in some later works. This detached agnostic stance is there to guarantee a non-partisan outcome in research and was supposed to serve as the safety pin against getting on the wrong side of science, whichever side that may be. To fully appreciate this aspect of their work, it helps to remember, that a strongly objectivist stance among natural scientists was (and still is) the norm, a stance that at the same time views any investigation by non-scientists into the deeper, more internal aspects of science, as deeply suspicious and

very possibly hostile (examples of this will be most visible in Chapter 4 on the 'Science Wars').

In this context Lab Life can be seen both as a bold and original initiative that extends the reach of social science research right into the heart of science and as an independent objective study that calmly contributes to existing anthropological and ethnographic knowledge without the slightest hint of provocation. This interesting 'double-take' will remain a seductive yet infuriating, a masterly but confusing quality in Latour's later work. Woolgar and Latour's stance itself betrays a double direction balancing pure agnosticism and the deliberate provocation of a controversy: they claim to operate with a neutral detached stance in relation to science on the one hand, and admit to their excitement over 'scholarly muck-racking' on the other (Latour & Woolgar 1986: 21). This racy double-take becomes an elementary part of Latour's approach and remains an important aspect of the more mature ANT framework where it functions as a clever scholarly ploy: claiming to have conquered a new piece of Science Studies territory via original thinking yet at the same time highlighting the HPS-STS divide and helping ignite scholarly conflict[15]. In effect Woolgar and Latour mimic the scholarly processes through which sociology and philosophy of science have been seeking to justify their knowledge claim, but only in order to turn around and mock these scholarly processes and the values underpinning them as mere cultural styles in an attempt to legitimate a new 'radical' scholarly framework that aims to legitimate its own dogmatism.

[15] Such a conflict will erupt later in the 1990s as the 'Science War' following the so-called 'Sokal affair', both of which will be discussed in the next chapter.

This particular stance of mixing authority-boosting neutrality in the shape of agnosticism with the advancement of a radical action-oriented framework of social research must have come across at the time as fresh and bold yet measured and scholarly. Interestingly, this same stance was also considered by the authors to be an eminently 'critical' approach on the basis of providing a new radical way of looking into the very heart of science as opposed to traditional ways of inquiry in the same area while maintaining seamless scholarly neutrality. This is highly reminiscent of SSK's neutrality through symmetry that was supposed to come about through the equal treatment of science versus other spheres of knowledge-making that are imbued with social interest. The radical edge of both SSK and ANT partly come from their radical push to social constructivism: going into the heart of scientific phenomena that had been considered to lie beyond the reach of social explanation and showing their mundane constructedness mostly in relational terms, symbolically and according to principles of semiotics.

But this 'critical' new constructivist approach is born out of a rejection of the shared scholarly values of STS and HPS and leaves little space for alternative interpretations of what a critical approach means in Science Studies. From this very first lab study ANT has effectively usurped the mantle of a critical avant-garde, one that overcomes the HPS-STS divide by doing away with their epistemology and scholarly values and altogether rejecting their scholarly legacy, making way for the self-contained post-structural world of ANT. Instead of a bridging impetus ANT ends up with an obliterating impulse that treats the HPS-STS divide as a simple conceptual binary that needs to be abolished. From their normative ashes a brave new a-modern relativist framework will be born.

Although in his later work Latour distinguishes his ideas from post-modern thought, as early as Lab Life post-modern features appear in his work. There are many early examples in Lab Life such as a penchant for stylised writing and a highly convoluted and idiosyncratic thinking style. Latour both breaks with the tradition of rational scholarly writing and the convention of logical elucidation of scholarly thoughts. Instead of conventionally accepted scholarly reasoning he heavily relies on metaphors, playful language and logical (or illogical) flourishes, a nebulous and a generally self-referential style that is arguably a unique hallmark of Latour's[16]. A closely related postmodern view maintains that supreme rationality and logic are not necessarily the arbiters of universal civilisational value (and as illustrious examples of Enlightenment values they may deserve special repudiation), in fact, the irrational or non-rational, the unruly and the unstructured, the personal, accidental, spontaneous, uncodified and the marginal are as likely to be the carriers of meaning and value as their opposites, if not more so. Consequently, writing that tends towards this particular value system is to be hailed as an achievement over the tyranny of the traditional, the rational and the staid. Latour's writing is often very intimate, unsystematic, searching for meaning in the unglorified and the non-rational, operates with a self-declared opaqueness and in this sense is very much postmodern, despite some of his later disclaimers[17].

[16] There is an infinite number of potential quotes that could demonstrate these qualities inherent in Latour's work. It is enough to consult any of his writings at a random location and read a page or two.

[17] Many examples of Latour's writing could be quoted here. One amusing one can be found in Latour 2005 pages 141-156. Here we find a dialogue between a professor and a student on ANT. The style is playful and intimate yet it is decidedly difficult to ascertain the actual meaning of the conversation, it actively celebrates the murkiness, the diffuse, uncertain, contradictory and simply difficult-to-comprehend character of ANT. At the end the student realizes that ANT is not useful at all. The

Latour's style of writing and thinking, and his postmodern values are relevant here because the former heavily betrays internal inconsistencies and contradictions and therefore are a valid target practice for immanent critique (albeit one operating with self-proclaimed levels of coherence and rationality), as will be shown shortly. The latter, Latour's postmodern values, is important inasmuch as it greatly helps placing his scholarly commitments and locating some of his otherwise undeclared values. Being 'critical', for instance, is simply a style of presentation or a rhetorical gesture, not an orientation or scholarly value. His 'critical' stance is as impoverished as his sense of 'the social', the most important epistemological coordinate of sociology, and hence STS, that he simply throws away. All of these qualities bring him in direct collision with modernity theory and Critical Theory.

In continuing my discussion on the scholarly origins of ANT, there are several other influences that can be observed in Lab Life. Contemporary literary studies, via semiotics, exerted a major influence on the research methods of Woolgar and Latour and, as will be seen later, Latour's more mature work will continue this influence. Semiotics of the 1960s and '70s has already established the idea that science is not unique in its textual characteristics and has no special legitimate basis for claiming some ultimate truth. In this tradition of thought science can be considered just another discourse to be deconstructed. There is no need to borrow legitimacy from traditional social science. There is something else that both Lab Life and ANT have inherited from semiotics apart from this justificatory framework behind taking Science Studies to the 'heart of science' without appeal to the ultimate authority of the natural sciences. Semiotic thinking, without doubt, is behind the use of the idea

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professor takes it as a compliment! The student wonders what s/he wasted the conversation on and the professor concurs that he wonders himself!

of the material milieu of science as 'text'. Woolgar & Latour freely employ textual analysis on the minutiae of everyday scientific reality and draw on these for their analysis. Later works of Latour will continue to use semiotic methods, deployed to analyze both material objects, narratives, ready given texts and collectives or hybrids formed by all of the above.

Latour's mixed scholarly heritage may partly account for being at two (or more) minds at any given scholarly moment, and also for a colourful mix of scholarly tools in his toolbox that he may use without being bound to any given disciplinary protocol. Amusingly, he himself can take delight in the resulting hybridity. His 'mix and match' approach certainly allows him to pick and choose between different interpretive strategies and thereby take refuge in potentially contradictory or incompatible arguments. At times he also confessed to being dissatisfied with the apparent scattered/mosaic quality of his work (and it is not clear whether this state of affairs is attributable to the way the world works or only to the way Latour operates and sees the world):

> But now I want to do other things and the scientific controversies that are pressing us from every corner require, I agree, other types of concepts and other focuses of interest. I can see why this is so completely chaotic for a professional philosopher because it is far from being tidy. Sometimes I am highly conceptual, then I do fieldwork, then it is a variety of infra-arguments to move from one field work to the next. If that can reassure you, I too find this a disgusting *bricolage*. But I don't know how to think otherwise (Crease et al 2003: 20).

This dissatisfaction (or pleasure in feigned dissatisfaction) nevertheless allows Latour both to a seeming transparency about his own constructedness, which can be taken as a fulfillment of his own call to reflexivity and to move on without hang-ups after acknowledging the messiness of his work. However, appropriating messiness as a primary value in scholarship that reflects the honesty of the scholar also raises the question of whether such a value is the monopoly of this particular scholar working in Science Studies or could it perhaps be transferred to the natural sciences as well, making scientists much more honest about their work? (Or would this move end up reducing natural sciences to ineffectual ANT scholars?) If this is the monopoly of ANT theorists, how can one account for such a disparity? These are questions that can be further explored in philosophy of the social sciences, however, even in themselves they show up some of the elementary problems produced by the open celebration of scholarly unreason.

Latour's self-proclaimed 'disgusting bricolage' could be explained by looking at his scholarly social context at the time. Around and after the publication of 'Lab Life' theoretical and research directions were multiplying within the scholarly current of social constructivism, usually fusing theoretical and conceptual entities with social constructivist tenets, and moving constructivism into fields or areas of interest where it had no history of application. Latour & Woolgar themselves were pulling social constructivism into a new research area and were also engaging in a fair bit of theoretical fusion. In other words in a time of scholarly turmoil, excitement and experimentation there may have been some bricolage and mess as well. However, making this a celebrated value rather than an unavoidable but undesirable

characteristic of scholarly bumbling about could reasonably question either the overall strategic motives or the clarity of overall perception of the observer.

While self-reflexivity on messiness is evident, there is much less display of self-reflexivity in relation to the scholarly origins of ANT. It is hard to decipher one dominant theoretical orientation in 'Lab Life'. The epistemological and political cards are not yet declared at this stage, their identity is still somewhat fuzzy and malleable, a situation highly conducive to conceptual experimentation. There are several theoretical directions the authors were attracted to as evidenced from the book itself: ethnomethodology and related symbolical interactionism, phenomenology (Garfinkel, Schutz, Goffman, Althusser), the works of Bachelard, Callon and Habermas (all get a furtive mention), even Marxism (reification). The influence of semiotics is quite pronounced in the way scientific facts and objects are read as cultural 'texts'/signs. Conceptual tools are drawn from an array of theorists from a variety of fields: 'construction' (Knorr-Cetina, 1981, in press at the time), 'agnostic' (Lyotard), 'materialisation/reification' (Sartre), 'credibility' (Bourdieu), 'circumstances' (Serres), 'noise' (Brillouin) (Latour & Woolgar 1979, 1986: 236-240). The circle of interest spreads from economics to linguistics via philosophy and anthropology, a rich set of disciplinary resources by any means.

On the one hand ANT shows a free opportunism and lack of consideration in what these different traditions represent, but this could be considered an innocent free-style approach. The bigger problem is that ANT attempts to disavow any normative tension between HPS and STS and this rests on its claim that there are no secure cultural norms that provide a common base for Science Studies. This is false

because HPS and STS do have a shared interest in studying science from a non-natural scientific point of view and both subscribe to scholarly norms inherited from the Enlightenment. This shared heritage turns out to be the common ground from which these two distinct accounts of the cultural value of science can strike up a dialogue in which each learns from the other the dangers of failing to check their own account of the value of science against the alternative description. By claiming that there are no secure common cultural norms for a common base and dialogue between HPS and STS Latour distances himself even further from the shared rational scholarly norms of Science Studies.

The most important of these scholarly norms would have to be scholarly openness and skepticism, responsibility and accountability of knowledge claims, all vital collective scholarly norms that underpin discourse in which those knowledge claims are judged on the basis of evidence and a reasoned argument. ANT considers these norms to be just trappings of a style of thinking that illegitimately claims to be 'normative'. ANT's stance is a complete turning away from the Science Studies heritage of rationality, from a reasoned and logical way of conducting research. It actively plays with and deconstructs the shared normative framework of Science Studies in order to make way for its own self-contained system which is far from lacking normativity itself! When the full ANT treatment of Science Studies is considered it becomes clear that ANT only manages to distance itself from the specific cultural forms of justification of these shared HPS-STS normativities and not from normativity itself. Therefore ANT's own normative stance that celebrates opaqueness, uncertainty and contradiction becomes dogmatic and cannot be justified in light of its scholarly influences and its critique of these. This dogmatism rejects

the shared scholarly project of justification in STS-HPS. It is this shared project and the above scholarly values that are lost with ANT's dogmatic stance.

Yet out of all the above scholarly influences the authors conjured up the so far described basic guiding elements of their lab study: social constructivism, anthropological fieldwork and agnosticism, adding up to an empirical study of science as culture, as tribe, as action. So far, these aspects of 'Laboratory Life' separately seem in line with the developments of 1970s Science Studies and what passed before for the study of science. After all social constructivism and anthropological lab studies were concurrently being carried out by Knorr-Cetina (1981), action-oriented research was advanced by several strains of sociological theory in other subject areas and objectivist accounts of science akin to an agnostic stance had been part of the self-made history of the natural sciences. Moreover, SSK has already made its claim to a scientistic outlook in studying science that the agnostic stance of Lab Life echoes in neutrality to subject matter. Reflexivity was emerging elsewhere too, both in philosophy and in the social sciences and the cultural turn was making headway in surrounding disciplines. However, all these aspects together present a stark new configuration, a new way of studying science from inside but with selective tools from across the social sciences.

The special ingredient that Latour and Woolgar found was therefore the idea of bringing these aspects together in one study. Their claim that they hit upon a radically new research concept could be tied to their recognition of the confluence of current trends and the bold realization of this in a new research context: that of the everyday actions and micro processes of a small-scale scientific research lab. After

this particular scholarly success Latour was not going to calmly sit on his laurels, he was to become the real creative progressive: he kept 'progressing' in his position, in his conceptual arsenal, study matter and interpretive practices and eventually extended his radical ideas well beyond that of Lab Life. By doing all this he will help to bring to life a post-humanist creature to be remembered: the fully matured Actor-Network Theory.

## Latourean mixes

The late 1980s and 1990s saw several new empirical and theoretical works by Latour that put forth the concepts, methods and framework of Actor-Network Theory[18]. In Pasteurization of France (1988) he presented a semiotic study of Pasteur and the microbes, recasting an old story in the history of science in a new ANT mould. Several other tomes combine theoretical Science Studies themes with Latour's own empirical research. These together present the mature ANT project: 'Science in Action' (1987) articulates his increasingly complex approach to the study of science, 'We Have Never Been Modern' (1993) presents Latour's grand metaphysical vision that expands on his philosophical scheme. Finally, 'Pandora's Hope – Essays on the Reality of Science Studies' (1999a) further extends Latour's approach, makes it intelligible in the context of Science Studies and its recent internal scholarly debates, including the 'Science War'. His even more recent 'Politics of nature: how to bring the sciences into democracy' (2004a) has expanded

[18] In a mock ANT fashion one could say the actors (subjects and objects) within his subject matter found Latour and translated their power through his writings.

from the standard ANT project and brought political ecology into the ANT domain as a logical extension of ANT's post-human framework. Perhaps this was also an answer to Latour's critics who questioned the ability of ANT to meaningfully connect to democracy. Instead of using any conventional ideas of what science, nature and democracy are or could become, here Latour canvasses an arguably over-ambitious vision of nature merging with humanity's future democratic framework, a supposedly logical theoretical extension of ANT's binary-breaking and 'symmetrising' meta-ontology. Finally in his most recent 'Reassembling the Social: An Introduction to Actor-Network-Theory' (2005) Latour returns to his previously deconstructed 'social'. Here he explains how social facts can only be accepted as such if they have been shown to be constructed according to ANT concepts such as 'assemblages' (Langlais 2006: 100). This rule would mean that all sociological knowledge has to be re-examined according to ANT principles in order for them to have any validity at all. Apart from being both a theoretical work and an 'ANT manual' this last work by Latour continues his work in deconstructing both philosophy and sociology of science in order to re-assemble them again according to the grand ANT formula that refuses to recognize and acknowledge the Science Studies heritage it is attempting to re-constitute.

These works together articulate the ANT agenda and position Latour's thoughts philosophically[19]. However, they don't form a neat and coherent project which is demonstrated by Latour's own ambivalence and inconsistency about his own work: in many of his writings he has disavowed the idea that he has ever compiled a coherent approach (which he both celebrates as a wonderful mess and laments that it

is of sub-standard quality) and in Latour (2005: 207) he expresses irritation at scholars who have been using the earlier 'Beta version' of ANT rather than its most recent 'Version 6.5' of 2006. Therefore Latour's own view of his work is that of a messy and incoherent oeuvre, a view that I will come to wholeheartedly agree with, despite decidedly rejecting his view that this messiness is any cause for post-modern/a-modern celebration. Alternatively this celebration of messiness can be viewed as nothing more than part of Latour's grand mocking strategy towards 'foundational' philosophy and sociology of science.

Because of Latour's deliberate messiness I decided against a strict chronological ordering of ideas as these would only reveal the non-linearity of the development of Latour's concepts through a thematic muddle, or become an unsettling 'settlement of circulating reference'. Although for Latour a muddle may be a celebrated value, for someone writing a PhD thesis it certainly cannot be. So instead, I will present the most robust and important aspects of ANT in subsections that move through methodological, conceptual, and epistemological issues, though as these are not delineated from each other in Latour's work, I will have to reveal a messy interconnectedness.

Firstly I will discuss how the basic ideas of actants and networks emerge in ANT, then look at ANT's post-structuralism and epistemology in light of its post-humanism and emerging idea of the non-modern. Then I'll attempt to thematise Latour's conceptual meta-scheme and relate it back to the HPS-STS divide. Here it will be revealed how Latour's scheme rejects the values of both sides as ANT is

[19] I refer to Latour's overall ideas here as his 'thoughts' rather than 'thought' because I do take seriously his insistence that his expressed ideas do not add up to a scary totalizing whole. Later in this

elevated into an overarching and superior ontological system. As Latour's scheme grows his critics note more and more internal problems with ANT: inconsistencies, incoherence and confusion, qualities his theory often celebrates in a deconstructionist fashion but qualities that clash with and undermine rigorous productive scholarship. Finally I will show how Latour's radical attempt to deconstruct the most basic concepts and interests of HPS and STS ends up distorting both and leaving ANT with a normative deficit that strips it of its ability to conceptualise science and show a way forward for Science Studies.

## Latourean mix No 1: actants, networks, post-structuralism, relativism, post-humanism

The concepts of actants and networks had to emerge at the same time as they are the two sides of the same post-structural coin. In The Pasteurization of France (1988) Latour takes the story of Pasteur, and shows that it is a hagiographic construction of events that glorifies one scientist and conceals the actions of multiple agents: the microbes, medicine, and hygienists. He follows a 'semiotic method', reviewing relevant scientific journals and bureaucratic documents of the time and tracing the actors and connections between them. Pasteurian science and its theory of germs at the time seem like just one factor among many in the control of disease. There are other relevant events, discourses and actors: the social movement of the hygienists seems a very important one at the time as their methods seem to be the only ones

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section arguments of Latour's critics to his incoherence will reinforce this distinction.

that may control disease, international exhibitions and conferences showcase hygienic lifestyles and provide fora for scientific discussion, and there are also other European physicians who become scientific dissenters and authorities, actors who come to reside over sanitation projects as part of a larger hygienic social policy.

Latour describes the contention, power struggles, and events that lead to Pasteur's 'medical coup d'état' (Latour 1988:29) and position his laboratory as the centre of events. He does this by reorganizing a conventional understanding of power, individualism and action. In his scheme the microbes themselves show up as agents as they 'intervene' with their 'aims' in situations frustrating human actors and changing outcomes. They become the enemy when feeding a child becomes poisoning, giving birth a death sentence, and the yeast in beer making simply refuse to 'behave'. Microbes are 'agents' 'in a semiotic sense' (ibid: 35), Latour says, they transform social relations, link people, disturb the hierarchy of interests. He tracks the microbial actors and the connection they make through what transpires from original texts, and literal descriptions of various actors.

There is a radical transformation of the original story as it is reconstructed in front of the readers' eyes (literally re-constructed as Latour re-traces the original construction of 'events' and 'facts'), from a straightforward story of the 'hero' scientist who single-handedly triumphs over the biggest social problem of his time to a story of multiple actors, some human, some not, who are linked through a network of connections through which they exert influence over each other. Pasteur's triumph now resides in his ability to transform complex connections between actors in the outside world through scientific activities inside the lab.

Numerous actors emerge here from outside his lab whose actions get ‘translated’ (appropriate and co-opted) by his scientific work: microbes, farmers, farm animals, vets, and landlords, physical objects in the pathway of ‘contagion’, infected people, and bureaucrats. ‘Through the leverage point of the lab, which is a moment in a dynamic process, the farm system has been displaced’ (Latour 1999c: 265).

Pasteur dissolves the inside/outside distinction and transforms the network of connections between actors around him: vaccines are produced, animal and human lives are saved, agriculture is transformed in its efficiency and in its relation to science, and anthrax is eradicated from its domesticated hosts. He ‘translates’ back and forth between the outside world and his lab the microbiological processes central to contagion, thereby connecting the micro and macro worlds. In that process he has to make sure that processes inside the lab represent processes outside and vice versa, except for scale and controllability, which are the procedural qualities he can manipulate freely inside his lab. These allow him to magnify, select, breed and observe microbes then to experiment on them with the freedom to make repeated mistakes without consequences, before re-introducing now specifically altered microbial processes through vaccination to the farm. This move transforms the ‘outside’ situation so that it fits laboratory prescriptions and ‘translates’ back Pasteur’s control over microbes to the larger scale (Latour 1999c: 270-2). According to Latour, this ‘negotiation on the equivalence of nonequivalent situations is always what characterizes the spread of science’ (ibid: 266). In effect microbiology also ‘displaces’ the microbes, its spread is in direct connection with its ability to halt the spread of the microbes and exert influence over a network of actors.

Through this detailed empirical study of Pasteur and the microbes Latour has established networks and actors as intertwined conceptual entities at the heart of his framework. He also re-confirmed aspects of ANT already present in Lab Life: the emphasis on action and mundane scientific practices inside the lab, the breaking with traditional sociological concepts in analysing science, especially structuralist thinking, and the continued use of semiotic methods in tracing the construction of facts, processes and actors.

There are also important new themes built around actors and networks: Latour comes to redefine politics, extends post-structuralism to 'transcend' micro/macro levels and continues to smash dichotomies in social theory, including the human/non-human distinction. Social constructivism is also redefined, the 'social' is not only dropped from social constructivism but becomes a target of derision and Sociology the hollow centre around which Latour aims to re-create his theory.

These new themes continue developing in a wave of works on Science Studies and ANT theory. If anything, there is an escalation of theoretical development in these. A self-consciously defined 'radicalism' appears in 'Science in Action' that later remains a credo of Latour's. In 'We Have Never Been Modern' Latour presents the grandest of conceptions to re-constitute social theory as a whole with ANT instituted as the radical new project to replace all previous ones. Latour attempts to debunk the Enlightenment ambitions of rationality and a reasoned coherent argument that underscore both HPS and STS, while he elevates to a higher position the postmodern disbelief in their aspirations to articulate the 'truth' of science. His relativism, post-structuralism and postmodernism (post-postmodernism, aka nonmodernism) are

pushed to new heights where they can replace the 'outmoded' frameworks of thinking in both HPS and STS. He even attempts to usurp surrounding interdisciplinary areas such as political ecology in his most recent 'Politics of Nature' (2004a).

Latour's radical displacement strategy towards the combined framework of HPS and STS prompted me to adopt two pathways of analysis in the remainder of this chapter. Firstly I want to show why ANT's is not a productive response to the question of how to negotiate the HPS-STS divide, and secondly to show where I need to turn my attention next in order to find a satisfactory way of negotiating that divide. This latter move will continue in later chapters where I will re-articulate the shared values and commitments of HPS and STS that ANT has rejected, especially their rational values, and will embark on the discussion on how to productively bring into dialogue the epistemological differences of HPS and STS. This last move has to be done in a way that serves to retain their distinct cultural values and at the same time opens each to a needed negotiation with alternative descriptions of the value of science.

## Latourean mix No 2: Post-structuralism, symmetries, radical realism, non-modernity

In 'Science in Action' (1987) Latour again presents empirical details from enthnographic data gathered about 'machines and facts' and the attached humans. These are scattered in time and space between microbiology and computer science

labs. Latour wants to open up wide the black box of 'ready made science' that popular and standard conceptions employ and consciously reveal what's inside: science in the making, science in the process of active construction (Latour 1987: 15). This is why he starts out with a set of messy interactions between actors inside labs, a 'disorderly mixture revealed by science in action' (ibid: 15) and then tracks the way scientific facts are constructed out of this mess. At the same time Latour sees too much order in the disciplinary matrix of STS. He sees too many factions that do not talk across to each other allowing the study of science to fragment. Latour sees a beautiful opportunity for observing symmetry here: between the sides of the studied objects and the studying scholars. He cleverly 'post-structuralizes' both: the object descriptively and the subject prescriptively. On the side of the objects: he opens the 'black box' of everyday science and uncovers an unstructured mess that is science in the making. With this move the object of STS is empirically shown to be a blob of stuff which is now ripe for reconstruction with new concepts and ideas. On the side of the subject: he wants to prescriptively 'post-structuralize' the disciplines that loosely comprise STS, from economy to literary studies. They seem too specialised and specific for Latour as they are, with little unity in either their problem definition or their methods. To overhaul the disciplinary system of STS, Latour proposes a set of rules of method and principles (ibid: 258-9) that could, if adopted, propel STS beyond specialisations and towards a network of researchers studying a common set of objects. This move allows Latour to seize the moment and propose new methods and principles that could be adopted across the board. By 'post-structuralising' symmetrically, both on the side of the object of STS and on the side of the subjects who carry out STS work, Latour effectively prepares

the rhetorical ground for a fully fledged version of ANT that is ready to take over the field of Science Studies.

His 'Rules of Method' and the related set of 'Principles' (Latour 1987: 258-9) reveal the deepening and further elaboration of existing themes, not dissimilar to the SSK tenets described in Chapter 2:

Rule 1 states that science is to be studied 'in action', either before its contents become black boxed, or through controversies that re-open its construction. This rule is a further qualification of constructivism. It demonstrates the radical nature of ANT's interpretation of constructivism in that it goes deep inside the black box where no-one else goes with such conviction. It also points out special instances when empirical ANT work can be carried out: internal scientific or technical controversies. These seem to resemble Kuhn's 'revolutionary' phases of science when paradigms are openly debated and otherwise closed off ideas are engaged with vehemence[20].

Rule 2 states that the subjectivity or objectivity of claims and the success of mechanisms has to be judged not on the basis of their intrinsic qualities but in the 'transformations they undergo *later* in the hands of others'. This rule highlights ANT's focus on action between agents, confirms that previously established values of prior connections are discounted (blank slate) and that construction is ongoing and potentially never closed.

[20] Kuhn's basic model of scientific paradigms will be discussed in Chapter 5.

Rules 3 and 4 declare that the settlement of controversies are the cause, not the consequence, of Nature and Society's stability and that efforts to enroll human and non-human resources should be considered symmetrically. Nature and Society are therefore co-constructed through 'science in action', neither are to be used to explain science. It is rather the everyday actions and interactions of actors, human and non-human, that are shown to construct both Nature and Society. Symmetry is maintained between Nature and Society, and humans and non-humans. SSK's symmetry principle is further radicalized both methodologically and ontologically. Construction has moved beyond the social, a new ontology is revealed, rooted in the everyday actions of post-structurally networked post-human actors.

Rule 5 further strengthens the researcher's agnosticism (and asks researchers to disregard their prior conceptions about what science and technology are) and prescribes that whenever an inside/outside distinction crops up, it has to be overcome by establishing symmetry in focus and in assigning actors on each side.

Rules 6 states that: 'Confronted with the accusation of irrationality, we look neither at what rule of logic has been broken, nor at what structure of society could explain the distortion, but to the angle and direction of the observer's displacement, and to the length of the network thus being built' (Latour 1987: 259). While this sounds more cryptic than the other rules, it seems to want to immunise researchers to interference and critical engagement with researchers who question ANT methods and encourage them to understand the situation through ANT concepts and rules. This rule seems to be about analytic distance as dogmatic tool.

Rule 7 prioritises factors to be considered in explanation: first come the role of inscriptions in networks, and only later, when explanations are still incomplete, cognitive factors. This seems to strengthen the semiotic nature of these rules and the consideration of networks and actions over humans and discourage humanistic approaches that weaken the prescribed ontology.

One of the most important conceptual themes that traverse all these rules and the mature ANT program is the idea that the world is a much more interconnected place than it is usually assumed, that it is an immense network of things that traverses structuralist understanding of systems. Such an understanding applies for both science and technology which are part of an interconnected world, and the study of science and technology that now has to operate beyond 'limited' conceptions of reality. Latour envisions smashing all binary oppositions that he sees cropping up everywhere in people's conceptions: between Nature and Society, between content and context (Latour 1987: 4), micro and macro, sciences and humanities, human and non-human. In Pandora's Hope he declares: 'For science studies there is no sense in talking independently of epistemology, ontology, psychology, and politics – not to mention theology. In short: "out there", "nature"; "in there", the mind; "down there", the social; "up there", God. We do not claim that these spheres are cut off from one another, but rather that they all pertain to the same settlement, a settlement that can be replaced by several alternative ones (Latour 1999b:14)'. In effect Latour proclaims all pre-ANT (especially structuralist) ways of conceptualizing the world to be false and wants to reveal true knowledge instead that shows the world as interconnected and sees binary thinking as a distortion.

Bringing together humans and non-humans as interconnected actants[21] inside networks also implies, at least to Latour, that all separations are dissolved: between humanities and sciences, large disciplinary sides that take human and nonhumans as their subject matter. For Latour this 'purification', the act of artificially separating out humans and non-humans, is a 'monstrous form of inhumanity' (Latour 1999b: 15). When separating out non-humans, science grants the outside world an 'a-historical, isolated, inhuman, cold and objective existence' and constructs an objective realm that can be used as an absolute transcendent force for the domination of people (ibid: 15). Sciences can only be accurate 'when they have been purged of any contamination by subjectivity, politics, or passion (ibid: 18)'. When separating out humans, the humanities (and assumedly social sciences) want to protect humanity, subjectivity and morality from contact with science, technology and objectivity. Humanities have 'purified' an independent looking social world that can be seen either as the inhuman force that 'breaks the back of objective reality' or a threatening mob, a "human debris" that justifies 'the search for a force strong enough to reverse the power of "ten thousand fools"'. For Latour there is no need to squash one form of inhumanity with another (ibid: 15). There is a peaceful interconnectivity: the world of science is thoroughly social and the world of humans is populated with objects capable of action; there is no need for Science Wars that ruthlessly debate epistemologies between worlds that belong together. It is the task of Science Studies to reveal the conjoined collectivity in its post-humanist and post-structuralist form. This would wash away the 'three poles' that are reality, mind and people and present them as an interconnected collective, a universe that is an

[21] 'Actants' as concepts are introduced in Science in Action (Lenoir 1999: 293).

'ordered whole' instead of a disorderly mess (Latour citing Socrates in Latour 1999b: 16).

Latour's language is evocative and his ideas may sound radical and fresh, but in effect they hark back to classic criticisms of the project of Enlightenment which see it as a totalizing discourse to be taken apart. Yet there are a number of problems with his above contentions. How could science be purged of 'human contamination' when science is a thoroughly human enterprise whose social constructedness is the task of Science Studies to investigate? The assumption that Science Studies has not been able to see the interconnectedness of actors and objects, and that the basic conceptual signposts of studying science are mere poles to be washed away are gross distortions of the project of both HPS and STS. The Science Wars broke out for a number of reasons not least because epistemological debates have brought up the important question of how to understand the HPS-STS divide and how to carry on with research in a field that possesses both shared commitments and epistemological differences, not because its scholarly values ceased to be of value or were incapable of constructively renewing themselves through rational debate.

For Latour the superconnectivity of the world is not a form of super-relativism, but rather what he calls a radical realism, which goes back to a time before realism could have 'purified' the world into discrete categories and connectivity was broken. Radical realism also avoids the postmodern pitfall: deploying even more relativism to overcome realism resulting in further separation of categories severing even more connections. This radical realism is in close association with another of Latour's grand concepts: non-modernity. Modernity is the equivalent of realism in the above

logical relationship, and 'post-modernity' can be substituted for 'relativism' and 'non-modernity' for 'radical realism'. Modernist categories need to be not so much disassembled or made to disintegrate as post-modernist deconstruction may have done but rather dissolved and undone so that new ways of analysing the world can be introduced. All post-modernists did was further fragment ideas and categories, instead, radical realism wants to bring them all back together, before modernism could have falsely separated them out. With a bit of systematic re-arrangement of Latour's ideas one can situate his scheme in the following table:

| scholarship | natural sciences | classical social theory | relativist Science Studies | Actor-Network Theory |
|---|---|---|---|---|
| Condition (*settlement) | modernity | modernity | post-modernity | non-modernity |
| orientation of research practice | classical scientific method | constructivism | deconstructivism | re-constructed constructivism |
| epistemology | realism | social realism | relativism | radical realism |

Table 1: Latour's conceptual scheme that separates ANT out from other approaches[22]

Radical realism is supposed to put an end to having to choose between realism, constructivism and deconstructivism by providing another option (in the marketplace of ideas, if nothing else). According to Latour post-modernists maintain

[22] This table itself probably betrays analytic precision, sense of order and clarity (re-creation of trinaries instead of binaries?) and modernist thinking to any post-structuralist or ANT thinker (if it was not clear, these are all negative attributes in an ANT frame of reference!). It also betrays a lack of complicity in wanting to play multi-textual language games in that it refuses to accept the games' rules as the exclusive legitimate starting points for engagement. And thirdly, in a minimalist scenario it at least demonstrates a clear preference for scholarly values of coherence instead of language games.

that constructed reality may be just a series of stories or illusions, so make-believe and reality are the same thing. Realists, on the other hand, conceive of a reality independent in its existence either from human understanding and is waiting to be discovered by objective methods (natural scientific realism), or from nature-centered understanding and is waiting to be explained with reference to society (social realism). But they conceive of a human-independent reality and society as separate categories and in that misguided approach they deceive themselves, as all they have discovered is a useless binary opposition. For Latour "construction" and "autonomous reality" are synonyms (Latour 1999b: 275) as construction itself makes things real and autonomous. Here we have a new ANT concept: the factish, a new hybrid built on the ruins of another shattered binary between the real and the constructed, facts and norms. Factishes are types of action 'that do not fall into a comminatory choice between fact and belief' (ibid: 306), the binary opposition between facts and norms is eliminated and thereby a new hybrid intermediary is born that contains both.

Actors and networks themselves are hybrids like factishes are and this quality makes them conceptually very flexible. Actors are hybrids that transcend the binary of human and non-human, sometimes an actor can be both at the same time, a semiotic hybrid (even more inclusive than Donna Haraway's cyborg, and a conceptual relative), such as a man with a gun in his hand (Latour 1999b: 177-180). The notion of network is 'more supple than the notion of system, more historical than the notion of structure, more empirical than the notion of complexity, the idea of network is the Ariadne's thread of these interwoven stories' (Latour 1993: 3). As such, together with the similarly 'radicalised' concept of the actor, it is the perfect notion to be part

of a theory that claims to have shown a way beyond a variety of binaries: of structure and agency, simplicity and complexity, human and nonhuman, objective and subjective, facts and norms, macro and micro, modernity theory/post-modernism, realism/relativism. Quite a cascade of transcendence! The last one of these binaries, realism and relativism, proves to be a pivotal one for Latour to try to overcome and crown all the other binary smashing 'achievements'.

So the reason why Latour is unfazed by this proliferation of hybrid intermediaries and superconnectivity that engulfs a multitude of basic concepts of human thinking, is that he does not intend to leave his deconstructed landscape in a deconstructed messy way, this is simply an intermediary step in the construction of his own elaborate scheme containing his own justificatory scheme for 'true' ANT knowledge. His persistent binary smashing is part of this move to displace existing scholarly values, concepts and rational justification of knowledge production in the whole of Science Studies, to be replaced by ANT's own post-structural concepts (networks, actants), post-modern values (celebration of 'muddle' and messiness) and an avant-garde dogmatism that will take the place of rational thinking as the basis of the justification of Science Studies knowledge.

## Avant-garde discipline smashing, post-humanist politics

Perhaps the most pivotal task for Latour to demonstrate is that ANT is capable of transcending both realism and relativism. It is a rather ambitious task as it is proposing to dismantle the arguably most important philosophical coordinates of

Science Studies. It seems like a worthwhile gamble as Latour believes he has come up with something novel and 'radical' that could lead the way for the whole field, a Latourean turn perhaps. It is curious though that picking these values themselves is a rather modern act in itself, which goes against the very foundations of 'We have never been modern' (Latour 1993).

Latour aims to 'overcome' the realism/relativism divide or at least aims to appear to have done so in order to appeal to the whole of Science Studies. He does this not by creating a new epistemological system as this would prove to be just another grand narrative parading as the sole vehicle of truth, and this could be seen as an edifice not unlike what he himself judged HPS and STS to be. Latour needs a radical post-structuralising move that displaces the values of rationality and clearly delineated analysis of HPS and STS as nothing more than 'styles of thinking'. He needs a debunking strategy that shows how the search for true knowledge about science does not reside in either HPS or STS, but can be sought in a free mixing of styles of thinking that characterizes ANT. To this radical end Latour wants to transcend epistemology altogether and elevate discourse on reality to an ontological level that hovers above both the realist and the relativist position. Latour pairs this ontologising discourse with empirical case studies of scientific practice in order to give solid ground to a post-structuralised Science Studies. This meta-move could be achieved by providing a framework of study that combines elements from both sociology and philosophy of science (empirical study of scientific practice combined with meta level theorising) and an explosion of philosophical framework to appropriate and surpass previous frameworks offered by these two constitutive disciplines (ontology instead of epistemologies).

Latour's main tool, a 'new' ontology is based on the fusion of subject and object, Society and Nature, human and non-human. Again, this move demonstrates a post-structuralizing motif, now at the meta-conceptual level, where the structures to be overcome are traditional epistemological entities. Latour's problem with social constructivism is that it is based on the ontology of Society and locks out non-humans as sources of action, while his problem with realism is that it is based on the ontology of Nature and locks out the action of humans. He sees his task as folding the two sides of STS and HPS together into a 'common transcendence' from which 'both societies and natures originate' (Latour 1999d: 283). This is the non-Modern Constitution from which reality flows. This Latourean ontological fusion is supposed to re-define history: 'we do not have, on the one hand, a history of contingent human events and, on the other, a science of necessary laws, but a common history of societies and things' (ibid.: 284). This is at the heart of the new Latourean post-structuralist genealogy of things.

As for philosophy and sociology of science, HPS and STS, the implications of Latour's scheme is now obvious, at least on his own level of thought. He contends that HPS and STS have considered Society and Nature apart from each other (artificially 'purified' them out in an act that is symbolic of Modernity) and missed out on the realization that they have unconsciously reproduced the old Kantian framework that caused all agencies to be restricted to either one of the two 'purified' domains, causing both HPS and STS to 'lose part of the plot'. For Latour philosophy and sociology of science are naïvely short-sighted undertakings as they continue to miss the opposite part of the picture from the other. This is both a provocative contention that could stand for a 'language game' and a serious assertion that is

assumed to be paving the way for a radically different future for the field. Instead of seeing HPS and STS as mutually constitutive in their relationship towards the larger tasks of a composite Science Studies, Latour simply sees them as entities locked into a symmetrical binary system that is now ripe for deconstruction. There is a palpable sense of satisfaction on Latour's part as he relishes the task of smashing the HPS-STS divide and proclaiming ANT to be the triumphant theoretical achievement resulting from this act, a radical post-structural style of scholarship to be born out of the ashes of deconstructing the field as a whole[23].

Although both sociology and philosophy are singled out for special treatment, it is still sociology of science that Latour spends the most time demolishing. When discussing the sociology of science he again points out the 'trap we built for ourselves' in separating out macro and micro perspectives:

> It seems that either the social science is subtle enough to explain the content of science but the making of a global society is left in the dark, or that macro-sociology is back in but the details of science disappear from view. (Latour 1999d: 277).

Sociology as a modernist discipline has been at the forefront of committing the sin of this act of 'purifying' micro and macro levels of explanation. Sociology has also based itself on the 'purification' of Society, a 'reified' concept and 'the *a priori* of all social science', (Latour 1999d: 208) then deposited a 'sui generis social order' that, in stark opposition to what sociologists have been led to believe, cannot be

[23] Again, it is rather ironic that the very construction of ANT shows strong modernist characteristics in its choice of values.

explained without reference to non-humans[24]. According to Latour the emerging picture teaches sociology, and more directly sociology of science, a hard lesson about the usefulness of their framework:

> The exact sciences elude social analysis not because they are distant or separated from society, but because they revolutionize the very conception of society and of what it comprises. Pasteurism is an admirable example. The few sociological explanations are feeble compared with the strictly sociological master stroke of the Pasteurians and their hygienist allies, who simply redefined the social link by including the action of the microbes in it. We cannot reduce the action of the microbe to a sociological explanation, since the action of the microbe redefined not only society but also nature and the whole caboodle (Latour 1988: 38)'.

It was not just Pasteur who made his master stroke in history. The very revealer of his action, Latour himself has made his conceptual master stroke here. He contends that microparasites and macroparasites, bugs and humans, are locked into a network that has suddenly lost its anthropocentrism and revealed itself to be outside the reach of 'traditional' sociology. The parasites spread themselves, Pasteur and the hygienists spread their program and influence, and Latour starts becoming infectious as he now possesses the only solution to the conceptual impasse plaguing 'the whole caboodle'. Latour has learnt from Pasteur: the trick is to 'redefine' existing elements and appropriate the action of a hitherto successful agent. Redefinition is an elementary aspect of ANT, even the terminology is radically new, and as for

[24] On his way, in less than a paragraph, Latour 'shows' how Durkheim erroneously explained social order because he purportedly missed non-human factors (Latour 1999b: 209).

appropriating the terrain from the hitherto successful, Latour is ambitious: he is prepared to attempt to appropriate the whole of HPS and STS.

By the 1990s Latour has established the coordinates of ANT's scholarly vision and has established himself as a radical avant-garde figure in Science Studies, one who is able to lead the field out of its supposedly fragmented, languishing state. For him and for many others in the field ANT has become a forward-pointing vehicle that helps transcend the theories of the past. His style reflects his awareness of having become a celebrated figurehead in Science Studies as he uses an unqualified royal 'we' that he makes things clear to, whom he leads to better pastures (Latour 1999b: 193)[25].

The grandness of his vision is obvious from the all-encompassing diagrams and schemes that grow with every major publication, not to mention the exponential escalation of his levels of thought: towards the end of Pandora's Hope not even a transcendent ontology is enough, he now has to fold together ontology, epistemology, ethics, politics and theology into one super sized collective (Latour 1999b: 293). By the time of Pandora's Hope, he has got four layers of mediation, 11 levels of pragmatogony[26] which together are a proposed alternative to the modernist myth of progress, diagrams connecting time, space, things and people, and all kinds of examples from areas such as history of chemistry, Greek mythology and so on. At one point Latour himself finds his own scenario overblown: '[…] once we shifted our attention to practice all those classical topics became shaky as well. Hence the

[25] He also reveals his self-intended role when in his glossary (1999b: 303) under 'actor, actant' he casually equates Science Studies with ANT.
[26] Latour says in his glossary (1999b): pragmatogony is 'a neologism invented by Michel Serres on the same template as "cosmogony" to mean a mythical genealogy of objects" (Latour 1999b: 309)

bouts of megalomania that, from time to time, seem to agitate science studies – some of them probably emanating from my own word processor' (Latour 1999b: 294). If it is megalomania, it is a metaphysical one that is supposed to 'enroll' Science Studies scholars into ANT's world of networks. His self-parodying style only adds to the contention that in the supposed wake of a traditional 'partition' in Science Studies scholarship is now all about styles and genres of reasoning, that traditional rationality as an arbiter in justifications of knowledge claims is dead and accepting ANT's scheme and style of reasoning is nothing more than moving with the times. In effect the previously shared scholarly normativity of HPS and STS is supposed to give way to 'grandiosity' of style and popularity of argument whose primary custodian is ANT.

For Latour, all his investigation and thinking has finally come together. The main themes of ANT, post-structuralism, non-modernity, radical realism, smashing of binaries, radical interdisciplinary stance, new ontology, all cohere into something novel, 'cutting-edge' and satisfying:

> The modern Critique was a nice try but it makes less and less sense, and now that we have realized that neither Nature nor Society can be put at the two opposing poles, it is better to recognize that we have never been modern, that we have never ceased to do in practice what major schools of philosophy forbade us to do, that is to mix objects and subjects, grant intentionality to things, socialize matter, redefine humans (Latour 1999d: 287).

The last question that remains to be answered by Latour is this: after all his insights have been recognised and arguments accepted, what happens to politics? After all, humans and non-humans have become networked, any division between them has been erased, and no reference point has been left without some thorough re-definition. Where does this post-humanist non-modernity leave morality, politics, normativity and democracy?

One thing is sure: none of these can be left unchanged by the sweeping changes that reach every concept and construction that matters in Science Studies, including sociology of science. For a start, no ANT inspired politics can be based on humans alone, as non-humans are now part of a common collective. According to Latour, soon this common collective will look back onto our time and see the exclusion of non-humans from politics as 'extravagant' as we now see the historical exclusion of women and slaves from political participation (Latour 1999b: 297). Latour sees it as an imperative to advance to the level of cosmopolitics that includes everything: 'billions of animals, stars, prions, cows, robots, chips, and bytes' (ibid: 299). This is then ANT's envisioned political constituency: a huge post-human collective. However, there are questions to be answered about both the feasibility and the desirability of such a re-hauling of our political and social collective. For Latour though, this may be a redundant question since according to his vision we already inhabit the reality of such a collective, it's now just a matter of giving it political recognition. Yet this radical bolting forward does not establish a dialogue with the logic and values that underpin the current state of democracy and politics, in fact it outright rejects the normative basis of democratic discourse, the very value of rationality and logical argument that underpin scholarly knowledge claims to

validity. Both democracy and scholarship are underpinned by a commitment to rational justification of claims, the very framework Latour tries to sink. Without a democratic dialogue and rational framework for knowledge claims it is hard to imagine how Latour aims to establish scholarly conversation and exchange of ideas that underpin the collective mechanisms of the culture and practice of scholarship in both HPS and STS. And if ANT was to deliberately continue on with no meaningful dialogue with existing Science Studies then it can hardly be considered part of it or a logical re-ordering of the field in general. By refusing to play by the collective ground rules of the Science Studies community and refusing to recognize the normative basis of valid knowledge claims ANT opts out and pursues its own dogmatic theorizing.

Yet for Latour the scene of contention is larger again. He sees the progression of history in terms of switching from master to master[27]: shift from 'the God of Creation to Godless Nature, from there to *Homo faber*, then to structures that make us act, fields of discourse that make us speak, anonymous fields of force in which everything is dissolved – but we have not yet tried to *have no master at all*. (Latour 1999b: 298)' Perhaps the above stand for Church, Science, structuralism and post-modernity, a grand collection of entities destined for Latourean dissolution, yet this grand dissolution does not lead to a liberated Science Studies with no masters at all, but rather a re-hauled Science Studies stripped of its traditional rules and values of scholarship that have been replaced with the rule of ANT ideas.

[27] Latour partly echoes Nietzsche (very different prescriptive conclusion), and even more so Foucault.

Latour possesses some rather peculiar ideas on societal organization and freedom. He sees self-rule, in the form of democracy, as a species of subordination or an organizational form simply absent in his sweeping depiction of historical progression.

In his scheme even atheism and anarchy assume a human master, the same master he wants to free both humans and non-humans from. The final aim is to have no master at all. Once people have understood that categories cannot be imposed on matter, that no-one is in command in the realm of techniques, and nothing is a property of anything else, there may be a spontaneous dissolution of the current political system, or at least this seems to follow from Latour's flow of ideas. The conceptions of progress belonging to modernism (realism in Science Studies) and postmodernism (relativism) are now both swept away, yet there is 'no need to abandon the arrow of time' (Latour 1999b: 298-299), as in the wake of this flurry of deconstruction comes a Latourean future. He envisions nothing less than a radically new end to the end of history, world transformation that is an expression of a truer realization of what everything already is. His own description implicates Latour as a revolutionary and one with the privileged position to oversee this whole spectacle, perhaps even one who is in the position to make a grand declaration: that we have been saved and all is not lost, we can now be re-envisaged through the peculiar prism of ANT.

It is almost tempting to get lost in the grand Latourean tale, however, it is important to re-gain the larger perspective and see where his grandiose vision stands in relation to the rest of Science Studies. ANT's vision of Science Studies is not one of

peaceful, considered and convincingly justified theoretical re-arrangement, but aggressive deconstruction of existing thought that brings with it a loss of important analytic commitments that are necessary for any potential transformation of the field. Instead of the conventional ordering of philosophical and sociological ideas Latour offers up a grandiose and inconsistently articulated ontological scheme that does not establish a dialogue with the rest of Science Studies let alone offer up a compatible and reasoned perspective, but instead charges forward into its own radical, post-human imaginary meta-theory. By doing this Latour undermines the grounds upon which we might weigh up advantages and sweeps away our ability to make a reasoned choice.

ANT abandons the modern project of advancing scholarship through rationally justifiable knowledge claims but there is a very real cost to this move. If Science Studies were to go down the ANT route it would come to a framework of theorizing that lifts the discourse on science out of the arena of collective debate, and with it abandons the scholarly accountability that an open field of scholarly contention is able to demand. By going down this path ANT becomes a set of knowledge claims that is now impossible to open up to collective rational scrutiny as it has withdrawn itself from the democratic scholarly discourse of open debate and rational discussion. Science Studies cannot and must not give up on the project of opening up knowledge claims to publicly available rules of assessment as this inevitably leads to lifting knowledge claims, including that of ANT itself, outside the norms of rational discussion without which there is no democratic accountability for either science or Science Studies itself.

# Immanent problems & ANT's place in Science Studies

ANT's high revolutionary expectations are simply too much to live up to, and indeed, perhaps not surprisingly, ANT struggles to live up to them. For all the radical promises that ANT offered up there are corresponding disappointments and criticism. By the 1990s critics have started pointing out ANT's internal problems via immanent critique: its inconsistencies, circularity of argument, confusion of terminology and logic, and performative contradictions reminiscent of postmodern thought generally. These characteristics subvert the internal cohesion of ANT and undermine the very claims based on its validity.

Circularity in scholarly texts refers to a type of reasoning that returns to where it started, forming a circle of logical propositions that reveals no etymology outside the circle (Audi 1995: 124). Latour's texts display ontological/semiotic circularity, such as this one: Latour emphasises that the redefinition of politics occurs through everyday practice, but also that everyday practice is itself the place where the redefinition of politics occurs. Such circularity is the very stuff networks and actors are 'made of' and indeed their ontology is itself circular.

The problem with circular reasoning is that it revolves around circular meaning that allows no analytic entry point, therefore there is no grip for criticism. In effect its logic is unquestionable. As external propositions have no grip and questioning is pre-empted, productive dialogue becomes disabled and this reinforces separation between scholars who profess the theory (that uses circular arguments) and others who don't, making the acceptance of the theory's reasoning more a function of

belief than intellectual persuasion. Circularity also reduces the explanatory power of the argument reducing its general usefulness. Latour is right in that circularity sometimes characterizes modes of justification and the legitimation of normative claims, yet it is important to hold onto the project of reasoned debate in order to avoid keep falling into circular modes of reasoning.

But instead of trying to avoid circularity, Latour professes that it is a positive universal force for humanity to draw on and with this he betrays his previous contention of value-free scholarship. He envisions that in the future 'circulating reference' will be provided to 'every household, like gas, water, and electricity' (Latour 1999b: 297). This is another humorous language game that is the hallmark of Latour's, however, the flamboyant metaphor is underscored by a relativist claim that there is no consensual scholarly value to be upheld, that rational reasoning and logic are mere styles of thinking to be chosen and discarded freely, and that any HPS or STS scholarship that continues to operate with those values can be deemed irrelevant. In effect ANT is given free license to write its own rules of scholarly engagement based on its own values with no reference to anyone else's work. This is a style of scholarly conduct very much at odds with mutual considered engagement and rational debate, qualities that Science Studies cannot operate without in order to create collective meaning.

Another internal problem that plagues ANT is performative contradiction. This occurs when the meaning of a statement or pronouncement is in direct contradiction with the way it was said: eg. when solemnity is demanded from everyone as the only acceptable way of addressing others but the pronouncement is made in a manner that

itself mocks solemnity, bringing into doubt either the validity of the pronouncement or the seriousness of the person making the pronouncement, perhaps even both. All theories of constructivism proclaim some level of self-reflexivity[28] and ANT is no exception. Performative contradiction is a definite problem for these because it directly undermines claims to self-reflexivity therefore also evoking the charge of inconsistency. Performative contradictions bring into doubt either the validity or the seriousness of ANT as a theory.

Lack of clarity and high levels of inconsistency are trademark characteristics of the writings of Latour and generally of ANT. Latour attempts to rebut such criticism by arguing that confusion and incoherence are either positive qualities or matter-of-fact unavoidable aspects of doing theory. However, all these characteristics are generally regarded as negative traits of scholarship across all disciplines, if for no other reason then for the practical reasons of clear communication and unhindered exchange that underscore collective scholarship. Without the latter there would be no Science Studies or even socially recognizable intellectual entities and movements.

In relation to these scholarly qualities Latour certainly does not display performative contradiction: he writes with considerable lack of clarity and extols the virtues of murkiness; he writes inconsistently and praises inconsistency, he provides circular explanations and supports circular arguments as a way of revealing important aspects of phenomena. To answer accusations of confusion in his own work, he declares: 'I can see why this is so completely chaotic for a professional philosopher because it is far from being tidy. […] If that can reassure you, I too find this a

[28] This is the logical consequence of awareness of one's own constructedness.

disgusting *bricolage*. But I don't know how to think otherwise.' (Crease et al (eds) (2003): 20) This pronouncement is yet another instance of finding an escape route via language games. On the surface Latour admits to his fault and protests that there is realistically no way for him of doing scholarship any other way; while on the other hand he calls this mess a disgusting bricolage, in effect an attractive proposition and a quality to aspire for since it bestows validating qualities on the scholar in question. This pronouncement is also an 'educational' one as it demonstrates to fellow scholars how to communicate successfully in an ambiguous way using double meaning and playing with interpretations that silence detractors while also winking at fellow post/a-moderns.

Vagueness, contradiction, murkiness and intractable elusiveness seem to be characteristic of Latour's expression. He proclaims the view that such a state of affairs is the property of reality, therefore no better 'clarity' can be expected from someone talking about it. Lack of clarity is compounded by Latour's systematic failure to cite the origin of many of his ideas. His references are often oblique or non-existent for instance in his failure to properly cite the origin of his semiotics that seems to originate from the work of Greimas and Hjelmslev[29]. ANT's link to these thinkers is not tangential, but quite central and encompasses Latour's epistemological and methodological thinking (meaning formation by actants, ethnomethodological methods), terminology ('translation') and his ideas on ontology and actants. There is also a strong resemblance between Latour's diagrams and the semiotic tables in the work of Greimas. Hostaker (2005) ingenuously traces a further linguistic shift: Latour does not only take the linguistic model of Greimas

[29] Hostaker (2005) goes on to discuss this unacknowledged connection in great detail.

in its original terrain of language and representations but also extends it to the social and natural worlds, all becoming one 'immanent field held together by language' (ibid: 15). The text eats up the context[30] and so there is no independent reality left that sociology can study in order to comment on either actants or science[31]. This example shows how the warped ontology of ANT disables entry points into its epistemology and how Latour himself cultivates this same 'boundedness' and scholarly elusiveness in his own texts bringing into question the validity of his pronouncements and scholarly honesty.

All the above immanent problems are systematic through ANT texts and together help disable critique, dissolve explanation and make ANT a less than desirable way of doing Science Studies.

Although ANT is a passionately argued, sometimes creative, often amusing and frequently infuriating school of thought it also has to be recognized as an elaborate attempt to displace a large chunk of valuable scholarship in Science Studies. It has failed to engage with and actively tried to displace the framework of both HPS and STS. In the case of HPS, ANT erected an ontological superstructure on top of epistemology that supposedly evacuates the substance of philosophy, and it displaced the traditional HPS model for the justification of scientific knowledge claims with a diffuse post structural post-humanist network of action. In the case of STS, ANT attacked the very foundations of the discipline, including the existence of social facts and the existence of the category of 'the social' itself. In both cases ANT did more than simply displace the scholarly content of each Science Studies area,

[30] Latour himself expounds this clearly enough in 1987: 4.
[31] Incidentally this also clashes with Latour's claims to be a realist, which in turn clashes with other

ANT has also created a normative deficit by excising the most valuable scholarly values of the field: the scholarly rationality, rigour and logic that underpin the criteria for collective exchange and deliberation of ideas. Instead ANT followed the postmodernist path of celebrating the negative values of messiness and inconsistency in the concepts of bricolage and assemblages, and has mastered a strategically convenient hide-and-seek type language game that is successfully deployed to gain advantage in the most pressing and embarrassing moments within scholarly disputes.

ANT's post-structural move has done away with inconvenient boundaries and conceptual differentiations that are said to be falsely 'purifying' binaries. Latour has attempted to demolish the very divide between the traditionally 'internalist' philosophy of science (HPS) whose task was to analyse the logic and investigate the knowledge claims of science, and the more normatively charged 'externalist' sociology of science (STS) whose terrain was the social context and the social constructedness of science. Latour wanted to extinguish the very categories of 'Society' and 'Nature' that underpin the divide. By post-structurally then ontologically fleeing such a division Latour did not end up with an organically connected and radically liberated Science Studies but one that is unable to respond to the societal normativity and human interest that saturate science and technology in society. By shrugging off the important task of investigating and analyzing the underlying reasons for the field's 'double-sidedness' Latour has given up on understanding where HPS and STS have come from, what they stand for and why they work the way they do. In order to understand the HPS-STS relationship it is

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relativist ideas in his writings.

important to investigate both their divide based on their differing epistemologies and methodologies and their relationship based on their common task of accounting for and explaining science. The project of Science Studies cannot be done by throwing away important scholarly values, it has to be done with those values refined and sharpened. Any future reconstruction of the field of Science Studies has to operate with an understanding and acknowledgement of the scholarly legacies that it harbours. These legacies involve epistemologies, methodologies and useful scholarly values, they also involve a diversity of already existing critical approaches to the politics of science, responsibility and role of scholarship, and the relationship between science and democracy. Latour thought it important to smash up the 'totalizing discourses' of HPS and STS but by doing so ANT has given up on the collective intellectual project of producing scholarship that is collectively accountable, building knowledge that is responsible and to generally operate with openness and skepticism. The overall achievements of HPS and STS can definitely be debated and analysed, but throwing away the very project that gives us the normative tools to carry this out is intellectually dogmatic and a decidedly unproductive way forward for Science Studies. Instead, the field needs to hold onto these scholarly values of rationality, responsibility, accountability, openness and skepticism that underpin its scholarly processes and make it possible to keep debating what is of value and which theoretical pathways are worth pursuing in the future.

# Chapter 4

# Tensions and dilemmas in Science Studies

SSK and ANT have become the most successful social constructivist theories in recent STS. Both of them have attempted to re-define what the study of science is about, SSK in a naturalistic empirical relativist fashion and ANT in a 'radical' post-structural post-humanist way. Both have attempted to radically re-invigorate Science Studies but failed to do so in a progressive way. The problem is that neither of these theories managed to bridge the HPS-STS divide, neither of them understood the necessity for a mutual scrutiny between the two traditions and neither of them managed to hold onto the two distinct descriptions of the cultural values of science. Even though both theories professed to offer a new direction for the field, both of them failed to clarify the combined tasks of HPS and STS, and both have provided a muddied philosophical understanding of this essential relationship at the heart of the field as a whole.

As the combined field of Science Studies stands today young scholars with an interest in the social workings of science and technology who are coming into the institutional vessels of Science Studies have a rather narrow band of choices in front of them: SSK, ANT or a closely related approach in the same cultural, reflexive or post-structural turn[32]. Major viable sociological alternatives are difficult to discern

[32] This can be clearly seen not only from the scholarship of the field as a whole, but from conferences such as 4S (Society for the Social Studies of Science), the most prominent international Science Studies conference. I have been attending their meetings for a number of years and a strong shift towards ANT can be witnessed in the theory strands.

while the theoretical offerings of HPS are often opposed to the very idea of social constructivism and the idea of studying science in its social context. This is especially true for old-style HPS that tends towards internalist philosophical accounts of scientific knowledge; it is often positivist or empiricist in outlook and has a strong natural realist backing.

With SSK and ANT on one side, empiricist-realist conceptions of HPS on the other and little in the way of how to re-establish the relationship of STS and HPS for a renewed Science Studies perhaps it was unavoidable that of the 'two sides' would be brought into a clash. The Science Wars of the 1990s can be broadly understood as the manifestation of this state of affairs: STS and HPS being pursued with different aims and new fashionable theories that simply fail to establish a dialogue between the disciplinary sides.

The tumultuous intellectual debates of these 'Science Wars', academic and more widely public, have been evaluated and interpreted in terms of a clash of epistemologies, disciplinary politics and the stance of science today, but not so much in terms of the re-evaluation of the HPS-STS divide. Instead of doing a meta-analysis of all these interpretations, in this chapter I want to shine a light on the Science Wars both as a manifestation of underlying disciplinary and epistemological tensions and a sign that the field of Science Studies is ready for a meaningful re-conceptualisation of itself. There needs to be a re-evaluation of how to productively understand the HPS-STS divide and continue with useful work with this new self-understanding. The Science Wars have brought to the fore important issues about science, authority, legitimation, methodology, epistemology and the Culture/Nature

divide but have done so without recognizing the distinct contributions each side brings to the understanding of science and without bringing the warring sides into a dialogue. Instead the wars have provided a distinctly black-and-white view with 'pro' and 'anti-science' sides corresponding to traditional HPS and social constructivist STS. The debate slowly lost momentum in the late 1990s and eventually died down but without it taking the field of Science Studies beyond the original confusion of scholarly aims and values inherent in the two traditions. The Science Wars ended up being more symptomatic of the state of Science Studies than a resolution or a dialogue opener.

What I want to do here is firstly describe the wars and draw out the underlying philosophical differences that clarify the warring positions. Through these it emerges what is at stake, what are the basic differences in position, what are the possible points for dialogue and basis for a reconstructed understanding for the combined field of Science Studies. I also want to point out what is ultimately lost in the debate: the possibility of a non-dogmatic mediated view of the field, a field that consists of distinctly different disciplinary approaches that share a broad scholarly task and can continue to enrich themselves by maintaining a critical rational dialogue. Moreover, this dialogue needs to be propelled forward by mutual scrutiny of the limits of each.

SSK and ANT proponents may have become fashionable because their conception of Science Studies did away with the HPS-STS divide. Both these approaches simply ignored the important relationship between the constituent disciplines by freely mixing HPS and STS-style ideas and methods without even acknowledging

their origins and functions. Such a move could never have led to a renewed and reflexive self-understanding of the field of Science Studies as a whole, let alone a dialogue between its constituent disciplinary orientations: philosophical and sociological.

In this chapter I want to look at the HPS-STS divide through the lens of the Science Wars. By discussing the actions and reactions of participants and analysing some of the points of the debate I aim to show that we cannot ignore or gloss over this fissure as it brought out the underlying problems of the field as a whole. Its existence has to be noted both conceptually and in light of the politics of the field too. Both supporters of the more classical view of the truth and rationality of science in HPS and supporters of post-structural and relativist theories in STS have political leverage at times. Both are often in the position to influence practical decisions about science policy or science-related communication to the general public, so consequences underlying the debate cut across very real political issues. Yet once the fissure has been explored and articulated through the warring sides it has to be reconsidered: it is not a monstrous insurmountable obstacle, but rather the symptom of a field where dialogue between HPS and STS has been sorely neglected. This dialogue can only be established again once common ground is found and this can only be achieved when the underlying aims and scholarly values of the subfields are considered and a clearer division of labour can be found.

The continuation of scholarly discussion over the Science Wars shows the variety, depth and continued relevance of issues raised by the incident that cannot be put aside as misunderstandings or talking across purposes only. I'll argue that the divide

cannot be ignored and that there needs to be an attempt to find the common ground and bring the sides into constructive dialogue. After all they share the interdisciplinary space of Science Studies, have a shared interest in studying science and technology from outside of science and technology, and have invested in the project of rationally justified knowledge. Simply re-visiting the idea of 'the two cultures' (C.P. Snow) is not enough in itself. There is a need to work backwards through time and agendas to reach the basic scholarly and organizational issues that underpin Science Studies as a whole. These basic underlying scholarly tensions can be made productive again once HPS and STS are engaged as distinct yet joint efforts with a shared general agenda but differing tasks and tools.

While there is an undeniable inter-disciplinary political aspect to the Science Wars debate that involves issues of scholarly authority and appropriate intellectual depiction of science, neither of the more skewed versions of opposing positions provide space within their conceptualisation of science for a deeper politicization of their subject of study in its actual societal context: the resulting 'sides' of the Science Wars leave behind a gap between them for approaches that go beyond both. This existing gap between orthodox scientism and Cultural Studies oriented STS shows up the shortcomings of both: orthodox scientism in HPS operates with a conservatism and rigidity that is inadequate in light of a new diversity of theories, and Cultural Studies oriented STS fails to advance meaningful alternatives that could re-formulate the values, joint philosophical-sociological foundations and aims for a new critical Science Studies. This can only be done when the two sides are engaged in a dialogue in which each side seeks to make the other accountable in terms of their own alternative values.

# Science Wars – a debated symptom

Researching the Science Wars is an interesting exercise of getting lost in the complex details of debate and related analyses yet also a wonderful chance for scholarly clarification. The latter in my mind is necessitated by the former, both personally and for the field of Science Studies as a whole.

Science Wars can be described as a collection of debates, scholarly and public, that followed the publication of high profile criticisms directed against STS-type scholarship that were seen to be attacking science (Cooper 1999:2.1). These criticisms came from scientists who saw this attack coming from the 'academic left', a label that was applied very loosely, and for some definitely erroneously, to a group of postmodern and social constructivist approaches. Sokal, Gross, Bricmont and other scientists wanted to defend traditional realism, objectivism and scientific rationality from this alleged offense attributed to the above grouping of 'leftist' scholars.

The Science Wars has broader precursors in the early 20th century, in the so-called Methodenstreit. This was a cluster of scholarly debates that centered on the methodology and epistemology of the social sciences and the question of whether objective sociological knowledge is possible and desirable. Another distant source is a cluster of debates in the philosophy of science and of social science in the second half of the 20th century that touched on rationality and the nature of sociological knowledge. However the direct precursors to the wars all happened in the 1990s: a book by Gross and Levitt (1994) called 'Higher Superstition: the academic left and

its quarrels with science', a conference proceedings published as 'The Flight from Science and Reason' (Gross et al, 1996) and the so-called Sokal hoax in which a theoretical physicist published a fake postmodern article in Social Text (Sokal 1996) that was later revealed by himself to be a lampooning of how STS theorists misuse science for their own fashionable but ultimately nonsensical, ignorant and incompetent scholarship.

Sokal's 'literary hoax' was designed to 'parody postmodern science criticism' (Sokal 2001) and was the definitive trigger to a barrage of claims and counter-claims among scientists, philosophers and sociologists of science. Even public discourse picked up on the debate, especially in the US and France. The hoax took the shape of an article written by Alan D. Sokal, and published in 1996 in *Social Text*, a journal where STS and HPS articles, especially with a literary bent, had appeared in the past. Sokal's article was a last-minute addition to an issue on 'the Science Wars' in which constructionists and theorists of feminist Science Studies received an opportunity to defend their views in light of attacks on their position from scientists. These previous attacks by philosophically minded scientists were trying to defend traditional science from allegedly 'irrational' or 'extreme attacks' in the shape of radical STS theorising. The article was a disguised caricature of cultural and literary approaches in the field of Science Studies designed to expose the botched scholarship and hypocrisy of a bunch of allegedly postmodern figures in the sociology and philosophy of science[33]. Shortly after publication Sokal exposed his scheme in *Lingua Franca* and as he put it 'all hell broke loose' (Sokal 2001).

[33] Sokal's article was titled 'Transgressing the boundaries: toward a transformative hermeneutics of quantum gravity', in itself emulating and caricaturing the style of the target group (Sokal 1996).

Underlying issues and unresolved questions were unearthed by this controversy: what it means to be doing social constructivism, whether this methodology implies an attack on science or not, and how and why science should or shouldn't be studied. Some new issues and questions have also came into play that Science Studies scholarship, including SSK and ANT as some of the most prominent ones, had failed to clarify prior to the wars. Some of these questions go to the heart of the philosophy of social sciences and continue this new type of Methodenstreit in the shape of the Science Wars: is there a difference between social constructivism and relativism or are they the same, do the new theories in Science Studies break new ground or simply encroach on science's own territory and even end up de-legitimising science, is social constructivism a legitimate way of studying science, how should the sociological and philosophical elements in Science Studies be evaluated and understood?

Unfortunately as both SSK and ANT have failed to shed light on these questions, especially on the last question about the state of the HPS-STS divide. As a result the field inherited a culture of discussion that was confused and confusing, both to Science Studies scholars themselves and to scientists who suddenly saw these scholars as engaging in dangerous 'anti-science' behaviour such as evaluating science and tarot reading as equally valid forms of knowledge (SSK's symmetry and neutrality tenets) and considering microbes and machinery to be actants with potentially more inherent capacity to 'create' reality and provide explanations than scientists themselves (ANT).

Sokal's original piece in *Social Text* was structured around 'silly' quotes from postmodern, post-structural and feminist theorists and he used texts from quantum physics to support postmodern criticism of the objectivity of science. 'Postmodern' quotations were taken from Gilles Deleuze, Félix Guattari, Jacques Lacan, Luce Irigaray, Jean-François Lyotard, Paul Virilio, Michel Serres, Bruno Latour and so on (Sokal 2001: 18). The quotes are on a wide range of topics including differential topology, relativity, cosmology, nonlinear time etc. and together could be construed as part of a wider set of philosophical writings, although other quotes, such as Latour's, on Einstein's work on general relativity, definitely centre on specific natural scientific work, although the actual topic of discussion Latour wants to advance happens to be on the sociology of delegation. As it can be surmised from this rather haphazard list, the territory is ripe for disagreement or misunderstandings, considering that the actual topic of discussion may be interpreted as several different things.

One of the main issues that emerges for Sokal is the strongly felt anti-realism of 'postmodernist' STS theorists, especially those aligned with ANT, SSK and some cultural and feminist studies of science:

> […] I think most scientists and philosophers of science would be astonished to learn that "the natural world has a small or nonexistent role in the construction of scientific knowledge," as prominent sociologist of science Harry Collins claims, or that "reality is the consequence rather than

> the cause" of the so-called "social construction of facts", as Bruno Latour and Steve Woolgar assert (Sokal 2001: 16).

This perceived anti-realism is hurting in more ways than one: Sokal, and other more traditional realist philosophers and scientists on his side of the Science Wars see red. To them, such expressions of an extreme social constructivist position signify an attempt to 'meddle' with the internal business of science, including its knowledge claims. Even the expression 'knowledge claim' rather than simply 'knowledge', may be perceived as throwing down the gauntlet on the 'relativising' side. Social constructivists therefore are all considered to be relativists who are hell-bent on destroying the legitimacy of science. This is where basic ontological and epistemological positions collide and the final object of debate remains science as an enterprise and an object of study, and for Sokal, its legitimacy in the world as well. Postmodern approaches, feminist science studies, relativist social constructivism are all thrown into the same basket and labeled as dangerous for the enterprise of science as they challenge science's very legitimacy while probing deeply into its everyday business by researching its detailed practices.

Sokal does not deny that social factors influence the working of science, but he wants to see such influences limited to relatively external characteristics of science: funding, ideological considerations and policy debate, leaving sociology to comment on racist or ecologically unsound applications and theory-choice blinded by prejudice. In other words social shaping only comes into effect through personal or group interest, scientists' biases, issues of power and prestige, choice of scientific problem and in the process of application. Social factors in this framework will turn

out to be errors, discrepancies, mistakes or superficial effects that do not deeply disturb the core business of science. These are roughly the same 'externalist' issues that sociologists of science in the 1930s were focusing on and Sokal seems to support the underlying assumptions most of them represented then: any effect from the social world is necessarily a distorting one, and any distortion in science necessarily comes from the sphere of the social. The 'internal logic of scientific inquiry' is off-limits and cannot be shaped by political, economic and other 'external' forces. This is the inner core Sokal is defending, the same core SSK has vouched to break into via the extension of constructivist tenets (as discussed in Chapter 2) and thereby radically extending the project of older constructivist sociology of science. The basis of contention is that Sokal wants to keep sociology out of the inner sanctum of science while Science Studies theorists have been ardently tinkering with just that inner core as a new frontier for their scholarship. This then is both a philosophical and political clash: a collision over epistemology but also over the legitimacy of science.

Sokal in effect managed to demonize a haphazard and incongruous collection of Science Studies theories and treated them as primary threats to the objectivity of science (Callon 1999: 265). This move is rather effective on the polemical front (and is seen by many STS scholars as breathtakingly ignorant and crude (ibid)) but social constructivism does not necessarily contrast with scientific objectivity, does not necessarily include relativistic approaches and as a basic epistemological framework it needs to be preserved for sociology of science unless Science Studies is to be thrown back by almost a hundred years in its distinguished history. There is a clear middle-ground in social constructivism then that goes beyond such a zero-sum game

played out in the Science Wars, a less warring position that considers social constructivism in STS entirely compatible with scientific objectivity. As Bloor and Edge (2000) point out: 'evidence is *both* a social construct *and* a reference to reality, not something spun out of our heads in a fantasy world. Reliable cognition presumes social construction' (Bloor and Edge 2000: 159, emphasis in original).

Relativism, although not in strict logical opposition with realism, is another sore point for Sokal as it seemingly wipes out the criteria on which knowledge claims can be judged against each other as more or less valid. For Sokal this is not only anarchic but also destructive: the point where existing truth hierarchies collapse and scientific analysis and judgment become meaningless. Merit and its criteria are thrown out the window, whether they are to be applied to competing explanations for natural phenomena or selection of worthy grant proposals, thereby effecting both the philosophical foundations of science directly applied in its everyday workings as well as rational logic as the mainstay of internal social decision making. Another compounding effect is that in a relativistically conceived universe all other boundaries and hierarchies may be dissolved, so relativist positions supposedly trying to disassemble science could be considered to be just as valid and relevant as their scientific target of criticism (although perhaps not more valid either, which is a common enough logics-based argument against any relativist epistemology, partly advanced by Sokal himself in Sokal 2001). Such a state of affairs would contradict the idea that objectivity exemplified by the correctly carried out practices of the natural sciences delivers truths or at least helps scientists progressively approximate truths that are existing and valid independent of human reality. Relativism seems to

call into question the building blocks of orthodox natural scientific epistemology: realism and objectivity.

> […] some sociologists and literary intellectuals over the past two decades have gotten greedier: roughly speaking, they want to attack the normative conception of scientific inquiry as a search for truths or approximate truths about the world; they want to see science as just another social practice, which produces "narrations" and "myths" that are no more valid than those produced by other social practices […] (Sokal 2001: 16).

Relativism for Sokal is an outright attack on scientific objectivity and its claims to truth about the world. In the above quote he falsely equates relativism with social constructivism, ignoring the important distinction between full-scale relativism and social constructivism. Conceptual and philosophical distinctions have lost out to the importance of making a strong political point. Again, Science Studies as a field could have provided the attenuating factor here of differentiating between sociological and philosophical ways of studying science. Leading theorists of the field could have articulated the differing scholarly values that go with the HPS and STS sides. Their failure to do so does not exonerate Sokal and his confused argument, but explains why the field was a hotbed of misunderstandings in the first place.

Another issue for Sokal is the perceived or real attack on the very rationality of science. He sees scientific rationality as the most basic procedural logic available to scientists and its strongest link to Enlightenment and modernity. As such it is seen as an integral part of humanity's advancement and indispensable to its future development. This link between scientific rationality, modernity and human development is seen as the basis for the societal legitimacy of science. In this framework of thinking, rationality helps to order the world and subsequently mentally and physically manipulate it instrumentally for human purposes. Rationality is even used to delineate science from certain instances of non-science and therefore taking rationality away seems to irrevocably destabilise the defining boundaries of science.

Sokal clearly has a different understanding of scholarly values and tasks that should guide investigators of science than his perceived adversaries. His words betray a traditional HPS-style framework of thinking:

> The extreme versions of social constructivism and relativism – such as the Edinburgh "Strong Program" [that is, SSK] – are, I think, largely based on the same failure to distinguish clearly between ontology, epistemology, and the sociology of knowledge (Sokal 2001: 22).

Sokal's position indicates at least a preliminary understanding that philosophical and sociological questions pertaining to science are of a different kind. The philosophical questions would probe what objects exist in the world, what true statements could be made about them and how science forms such valid knowledge

claims. The sociological questions would be the ones that refer to how human beings organize and go about their endeavour to obtain scientific knowledge, their scientific culture and values, how these are negotiated, changed and maintained, and how the relationship of science and the rest of society can be understood including the potentially distorting or shaping effects of markets and political systems.

However this differentiation is never articulated by Sokal in such a form and is most definitely not subscribed to by his adversaries in the Science Wars. Even his simpler differentiation of ontology and epistemology may not be kindly received by his opponents. Scholars subscribing to phenomenological thinking, for instance, may consider the separation of ontology and epistemology an unjustified and impossible exercise. But by leaving Sokal, phenomenology and relativistic STS behind it is easy to discern a general consensus in the philosophy of the social sciences about what separates conceptually investigators who study objects as opposed to subjects with consciousness and subjectivity. The natural sciences deal with objects, while the social sciences deal with subjects who construct their own social reality. It is also an accepted social constructivist STS point that subjects, such as scientists themselves, exist in the world through their own subjective human experience, and so knowledge about them may be obtained via an exploration of that human subjectivity. Whether the study of this socially constructed reality that scientists are part of then proceeds with built-in relativism and whether it denies scientific objectivity is a different point altogether. In this case it is entirely possible that Sokal's anti-realist, relativist and 'irrational' opponents may not so much confuse his philosophical categories, as not recognise their particular separation as valid[34]. Again, a failure to understand the

[34] Interestingly, H.M.Collins states the same conclusion (reached several years before me, of course!) in his 'The Science Police' (1999): p. 288, with the difference that he does not just assign the

differing value systems behind HPS and STS leads to this confusion. All Sokal can do therefore is re-state that realism, objectivity and rationality underpin his understanding of science and argue that these should be carried over to any discipline that takes science as its object of study. According to him all these approaches in the whole of Science Studies should also respect the tenets of science by not effectively problematising them.

There is a definite problem with Sokal's argument when he asks Science Studies scholars to 'respect' science and refrain from problematising its core assumptions. The problem is that this would effectively mean relinquishing the project of social constructivism or relegating it to the narrow margins of sociology of science where scholarly insights will not be particularly interesting or critical. For many in the Science Wars this argument is tantamount to actively silencing critical STS voices (Callon 1999: 261)). The characterization of the debate in terms of 'pro' and 'anti-science' is also highly unhelpful, it simply deepens the battle lines and urges observers to take sides and continue with the fight. Sokal's argument supposedly invites open engagement yet it operates with a confused idea of what the scholarly tasks of Science Studies are, the differing value systems underpinning HPS and STS and the validity of using social constructivism to probe deeper sociological questions about the internal affairs of science. Similarly to SSK and ANT, Sokal too fails to establish a common ground between HPS and STS, between the philosophical and the sociological approaches. Without this common ground it is impossible to establish a dialogue between the sides and so perhaps it is not

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abolition of the difference between ontology and epistemology to 'philosophically inclined postmodernists' but to sociologists generally as well. Here our agreements would end as I would only categorise a subset of sociologists (and indeed STS theorists) as prescribing to such a state of affairs.

surprising that Sokal's role in the Science Wars was more of the rabble-rouser than mediator.

Sokal's elementary clashes with his opponents lead him to some more complaints. For him reviewed scholars are not engaged in any meaningful social scientific exercise. Their work is loaded with name-dropping, absurdity and a display of false erudition and lack rigour, the absence of a reasoned argument and of substantial empirical supporting evidence. Unfortunately, declaring that social science should stick to realism and the use of empirical evidence accepted by natural scientists only does not bring in any new debate into sociology, which has been living with a pluralist theoretical arrangement for many years. I have shown in Chapter 2 what happens when an STS approach, SSK, tries to appropriate scientific naturalism for STS theorizing: an unworkable stand-off opens up that demonstrates the elementary philosophical and methodological differences between the natural and the social sciences that cannot be bridged by transferring the orientation of one to the other. The same plurality of approaches applies to Science Studies, which in the last 30 or so years have produced a remarkable array of approaches, many constructivist, some arguably postmodernist or feminist in orientation. What Sokal's hoax seem to communicate to those in Science Studies is that probably some scientists still feel threatened by constructivism almost as much as by relativism. It is also evident that the resulting fissure of the Science Wars was not fixed by the repeated articulation of the exaggerated differences between the warring sides. If anything the escalation of the debate made it harder to establish any common ground and reach an HPS-STS dialogue.

Sokal and his allies saw their task as a defensible and justified one because they were fighting for the legitimacy of science. Yet shielding science from external scrutiny implies a dogmatic belief on their part in the idea that the transparency of science happens automatically. Their stance also implies that science should be left alone by sociologists of science and that studying science will result in the de-legitimation of its project. Excluding science from deeper scrutiny is neither logical nor desirable for sociologists of science. It is also not a democratically defensible argument for how science should operate in society. Sokal managed to elevate the debate to a consciously ideological level which raised the stakes and further fuelled the Science Wars.

There was another incident that preceded the Sokal hoax by a few years and yielded similar negative results[35]. After Sokal this was arguably one of the most potent attacks designed to shield science from the 'fashionable nonsense' of current sociology of science. Gross and Levitt's book 'Higher Superstition – The Academic Left and Its Quarrels with Science' aims to indict the 'Academic Left' for its 'muddle-headedness' in relation to science. They charge this loosely defined enemy with the 'crime' of enticing for a total overthrow of existing cultural orders and thereby endangering the scientific establishment. Furthermore these enemies are charged with being wholly unfamiliar with and contemptuous towards science and its achievements. 'Academic Left' here is taken to mean approaches that could be broadly allied with and use the 'doctrines' of postmodernism, any anti-Enlightenment attitude, neo-Marxism, radical feminism, militant multiculturalism

[35] 'Fashionable Nonsense: Postmodern Intellectuals' Abuse of Science' (Sokal & Bricmont 1998) was a 'follow-up' book to the Sokal hoax, in which Sokal the Bricmont expand in detail on the original ideas put forth about postmodern theorists' nonsensical treatment of science and provide further comments on the wars.

and environmentalism. These approaches are said to be weaved together using some or all of these 'threads' to challenge conventional scientific thinking (Gross and Levitt 1994: 4-5). A perceived lack of 'logical consistency' between these threads is taken to mean that only ideological partisanship may sustain their nexus, accompanied by a sense of supreme moral authority. Most of these groups, of course, overlap with Sokal's 'science attackers' and similarly are a very haphazard collection of approaches and groupings who themselves have complicated and deep disputes with each other.

As far as Gross and Levitt aimed to incite, despite their copious disclaimers, they have managed to lay the ground for Sokal's hoax and arguably pulled the first punches of the Science Wars. Again, the philosophical and ideological gap between 'old HPS' and 'postmodernist STS' has been highlighted and deepened but little has been offered towards a resolution or a dialogue. This is all the more difficult for Gross and Levitt because they have failed to find and articulate, let alone understand, what the actual scholarly differences are between HPS and STS and have also lost sight of their common aims that have brought them together into Science Studies. Reactions to Gross and Levitt vary as much as to Sokal showing both that the 'Academic Left' and STS are not monolithic blocs but rather loose formations with a great diversity within, and that the gap that the Science Wars have left behind may be pronounced but perspectives beyond both of them do exist. Most importantly there are social constructivist approaches that do not subscribe to relativism and do not aim to challenge the rationality of scientific knowledge.

Unfortunately neither the tone nor the methods of Gross and Levitt qualify as even vaguely non-partisan, measured or particularly rational and it would be hard to call their work anything but a polemical diatribe, leaving them wide open for internal criticism: inconsistency, incoherence, deficiencies of internally produced knowledge about the subject matter, dogmatism etc. There are other sharp criticisms against Sokal that have been advanced against his predecessors the same way: intellectual incompetence, anti-intellectualism, simplification, dogmatic 'know-nothingism' (as described in Robbins 1997: 4), ideological motivation, brashness. These accusations arguably mirror the opposing side's vindictive expressions, yet they also highlight how the Science Wars has eventually slipped away from the task of finding a common ground and establishing a scholarly dialogue between HPS and STS. Instead it has slid into an ideologically based debate and has eventually become a series of destructive non-scholarly acts of mud-slinging.

However, the 'impostures' had some worthwhile points to make. In fact, one of their strongest points is that authors put in one camp by Sokal as 'science defenders' do not constitute a common group in any meaningful sense. Most of them don't even belong to Science Studies as judged by scholars in that field or by the authors themselves: Julia Kristeva, Jacques Lacan, Luce Irigaray, Gilles Deleuze, Felix Guattari, Paul Virilio and Jean Baudrillard are certainly not Science Studies figures. Others, such as Paul Feyerabend would be considered as an HPS figure, not social scientists in any sense. This muddled understanding of the sides and the underlying confusion about the basic HPS-STS separation of Science Studies underscores the importance of clarifying anew the basic disciplinary and philosophical issues of the whole field: re-articulating the disciplinary outlook of the philosophical and the

sociological sides, describing their shared scholarly interest and negotiating between their differing disciplinary values.

Sokal could be justifiably accused of various offences discussed above, yet parties on the STS side have been deeply unhelpful too. The most prominent current theories in Science Studies, namely SSK and ANT have failed to conceptualise and articulate the relationship between HPS and STS. They have failed to understand the differing underlying values and so have been unwilling and unable to work towards a renewal of the field's self-understanding or opening a rational dialogue between HPS and STS. As I have shown in Chapters 2 and 3 both of these approaches have been muddying the conceptual divide between philosophy and sociology of science. Their confused and confusing scholarship may even have directly contributed to the Science Wars by supporting the conflation of social constructivism with relativism.

Yet the tradition of social constructivism also continues in a vein that steers clear of relativism and continues to uphold rationality as a core scholarly value. Constructivists for many years have been arguing that their approach does not in the least aim to discredit or depose science. The self-appointed constructivist aim is to describe and explain, thereby account for, scientific phenomena via social or socially mediated pathways, in effect making their aims aligned with those of HPS generally, although leaving both methodology and epistemology more open to variation. Within the sociological approach of social constructivism there are scholars who represent different shades of scholarship. A smaller subset of them, some of whom may work in STS and be even associated with postmodernism, may question the validity of natural scientific ontology and epistemology, however, most

of them do not venture into positions that would bring them into an outright conflict with such[36]. Still, social constructivism in STS generally neither aims to discredit, deconstruct nor replace or otherwise eliminate the natural sciences, without which their own inquiry would hardly be valuable. Bloor and Edge (1997: 159) gave a good description for the defense of the rationale behind social constructivist scholarship that resolves its apparent collusion with natural realism and could allay 'science warrior' fears:

> […] society does not simply distort our knowledge of the world, nor does it come between us and reality. Society is enabling: we know reality through it, not in spite of it. Society and culture act like spectacles: through them we collectively see and grasp the world; without them we can see and grasp little or nothing.

In the same vein Steve Fuller argues that rather than exposing science as a sham and curtailing its conceived sphere of influence, constructivist sociology of science produces a new layer of study and in effect extends the reach of science. Whether a middle-ground social constructivist approach ends up extending or critiquing science I believe it is a good start towards filling the gap left by the Science Wars as it holds onto the sociological project in studying science while not relinquishing rationality (Fuller 2001).

[36] And even if they did, as some no doubt do, in a free field of inquiry and in the spirit of open scholarship, surely their positions too could be the subject of formal debate before or even without an open political 'war'. In the same vain, obviously 'science defenders' too would have the right to do either, however, none of the above described freedoms equate with an outright relativism of all expressed positions, only a minimal civilised opportunity granted to everyone obeying the basic rules of the game to exercise their rights in expressing their standpoints within the same fora.

In the end, adjudication in the 'Science Wars' may not be achieved at all but that is scarcely nominated as a worthy or possible aim now. As it is becoming part of the history of the field, closing remarks and interpretations are offered, although as books attempting to sum up the 'wars' are appearing, reviews on those same books provide further opportunities to continue if not the debate itself, but lamentations over the lack of a 'proper' debate (Collins 1999), whatever that means for each commentator. The most extreme versions of each 'side', and these are really the only perspectives that the strongest of criticisms easily apply to, may be considered epistemologically incommensurate. However, between the two extremes of the spectrum there are many shades of scholarly approach that pull in directions unrepresented in the chapters of the 'wars'. Many 'radical' STS theorists and 'conservative' HPS theorists would not even fit the extreme positions assigned to them by the wars and even disciplinary position fails to predict a scholar's position. Indeed as Gieryn (1999) described, many 'science attackers' originally came from and many 'science warriors' originally had nothing to do with science. This state of affairs seems to undermine the idea that radical and conservative positions are fixed, strictly related to training and amount of internal insight into the workings of the natural sciences, the social sciences or any other disciplinary space.

For my analysis the most interesting point is that the Science Wars have highlighted a deep-running fissure in the field of Science Studies very much along the HPS-STS divide. The main issues that surfaced may have been exaggerated when assigned to the most extreme positions possible, but they do have a purchase on the basic philosophical-sociological division underlying the field. Realism, relativism, objectivity, rationality, social constructivism and the legitimacy of science are

defining philosophical coordinates for both philosophy and sociology of science. The heated confrontations of the Science Wars highlighted the continued relevance of these categories and brought to the surface the importance of defining the future direction of the whole field of Science Studies. In this sense the wars could be thought of as a symptom of un-clarified tensions and dilemmas facing the whole field. It would be the natural task of the most prominent recent theories in Science Studies to shine light on how these tensions and dilemmas could be understood anew towards the future of Science Studies. Unfortunately neither SSK nor ANT have been capable of living up to this task as they both let the opportunity for clarification pass, yet the relationship between HPS and STS needs to be clarified and new solutions offered towards their common future. They continue to share a common interdisciplinary space and have common goals in studying, analyzing and interpreting science and technology. Yet they have differing disciplinary traditions embodying differing values and methodologies.

The HPS-STS relationship was misconstrued and distorted in the Science Wars and so their perceived collision failed to shed light on how they could be brought into a dialogue where the values and limitations of each can be fleshed out. Two elementary needs remain unfulfilled and ready for resolution. Firstly a renewed and reflexive self-understanding needs to be provided for the whole field and a productive dialogue needs to be opened between the philosophical and the sociological sides, a dialogue that holds onto both their shared agenda and their differences. Secondly, lost theoretical opportunities need to be rekindled and the shortcomings of current approaches remedied. Both of these could be achieved by an overarching Critical Theory approach that embraces a non-dogmatic middle-

ground social constructivism and a critical rational scholarship to bring into dialogue HPS and STS-oriented approaches. Realising this move would both render the continuing unresolved issues of the Science Wars moot and provide a productive way for the original participants to carry on with their debates.

Before I turn to this transformative Science Studies task in Chapters 6 and 7, I need to turn to the discussion of the promising turn and precautionary tale of Thomas Kuhn's theory of scientific progress. Here I will show the early promise of social constructivism and how the beginnings of Science Studies already contained the seeds of later theories. I will locate the important beginnings of later disciplinary confusion that neither the Science Wars nor SSK and ANT have been able to clarify, yet a confusion that can and must be dispelled by understanding the roots of this confusion, tracking its disciplinary manifestations and development, and finally overcoming its resultant impasse through a renewed clarification of the HPS-STS divide and a Critical Theory bridging of the resulting gap.

# Chapter 5

# Kuhn – paradigm of an uncritical turn

It is rather hard to consider the development and eventual shape of scholarship in Science Studies without taking stock of the contribution and legacy of Thomas Kuhn. This is because some of his ideas still resonate in HPS and STS, his conceptual language and framework of thinking linger on, his legacy is currently being re-assessed and the resulting judgments counted towards an anticipated 'critical turn'. In this chapter therefore I'm interested in ascertaining what enduring effects Kuhn had on Science Studies generally and how to position a Critical Theory oriented approach in relation to his ideas and legacy.

As I showed in the previous two chapters both SSK and ANT, two of the most robust theoretical developments in Science Studies in the last 30 years, have evolved towards separating out normativity from considerations in relation to science via their own peculiar theoretical mechanisms, leaving them both 'parched soil' for any exercise in critical reconstruction of the field's present philosophical tasks. Did Kuhn influence their philosophical trajectory in some way by eliciting 'a historical and a linguistic turn' that flowed into a 'reflexive turn' and helped do away with normativity? Or on the contrary, Kuhn's social constructivism and apparent anti-foundationalism make him a good candidate for theoretical interrogation in order to answer the question: where to anchor normative considerations within the territory of studying science?

Recent renewed interest in the re-evaluation of Kuhn's scholarship provides two contemporary points of anchor for my task of developing a discriminating account of his legacy. Steve Fuller (2000) has compiled an extensive study of Kuhn in his socio-historical context and has produced a strongly argued but mostly negative account of his role in Science Studies scholarship. Wes Sharrock and Rupert Read (2002) in their even more recent book claim to have comprehensively re-evaluated Kuhn's work and have done so in a much more sympathetic way. Although their account is considerably more positive it is also muted in its praise.

Overall Kuhn's legacy is mixed and his worth debated but several points of limitation can be felt from a critical sociological vantage point. Kuhn's internalism is probably the most worrisome as it helps shield science from external scrutiny. Another problem is the general vagueness of Kuhn's scholarship which has given rise to multiple interpretations and makes it difficult to clearly evaluate his legacy. Vagueness is also a scholarly shortcoming in its own right. Kuhn's scientism causes further problems as both his theory and his pronouncements support a strongly natural scientific bias and facilitate a scholarly position that encourages HPS-style scholarship to cannibalise the one in STS.

Beyond these limitations Kuhn's scholarship has been appraised as marking a 'definitive moment' in the development of Science Studies in that his ideas were incorporated into a newly discovered broad social constructivist framework and it was around Kuhn's time that STS started splitting away from HPS. Kuhn is also credited with a historicist impulse, although both of these contentions are highly debated (especially in Fuller 2000b) In effect Kuhn's scholarship is ambiguous

rather than radical and his legacy for Science Studies could be considered regressive in that Kuhn's ideas fostered the exclusion of normativity from the framework of study, encouraged the encroaching of HPS on STS and have done little to facilitate critical ideas. In this regard, despite earlier assessments and more in line with current ones, Kuhn's theory has negatively effected the path of sociology of science and have both destabilised and muddled the HPS-STS relationship.

## Kuhn's basic model, points of praise

Depending on where one looks within the field of STS and HPS, there are different thoughts on why Kuhn's scholarship is of interest, where to situate him philosophically and what uses his ideas can be successfully put to. However, there is all-round agreement on the general impact of Kuhn's basic ideas across many disciplines as indicated by his extremely prominent place in the humanities and social sciences citation index, translations of his works and their placement on university curricula (Fuller 2000b: 1). 'Paradigm' and 'paradigm shift' are common expressions not only in politics and business, but also in everyday language, showing an influence of sorts that few fellow scholars could claim. Contradictory interpretations of his major work, *The Structure of Scientific Revolutions* (Structure from here forth), remain, but beyond explicit analyses, there are signs of his enduring effect in concepts and frameworks of thinking that testify to his legacy. Arguably, his most active time also coincided with major changes in the study of science and his work shaped Science Studies and the dominant orientation of present-day philosophy of science.

In terms of the HPS-STS divide Kuhn's work is at first seemingly fitting into both sides. His work is most obviously philosophical as this can be seen from his legacy, while a cursory glance reveals a view of scientists that looks decidedly social and historical with the idea of paradigm looking imposing, original and radical. When viewed from a distance Kuhn's theory looks like the precursor to social constructivism and potentially the begetter of progressive thought. As I will show later in this chapter the detailed picture is more complex and less flattering: his work is decidedly anti-sociological and in effect attempts to force STS ideas into an HPS mould, hijacking the sociological bits and melting them into a narrowly philosophical stream. In fact what this chapter will end up showing is a very uncritical turn that Kuhn's legacy represents, a legacy that did not so much beget social constructivism as began the misappropriation of the HPS-STS relationship to the latter's detriment. Before delving deeper into the uncritical legacy of Kuhn's scholarship I will re-cap the enduring parts of his HPS contribution.

Kuhn's basic ideas about scientific change as laid out in *Structure* are well-known in their schematic form, but are worth repeating as a foundation here. These concern an overhaul of the more traditional view of steady accumulation of knowledge in established sciences (his original example is physics) and instead describe scientific change as two phases alternating (in its simplest formulation): more quiet periods of problem-solving within 'paradigms' (matrices of knowledge) disrupted by more revolutionary periods when basic elements of a paradigm become challenged to the point of a sudden Gestalt-like switch into a new paradigm. The former is named 'normal science' and is characterised by a relatively conflict-free atmosphere in which scientists keep elaborating on the existing paradigm and focus on reconciling

new data with the existing framework. There are both epistemic and methodological parameters set within a paradigm and these provide the background to the ongoing everyday, successful 'puzzle-solving' work of scientists that keeps validating and refining the existing framework. Eventually discrepancies accrue, anomalies between nature and its existing representational model become progressively harder to ignore. When predictions are upset and results keep refusing to yield conjectures that fit into the existing paradigm, tension builds up and science hurtles towards an upheaval of its knowledge base. This revolutionary phase is said to be characterised by vigorous contention that stretches the existing framework to the point where it cannot be maintained. At this point new competing paradigms are proposed that pose a challenge to the old traditional one and a stage of 'crisis' ensues. Alternative formulations are proposed for acceptance and these are vigorously debated in a broadly rational manner with strong persuasive force. New boundaries are demarcated and eventually settled on as the dominant and accepted ones that will henceforth provide the basis for more peaceful work again (Peterson 1981 among many others).

Although Kuhn has produced other works later[37] his theory of scientific change advanced in his *Structure* has remained his major achievement as judged by peers and measured by responses and effect. His later works effectively qualify his former thought, philosophically further developing certain aspects, making them more nuanced and detailed; or answer to and comment on the thoughts of his critics,

[37] 'The Essential Tension: Studies in Scientific Tradition and Change' in 1977 and 'Black-Body Theory and the Quantum Discontinuity' in 1979 were both historical studies depicting periods of revolutionary change within a disciplinary paradigm (Sharrock and Read 2002: 1) and as such could be broadly considered applications and extensions of Structure. Kuhn's first book, 'The Copernican Revolution' published in 1957 was similarly a historical study. Later years mostly yielded philosophical essays, symposia papers, new forewords, reflections etc.

defending but also further elaborating and developing subsequent ideas, all effectively still within the same framework set by *Structure*. For this reason, and because novel parts of his later work either didn't seem to have a relevance for Science Studies as it remained more narrowly in HPS or otherwise didn't produce much of an impact inside Science Studies, I'm going to mostly restrict myself to the discussion of the legacy of *Structure*.

This new model of scientific change was put forward by a Thomas Kuhn working within a newly created interdisciplinary setting at Harvard University called General Education in Science, which could be considered an early blueprint for later STS courses, but still within a general studies-type curriculum for science students. 'Harvard President James Conant had designed this curriculum in order to keep "pure science" in the good favour of the American public, in whose eyes it suffered after the use of the atomic bomb (Fuller 1992: 241, contextualising the course and its orientation in a social constructivist vain). Kuhn's shift from theoretical physics to a history and philosophy of science orientation that started to manifest in his PhD fitted in with Conant's vision and the requirements of the course.

The general effect of Kuhn's work can be shown by the spread of his basic ideas. These could be traced as far a field as literary criticism and political theory and to publicists and popularizers (Geertz 2000: 161). More detailed and studied are the influences on linguistics, history and psychology, the latter being a special case as Kuhn's concepts and claims are often directly employed by psychologists today, especially when describing their own scientific and clinical practice (O'Donohue 1993: 267). However, an examination of psychological literature shows that Kuhn is

mostly cited as part of a rhetorical strategy than an element in substantive assertion (Coleman and Salamon cited in O'Donohue 1993: 268). Peterson (1981) also recognises this and adds that most of this use is rather superficial and uncritical. Kuhn's concepts are often used in a similar fashion amongst sociologists, natural scientists etc. This is probably not surprising considering that he is one of the most cited authors ever across varied areas, however, it does give credence to the argument that there are certain qualities to Kuhn's thought that very much lend themselves to uncritical recycling. Still, such use (or misuse) *in itself* is not necessarily an indicator of an inherent quality in Kuhn's thought.

The most obvious and well recognised scholarly effect Kuhn had was without doubt in these above scholarly areas. Apart from Feyerabend and Lakatos, Kuhn is considered to be the begetter of a 'new-style' philosophy of science that irrevocably established a historical direction (Bird 2000: viii). This is despite the fact that he was never trained in philosophy and his original disciplinary position while writing *Structure* was not philosophy but history of science. There is a widespread view among Kuhn's appraisers that he has been instrumental in undermining the current of logical positivism (Bird 2000: ix). Although some contemporary critics revisit this assertion, which is under debate, there is even more agreement regarding Kuhn's role in establishing the historical dimension in the philosophy of science (such as Nickles 2003b for example), which eventually then became HPS ('H' standing for History) and in strongly contributing to the creation of a scholarly space that Science Studies comes to occupy from the 1960s onwards primarily in the shape of STS departments at universities in mostly Anglo-Saxon Western countries. Even these broad claims have come under debate by recent in-depth studies of Kuhn.

Some tried to partially modify the existing view (Bird 2000, Hoyningen-Huene 1993), some worked toward a radical overhaul (Fuller 2000b), others have attempted to reinstate some and partially modify other basic views (Sharrock and Read 2002). These last two are significant as they represent the latest scholarly re-working of Kuhn's legacy, Sharrock and Read from a philosophical point of view and Fuller from a more sociological and interdisciplinary point of view. I will review both of them later in this chapter.

Kuhn's model was appealing at the time for several reasons. Overall, it depicts science in a less linear and formal fashion than previous models and activates a socio-historical view of scientific change with scientists as active, innovative social agents whose community is effected by their historical context (Peterson 1981: 2). This is a very different way of considering science than an older more hagiographic view that generally tried to arrange past events into a coherent and highly logical, supremely rational and neat path that gives the impression of a perfectly progressing enterprise mostly devoid of human frailties and historical unevenness. Kuhn's pragmatic formulation of 'what works in science becomes accepted' rather than 'ultra rational scientists painstakingly chiselling theory towards truth', ends up humanising the scientific process making it into a thoroughly everyday activity not so much (or just) in close proximity to truth, but in close proximity to 'normal' human experience strewn in with interests, feelings, intuition, the complexity of human-to-human behaviour. In other words Kuhn brings in elements of social scientific thinking, especially social psychology into his study of science, which then edges towards becoming a study of *scientists* as well.

This step had the obvious disadvantage of alienating some strictly formal logical-empiricists, some of whom still berate Kuhn for opening the door to a philosophy of 'irrationality' (eg. Musgrave 1983: 56). This has not stopped scholars from many disciplines, including staunch philosophers of science to engage with, and be influenced by Kuhn's ideas. However, Kuhn provided a bridge from philosophy of science, that until so far was mostly preoccupied with highly formalist logical constructs as the tools with which to comprehend science, towards an already existing sociology of science that concentrated on the institutional and loosely 'cultural' aspects of science (Merton, Sorokin). It is a broad/loose social constructivist background assumption that allows Kuhn to vest historical processes and within them, human agents, with the active capacity to shape the course of scientific change, but without placing an ontological onus on them. In turn, it is this active shaping and its relative/apparent decoupling from a forward-march towards an inevitable refinement of the underlying truth that conceptually transforms 'scientific progress' into 'scientific change'. It is not simply a change of expression, but one that is value-laden, and Kuhn's 'scientific change' has shed the hagiographic overtone of 'scientific progress' to leave a more value-neutral term behind. This move also had the danger of alienating philosophers of science and scientists who keep insisting on the rational truth-content and related authority of the natural sciences, on the other hand, it was possible to claim that it made the study of science a more objective exercise.

This latest element of bringing in social constructivism and 'accidentally misplacing' truth is the one that has earned Kuhn the tag of a 'relativist'. For if there are different paradigms floating in historical space that together do not necessarily

constitute an obvious sequence pointing towards truth, then the obviousness of progress disappears. If paradigms follow each other, not because rationality dictates their succession but because human agents on the basis of their intricate pragmatically-based arguments decide that one paradigm in light of current thinking makes more sense to employ than another, where are the universally objective criteria that could assume the role of the ultimate arbiter? Where is old realism that pronounces what the objective reality is and gives a solid and unshifting point of reference without deference to human experience? While Kuhn does not necessarily give final answers to ambiguous or questionably vague details regarding such questions, his new formulation clearly places the view of the scientific enterprise on a new footing with a strong historical and social element.

This footing also requires new ways of studying science: empirical methods that look beyond rational utterances and logical reconstructions. Arguably Kuhn has set an example to 'look beyond the positivist jargon that scientists use to justify their activities and to focus instead on what scientists actually do in their workplaces' (Fuller 2000b: 3).

Arguably many Science Studies practitioners from the 1970s onwards have effectively continued this orientation with empirical studies in labs, scientific projects etc (recall Woolgar and Latour, Knorr-Cetina etc.). Many of these have drawn on anthropological work that has always been empirically based and sociological roots that too have used empirical methods extensively, but before Kuhn such directly empirical methods have not been employed in the social study of science.

Other famous aspects of Kuhn's work, such as incommensurability (often discussed in conjunction with relativism for obvious conceptual reasons), are more interesting for analytic philosophers, especially those also interested in the implications of Kuhn's work for cognitive science, cognitive psychology, logic and linguistics (incommensurability created an especially strong interest in the last). Kuhn's later, less well-known works are dissected for relevant ideas on epistemic justification, logical paradoxes, small-scale details of scientific method(s), concept representation and perception (Nickles 2003b, Nersessian 2003, but potentially there is a long list of such). In these contexts social reality is only a backdrop and Kuhn's ideas are used in highly analytical logical formulations in HPS, but possibly just as commonly inside philosophy proper. These aspects are only indirectly connectable to Science Studies interests and are therefore not as central to the appraisal of Kuhn for sociology of science.

## Kuhnian links to SSK and ANT: scientism/naturalism, prescriptive 'paradigmatism' and science-as-practice

All the above noteworthy points in Kuhn's model seem to suggest that the new area of Science Studies had many good potential starting points in Kuhn's direction of ideas. Have these been taken up by sociologists of science and have they been able to use Kuhn's pointers for any critical effect? If there are clearly discernible links to later Science Studies research clusters such as SSK and ANT then Kuhn's legacy in this area could be clarified.

Kuhn's negative legacy on SSK can be most successfully traced in his views on the natural and social sciences. A strong scientism runs through Kuhn's ideas that can be seen in an almost unaltered form in SSK. This pertains to how only the natural sciences have achieved a paradigmatic status and therefore the social sciences can be considered inferior and good candidates for emulating the natural sciences in order to catch up in validity of knowledge creation and therefore legitimacy and authority. Although it has been suggested that Kuhn used the term 'paradigm' in many arguably different shades of meaning, some more metaphysical, sociological or artefactual (Peterson 1981: 6), it is clear enough what its existence implies about any given scientific field: an underlying epistemological and methodological coherence. As time passed during Kuhn's scholarship and there was a definite post WWII boom in R & D in the natural sciences only slight modifications needed to the idea of the paradigm to be able to maintain its validity: rather than viewing major fields in the natural sciences as subscribing to a monolithic paradigm it became more useful to assign one to smaller and smaller subfields within them. However, the social sciences kept resisting the application of even the crudest formulation of Kuhn's model of a paradigm. This observation did not elude Kuhn who noted the 'number and extent of the overt disagreements between social scientists about the nature of legitimate scientific problems and methods (Kuhn 1970a cited in Peterson 1981: 4)'. However, Kuhn was not interested in constructing a separate model for the social sciences, but assumed them to be not conforming to the paradigm model of the natural sciences. His words are as open to different interpretations as in most of his work, but are still worth reproducing. In his 'Reflections on my critics' Kuhn writes:

> […] the proto-sciences [such as the social sciences] lack some element which, in the mature sciences, permits the more obvious forms of progress. It is not, however, that a methodological prescription can provide. Unlike my present critics, Lakatos at this point concluded, I claim no therapy to assist the transformation of a proto-science to a science, nor do I suppose that anything of the sort is to be had. If, as Feyerabend suggests, some social scientists take from me the view that they can improve the status of their field by first legislating agreement on fundamentals and then turning to puzzle solving, they are badly misconstruing my point. […] maturity comes most surely to those who know how to wait. Fortunately, though no prescription will force it, the transition to maturity does come to many fields […] Other fields will surely experience the same transition in the future (Kuhn 1970b: 244-5).

The message could easily be construed as mixed: the social sciences are judged to be simply different in their historical development and specific internal characteristics on the one hand, and pronounced to be awaiting a more 'progressed' level of maturity that is well worth waiting for. Social scientists cannot be given tools to assist them in reproducing the achievements of the 'real' sciences, but can patiently wait for a future transition that is predicted to somehow be 'the same', transforming them from pre-paradigmatic to paradigmatic 'developed' sciences. Kuhn's language alternates between a value-free and a value-laden language and although there are no officially endorsed leads given to a potential social scientist reader who wishes to propel her discipline into a 'mature' paradigmatic stage, there is a general underlying suggestion that the natural sciences are higher up in the overall hierarchy

and therefore are the ones to imitate[38]. The natural sciences have this position because their knowledge claims are deemed epistemologically superior. They are deemed superior similarly to how HPS is implicitly deemed superior to STS style thinking, a parallel judgment of value that underscores the credibility of Kuhn's own framework and undermines that of the opposing side, that of STS. In this sense Kuhn's scientism towards sociology goes hand-in-hand with the colonising intent from HPS towards STS, a move that maps onto Kuhn's scientism.

SSK scholars seem to have extrapolated from Kuhn's epistemological stance and transferred natural scientific methods to the sociology of science. The latter move can be linked to the above interpretation of Kuhn's model of paradigms, maintaining that paradigmatic maturity can be attained by reaching for those elements of the natural sciences that make their set-up unquestionably paradigmatic, in this case scientific methodology, so SSK has to study science with the tools of science. Kuhn's epistemological stance can be traced the following way. SSK aimed to treat all knowledge forms, scientific and non-scientific, as in principle possessing the same value and validity, just like science treats its objects with the same measured reverence or lack thereof. This is a 'radicalized' extension of, or extreme extrapolation from, the Kuhnian 'relativistic' but scientistic model that does not accept the taken-for-granted superiority of one framework of scientific work over another (paradigms) but also wants to treat all objects of inquiry the same way. Like

[38] There is an obvious and very large area of discussion for consideration here: how social scientists have seen these issues themselves and in what ways their insights have been played out in their research. This is a vast area of inquiry belonging to the philosophy of the social sciences and one that I cannot go into for its own sake. It should suffice to say here, that the history of philosophical self-reflection in the social sciences obviously demonstrates Kuhn's point on the one hand by not giving one unitary epistemological or methodological answer, but is also a very rich and mature history of philosophical dialogue on the other, that contains all the major arguments about why and how the social sciences are fundamentally different from the natural sciences and what scholarly ramifications could be made from these.

many uses of Kuhn's work, SSK did not preserve and did not aim to preserve the philosophical and structural coherence of Kuhn's original model, but some of its elements can be traced back to accepted interpretations of Kuhn's work.

There are other disciplines in which Kuhn's 'message' was taken in the above sense: psychology is probably the most obvious example, a discipline that has been shifting in its institutional location from the human sciences to first behavioural sciences and more recently as an adjunct discipline waiting for full invitation at the door of the natural sciences.

The entirety of German debate over positivism and methodology encapsulated in several waves of *Positivismusstreit* during the early years of the 20th century and later between the Popperians and economic theorists on the one hand and the Frankfurt School on the other, seems to have been largely wasted on Science Studies. However, the British 'rationality debate' managed to get attached to at least HPS thought. This debate 'concerned whether there were cross-culturally valid, universal standards of reasoning' (Fuller 1992: 247), which ties in well with the realism-anti-realism debates around Kuhn's work. This is important to note because later theoretical developments in Science Studies, notably SSK and ANT, may be said to be influenced more by the internalist elaborations fostered by the British-based debates than the broader, at least in possible implications and extrapolations, German-based debate. Looking for variations of scientific logic and analytically discerning their internal implications is more in line with certain aspects of later Science Studies theorising ('internalism' versus 'externalism') than an approach that

looks for alternative forms of rationality and aims to contextually evaluate their worth in terms of promise for human emancipation.

There are other readings of Kuhn: Rupert Read insists that both Kuhn's 'fans' and 'foes' 'have gotten him wrong in supposing his views to have […] drastic implications for the social sciences (Sharrock and Read 2002: 88)' and this may be due to 'a huge misconstrual of Kuhn' through 'misreadings and over-dramatizations' (ibid: 89, 90). According to Read Kuhn has been misread in prescriptive ways: as if he implied that the social sciences, assuming to largely include Science Studies now as well, should be aspiring to a 'paradigmatic' stage, to catch up with the assumedly more developed natural sciences via the adoption of either scientism or any other paradigmatic foundation. Read himself admits though that Kuhn's wordings may imply a 'teleological vision' (ibid: 91) but nevertheless he 'ought to neither to be praised nor buried for having apparently given 'pre-paradigmatic' sciences a road or a menu toward normal science' (ibid: 94).

Rouse 2003 emphasizes how Kuhn's *Structure* transformed the philosophical conception of science from a purely knowledge-focussed enterprise to one defined by scientific practice (Rouse 2003: 102). It was the historicist-empiricist detailing of actual scientists' work that helped bring the focus to the ongoing research activity as the central defining characteristic of science. Rouse wants to draw attention back to this transformation from an epistemological to a practical conception of science and thereby re-interpret Kuhn's legacy. He sees this as a real revolution in the predominant conception of science waiting to be recognised and enacted in HPS & STS. This conceptual breakthrough emerges 'from the historical record of the

research activity itself' (Kuhn 1970 cited in Rouse 2003: 102) and has the potential to overhaul the foundations of philosophy of science.

Rouse admits that Kuhn has been equally well assimilated into more traditional epistemological readings partly because Kuhn's lack of awareness of his revolutionary ideas or because ambiguity of his utterances, he still favours a more practice-oriented reading that allows for a better philosophical understanding of science. This better conception, assumedly also supported with data from good historical and contemporary empirical investigations, can help realise that transcendent goals of knowledge or truth are less relevant to the everyday work activities of actual scientists than small internal puzzle-solving chunks of activity that are more motivational and meaningful. Intellectual goals can, of course, be transformed into smaller practical components, which is what happens in 'normal science'. This generally also enables scientists to avoid getting involved in 'more far-reaching theoretical or evaluative disputes' (Rouse 2003: 105) helping them to sustain their focussed inquiry, even though this also happens to insulate scientists' preoccupation from a wider social reality (including issues of responsibility related to their research).

This re-interpretation advances a perception of science as an activity-based enterprise; paradigms are exemplary ways of conceptualizing and intervening in particular situations, participation in them is based on acquiring and practicing a set of skills, such as 'appropriate application of concepts to specific situations' or valid, relevant and circumspect 'deployment of mathematical tools', use of instruments, techniques and procedures etc. (Rouse 2003: 107). So 'practice' covers abstract

actions, such as analogical reasoning, while paradigm is not so much a matter of belief (orthodoxy) but usefulness, connecting practitioners whose work constructively mesh with each other's (ibid: 110).

I would argue that this conceptual overhaul has partially already been played out in STS theorising and practice in the last 30 years via ANT, social constructivist ethnographic lab work and even in the work of some SSK theorists. Ethnographic lab work, a basic original empirical version of cultural studies of science[39], has obvious elements of this practical conception of science with its shift of focus to the everyday lab life of scientists as a pivotal constitutive part of their work. ANT has extended this focus on the everyday practices of scientists and started organising scientists and related objects (including scientists' tools and instruments, their object of study and its context, functional and structural parts of objects and contexts etc.) into conceptual networks whose nodal relationships are made up of bits of everyday practice that involve or implicate each other in turn.

SSK is the weakest connection in this regard as even the approach's name betrays a stronger connection to science-as-knowledge than to science-as-practice. However, Barry Barnes, once prominently associated with SSK, can be found to strongly endorse the science-as-practice reading of Kuhn (Barnes 2003[40]), although practice according to the emphasis within his framework is primarily constituted by the intricate social relations between scientists bringing his approach closer to a neo-Mertonian one. He also points to another influence from Kuhn to SSK:

[39] Obvious references already cited in Chapter 4 would be the early work of Knorr-Cetina (1981) and Latour and Woolgar (1979).

> By way of another aside, here is the reason that Kuhn has been so important to the work of the Edinburgh School of sociology of science [SSK]. Their project is precisely to seek a causal-scientific understanding of the entire sphere of human action that admits of no exceptions. The self-referential character of this inescapably relativistic project makes it at once a part of the overall explanatory project of science and an enterprise that, in seeking to observe and explain science 'scientifically' from the outside, must in that way be alienated from it (Barnes 2003: 134).

Apart from, at the end of the quote, expressing how the Strong Programme has eventually drowned itself in the self-referential outcome of a radical 'reflexive turn', Barnes seems to want to emphasise the connection between Kuhn and SSK. In Kuhn there was an empiricist commitment but also a relativistic impulse, so were both of these present within SSK inside their Strong Programme's empirical programme of relativism. Whether Barnes' interpretation of Kuhn is agreeable is of no importance here. What is salient is that central aspects of SSK are thought to be traceable to Kuhn by SSK theorists themselves, or be even derived from him directly. Furthermore, Barnes proposes (ibid: 137) that Kuhn's work should be situated in continuity with that of Merton (even though this is contradicted by others, eg. Boyle and Wheale 1984: 32), placing him and SSK in a long line of sociology of science concentrating on science as social culture. He also acquiesces when discussing Kuhn's political vision for science in which scientific communities are mostly self-governed and regulated, but tacitly accepts a recent shift towards a 'market

[40] As do many others, such as Nickles (2003b) in the same volume.

regulated' scientific governance (ibid: 139). All in all, following Barnes, SSK has indeed partially traced its approach from (one particular interpretation of) Kuhn.

SSK and ANT may not have exhausted the inherent possibilities of science-as-practice and science-as-culture, but represent an appropriation of the basic idea from a 'cultural turn' direction[41]. The problem with these indirect appropriations from a Critical Theory point of view is that they neither produce any critical insights on top of Kuhn's science-as-practice interpretation nor problematise STS approaches that keep elaborating a purely descriptive internalist view. In this regard none of the so far discussed STS-related approaches tap into an unrealised potential from Kuhn and their aggregate could be taken to amount to a state of affairs in STS in which no one major approach shows signs of capability in critically tackling contemporary interest and power-laden social issues in science.

## Reconstructionist attempt: Sharrock and Read

Most recent re-appraisals of Kuhn have had the advantage of even more hindsight in contextually evaluating his legacy than HPS and STS scholars writing in the second half of the 20th century. These re-appraisals have started to answer questions about the overall impact of Kuhn's work on philosophical thought and Science Studies as part of a re-assessment of where the field is heading in the early 21st century. Kuhn's

[41] Many STS scholars and sociologists of science continue the path started by the 'cultural turn' and the 'reflexive turn', science-as-practice obviously gives broadly post-structural and postmodernist approaches a way of distancing themselves from structural, traditionally empiricist and also politically engaged ways of continuing sociology of science. Many such scholars also seize calling themselves sociologists altogether and find Cultural Studies, Media and Communication and English more suitable as scholarly frameworks to operate in.

legacy has been given a prominent workover most recently by Steve Fuller, and by Wes Sharrock and Rupert Read, displaying considerable attention to detail and especially Fuller, a freshness of approach. They use very different strategies in pursuing their subject matter and end up with very different evaluations. These two approaches demonstrate diverging contemporary scholarly routes within the wider field. They provide a useful foil for gauging the latest lessons about the legacy of Kuhn towards the future of the Science Studies field.

Sharrock and Read's re-evaluation does not easily yield answers to my central questions, but end up answering them sometimes indirectly, as is perhaps expected from authors both admitting to a Wittgensteinian bend and extolling the virtues of 'negative thinking', partly through their re-reading of Kuhn through such a lens.

These two authors aim to recover Kuhn's thought from beneath the statue of the legendary figure, providing a reading that remedies sketchy or 'skewed' views by reaching beyond the most well-known of Kuhn's works: *The Structure of Scientific Revolutions*. They also aim to bring focus back to Kuhn's later historical works but also de-emphasising the importance of historicity, recovering a supposedly more valid interpretation of his work by bringing attention to a 'neglected therapeutic aspect' (Sharrock and Read 2002: 201). This reconstruction aims to strike a conservative or at least very cautious balance between competing 'extremist' readings of Kuhn and reposition him as someone who tried to mediate between realism and relativism[42], thereby rendering what has been widely considered to be

[42] Although the philosophically meaningful oppositional pairing would be realism vs. idealism, I will keep mentioning realism vs. relativism. These two 'extremist' readings of Kuhn are the ones that tend to be contrasted, although the relativist side of argument could be more comprehensively summed up as containing a mixture of relativism, foundationalism and idealism.

the ‘enduring ambiguity of Kuhn’s thought’ (Peterson 1981: 16) more or less comprehensive, or at least philosophically defensible. Ambiguities are reconceived as ‘unresolved tensions’ that are not so much logical inconsistencies, but either understandable changes of emphasis throughout a life’s work or shifts of ‘metaphysics’ valuable in themselves as indications of the task’s complexity, underneath a constancy of purpose.

Sharrock and Read build on the earlier ‘middle-of-the-road’ book on Kuhn by Alexander Bird (2000), but otherwise mostly rely on strict HPS and philosophy material. Their interest too remains defensively philosophical, spanning issues of continuity of scientific knowledge, logical and cognitive attributes of paradigms and revolutions, and incommensurability, partially re-opening HPS debates around Popper, Lakatos, Carnap and Feyerabend, but going no further into sociology than discussing oblique (and retracted in the name of Kuhn (eg. ibid: 127)) extensions of Kuhn’s thought into the philosophy of the social sciences.

Their driving aim seems to be to firmly place Kuhn’s achievements back in philosophy, where they supposedly belong and re-confirm Kuhn’s legacy as a subtle negotiation of conservative and progressive elements. Kuhn is re-stated as a philosopher of science foremost who wanted to remain on terms with serious philosophers and avoid being identified with ‘historicising’ and ‘sociologising’ circles that perverted his intentions and contributed to misreadings (Sharrock and Read 2002: 201).

Despite identifying Kuhn's 'misreadings' with sociology, Sharrock and Read applaud Kuhn's social constructivist re-conceptualisation of science: Kuhn's model makes science 'real' by reconstituting scientists as social agents and does away with the idea of science as final adjudicator on 'truth', while retaining the momentum with science by pointing out that the question of the validity of claims to the nature of things is a scientific, not a philosophical one (ibid: 205). Although this appears to de-throne the positivist view of science and truth and thereby the kind of philosophy of science that closely predated Kuhn, it also abruptly bypasses any social scientific framework of investigation and sociological explanations and ultimately curls back into scientism. Sharrock and Read consider Kuhn's wondering into scientism and naturalism as a dangerous one, but only because it tricked him into believing that he belonged to science not philosophy, rather than because it led away from promising frameworks of thinking his social constructivist leanings pointed towards. Although scientism/naturalism is being interpreted as an unrealistic (and perhaps harmful) prescription on Kuhn's behalf for the social sciences as a way of reaching a paradigmatic, mature stage, there is little sense that it also helped to close down promising new ways of studying science from a non-scientistic, sociological, potentially critical point of view. The only conclusion readers get here is that social scientists have made too much of Kuhn and have done so at their own expense (ibid: 128-9; 137-9), and if their 'science' fails to become paradigmatic then no amount of striving will make it happen. From a sociological standpoint Sharrock and Read's criticism of Kuhn's scientism remains unhelpful in ascertaining his role within the Science Studies legacy. There is even a lingering background snickering: there is nothing more to be made here, sociologists fall on their faces and should return to small-scale ethnographic work depicting scientists and leave Kuhn to scientists and

non-critical HPS practitioners. This is highly problematic as Kuhn's scientism and internalism had an uncritical and negative effect on the sociological side of Science Studies. Kuhn in effect has hijacked the social constructivist subject material and has pulled the carpet from beneath the feet of sociologists of science. Cannibalising STS from the HPS side this way means that sociologists of science do not really have a field to return to where they can wait to reach a beneficial paradigmatic stage when they can finally talk to philosophers of science on the same footing. Kuhn in effect has sown the seeds for an unhealthy HPS-STS divide and for the failure in the field to advance a mutually constructive dialogue between the two sides. He effectively silenced the STS voice by appropriating its territory for an HPS agenda. This serves to keep Science Studies in its black box while the proposition that science can be captured in its everyday social activities pays lip service to the democratisation of science.

Sharrock and Read spend a fair bit of space on saving Kuhn from charges of relativism, both semantically and epistemologically, working over issues of how paradigms have been epistemologically constructed by Kuhn and also how incommensurability does not represent a prima facie case of relativism. Any charge of idealism is suppose to have no hold in this area either. Other commentators have repeatedly done all this treatment on Kuhn before, the only twist here seems to be that S&R want to start advancing the idea that Kuhn's scholarship had slight Kantian, Darwinian but also Wittgensteinian undertones. Kuhn's 'world changes' and the 'worlds' inherent in that Gestalt switch from paradigm to paradigm is seen by Sharrock & Read as an attempt on Kuhn's part to remain both a realist and an idealist, an unresolved tension in his inability to clearly assign philosophical

parameters to the 'phenomenal worlds' of scientists involved in the process (Sharrock and Read 2002: 178-9). Darwinism seems to creep into the picture when the epistemological status of an 'evolutionary (functional) niche' is understood to be neither entirely realist (its existence only comes about with agents constructing such meaning) nor idealist (such a construct exists as much as rocks do but in a different way), existing in the epistemological zone of 'assigned meaning' originating in interpretation (ibid: 191), just like that of paradigms. Sharrock & Read argue that Kuhn's 'worlds' are therefore phenomenal worlds, a niche themselves between scientific realism and idealism. 'The real point of the evolutionary analogy is to bridge the opposition between the 'object-sided' and 'subject-sided' worlds (ibid: 193)'. Interestingly, this Wittgensteinian interpretation of Kuhn strongly echoes the epistemological-ontological world of ANT, where subjects and objects (scientists, RNA molecules, genes and tubes for instance) are locked into networks in which they are all assigned the status of 'actors', creating a post-structural and post-humanist set-up.

More details come forth about this 'in-between' position when Sharrock & Read expand on Kuhn's proximity to realism. As a thinker without a 'transcendental point' in philosophy and with a framework in which no independent arbiter between incommensurate scientific paradigms is possible, Kuhn is sufficiently distanced from the realism of empirical positivism. But he is also clearly distinguishable from free-floating relativism by tying questions about science to the actual internal, technical workings of science and the practical rationality of scientists. Kuhn's internalism and scientism come together, forming a nexus that propels Kuhn towards a 'distrust of normative ambitions in the philosophy of science' (Sharrock and Read

2002: 201). This is a serious precedent that paves the way for both SSK and post-modernist theories such as ANT both of which regard normativity with open hostility and cannot comprehend that no scholarly orientation can proceed coherently without some normativity that underlies its knowledge claims. This may have been an unintended consequence on Kuhn's part, but that does not change the subsequent history of Science Studies theorising and its failure to settle the normative issues of the HPS-STS divide.

Sharrock & Read re-engage with the debate on whether Kuhn is a conservative or a radical at heart, but because they aim to reconstruct his legacy from his own writings and only look at contemporary HPS debates and only from Kuhn's vantage point, they end up saying nothing direct and comprehensive about Kuhn's enduring legacy, consciously or unconsciously bequeathed to Science Studies. Whether in the end Kuhn is thought of as a conservative or a radical (or beyond that dichotomy somehow) does not really matter. What does matter is the influence he had on the field of Science Studies, how the field absorbed his legacy. Sharrock & Read seem to want to have it both ways: Kuhn being a radical by reworking the conservative agenda from inside, a subtle subverter. The picture that emerges though is that of an accommodator and internal 're-worker', not a quintessentially progressive radical thinker. Kuhn does not end up subverting his own field and, although this is beyond the scope of Sharrock & Read, his work does not spark any obvious new development in the field of Science Studies today. The only supporting evidence from Sharrock & Read here is that they have none, which may be a highly meaningful absence from authors celebrating the meaningful subtlety of 'negative thinking'.

When discussing normativity Sharrock & Read take that expression in its mundane philosophy of science meaning, projected/attributed back into the subject matter of science. In this guise 'normativity' refers to everyday value judgments amongst scientists, the way Kuhn, and later SSK would take it to mean, that is scientists valuing 'accuracy, consistency, scope, simplicity, and fruitfulness (Musgrave 1983: 57)' within their work. Delimiting the meaning of normativity in this fashion is a convenient device in declaring no responsibility for having to engage with its 'intrusions' into the philosophical underpinnings of the practice of the inquirer and is directly related to a scientistic outlook as discussed earlier, in which 'normativity' is only an objectively observed phenomenon that forms part of scientific description, except in this case that observed phenomenon happens to encompass scientists. At best, such 'normativity' is translated back into a prescriptive device in which Kuhn is thought to be endorsing scientists' own norms as values worth preserving (Musgrave 1983: 58) and that props up the view that the political model most closely related to Kuhn's ideas is one that promotes scientific self-governance. However, Sharrock & Read do actually discuss the idea of 'science in a free society' and possible 'prescriptions' for science. This is the 'externalist' approach to the issue of normativity, the way internalist HPS conceives of the question of societal normativity and the issue of Science Studies or sociology of science engaging with that normativity within its research into science. Sharrock & Read bring up Popper and Feyerabend as contemporaries of Kuhn 'preferring to prescribe' (Sharrock and Read 2002: 110) how science supposed to operate. These two HPS theorists are berated for taking Kuhn's 'normal science' as an authoritarian and dogmatic prescription of how science should operate; they misunderstand Kuhn, who in fact is only trying to advance a strictly descriptive view. But Sharrock & Read risk

misunderstanding Popper and Feyerabend in turn themselves, taking their 'prescriptive' view to amount to an overhaul of the internal workings of science, rather than also conceiving of it as a challenge to the way science is governed and run within its context. So normativity is again lost in the internal details. Normal science is crowned as Kuhn's major subversively radical achievement: the most mundane, practical everyday working of science. In this, one could say Sharrock & Read are at one with SSK and ANT, and generally with post-structuralist and postmodernist studies of science: the really 'radical' aspects are to be found in the most un-radical looking details; to engage with and get lost in the details of these mundane occurrences is the most radical move. Unfortunately, the same move ensures that wider contextual and political connections remain unexamined.

Sharrock & Read's review of Kuhn's thought is mildly critical and elaborates more than explores. Their evaluation is mostly sympathetic to Kuhn and attempts to 'normalise' his legacy. This is a mistake as Kuhn had an overall negative and uncritical effect on the field of Science Studies. As I have shown in this chapter Kuhn's scientism and internalism have contributed to the colonisation of the sociological side and the pre-empting of critical social constructivist direction as can be see from his legacy in SSK and ANT. However, Sharrock & Read confirm some crucial characteristics of Kuhn's overall thought: its leaning to scientism, a very pronounced internalism both in description of and prescription for science and its practices, and a systematic locking out of 'normativity' from the critique of science as part of society. Unfortunately these confirmations only support the argument that Kuhn's overall effect on the field is a damaging one. The HPS-STS divide may be

much healthier and more productive today if it was not for the decidedly uncritical effects of the scholarship of Kuhn.

## Problematising the legacy: Fuller's critique

Steve Fuller's re-appraisal of Kuhn's legacy has been a strong feature of recent Science Studies: he published numerous articles on Kuhn and the effects of his scholarship in journals of HPS and STS, especially throughout the 1990s, then his major tome on Kuhn appeared in 2000, followed by more articles, symposia and general scholarly debate riding the waves unleashed by Fuller's controversial views. Fuller's work on Kuhn's legacy is extensive, assertive and highly critical. But what does it actually say about that legacy and where does it go with the gained insights?

Fuller's critique is not only one of the most recent ones based on an elaborate study of Kuhn's work, it is also one of the most elaborately critical (Rouse (2003: 101). Fuller also provides the richest socially contextualised map of details both for historically reconstructing Kuhn and his work and tracing his legacy within a wider theoretical stream of thought relevant for Science Studies (as well as for HPS, STS separately, science policy, activism and so on, demonstrating the breadth of Fuller's scholarship). Fuller is exhaustively reviewing positive effects attributed to Kuhn: his uniqueness and nuances in scholarly contribution, his special role and radical edge and he ends up critiquing Kuhn as well as his reception and heritage.

Fuller consciously espouses social constructivism when studying Kuhn in his own context. If Kuhn is considered as a social constructivist then this move by Fuller could be considered as a move to 'hoist Kuhn with his own petard'. In a more benign formulation Fuller can be said to apply immanent critique to Kuhn's own conceptual framework.

In 'Thomas Kuhn – a philosophical history for our times' Fuller presents Kuhn as a character who is deeply embedded in his social-historical context and can be studied for insights into how his legacy enabled the closure of the academic space in Science Studies and thereby prevented the development of a common dialogue about the ends and means of science (2000: 8). Fuller expertly traces Kuhn's contribution to an 'uncritical turn' in Science Studies, a turn which can be seen from the later succession of uncritical theories that are anti-sociological and shun normativity.

Fuller ambitiously locates Kuhn not only within the history of HPS, but also within the science establishment of the Cold War via its popularising connections to university curricula and funding, and sketches connections within Western philosophy as a whole. It is in relation to the preceding history of HPS that Kuhn is habitually credited with the bringing in of historicism and more controversially with an anti-positivist stance. Fuller rebuts Kuhn's crediting with both 'benign historicism' and anti-positivism. On the basis of a remarkably wide and varied list of direct and circumstantial evidence Fuller argues that Kuhn was a convenient vehicle for some philosophers of science (Dudley Shapere foremost) who wanted to abdicate positivism but without wanting to appear doing so, as he could be made into the new successful 'anti-positivist'. Kuhn's demonstrated closeness to Rudolph

Carnap, one of the Vienna Circle, certainly seems to contradict an anti-positivist stance and his deliberate attempts to leave an impression that he was influenced by positivists reinforces the idea that he was more a continuation of that legacy than a disavower (Fuller 1992, 2000)[43]. This would have to be understood partly as a criticism of what was happening around Kuhn, not just by Kuhn, the first such criticism by Fuller followed by a whole series of such often pointing to Kuhn as much as a pawn than as a faulty player.

Historicism, according to Fuller, was not a serious contender for scholarly attention in HPS until the publication of the famous Lakatos and Musgrave edited volume of 'Criticism and the Growth of Knowledge' as proceedings to the 1965 International HPS Symposium (1970). Although this meeting was to be devoted to Popperian thought, Kuhn 'stole the show' with his contribution to a Popper Festschrift after which all major contributors rewrote their papers accordingly; Kuhn has become a 'Trojan Horse' (Fuller 1992: 246). So Fuller credits Kuhn with less on his own than customary and posits that he was more a conservative than a radical, although one who was 'at the right place, at the right time'.

The actual content of Kuhn's historical account is also criticised by Fuller for repeating the official historiography of science in enlisting a succession of famous trailblazers as providers of ignition to scientific revolutions, in effect glorifying innovation to the detriment of focus on background development and knowledge diffusion (Fuller 2000b: 9)[44]. In endorsing and fuelling the official hagiographic

[43] Rouse (2003: 101& 119) refers to another 3 scholarly works that emphasize this continuity and/or collect examples of other works doing the same: Earman (1993) analyses connections between Kuhn and Carnap, Giere and Richardson (1996) and Friedman (1999) compile works on logical empiricism that can be used to study similar connections between Kuhn and his logical empiricist predecessors.
[44] Fuller claims these other more nebulous characteristics have been picked up by historians of science since, while a continued fixation on creative 'geniuses' in STS has lead to distortions in

impulse of science, Kuhn then allegedly actively contributed to the uncritical popularisation of science within Academia. Fuller shows how Kuhn's mentor, James Bryant Conant, president of Harvard University where Kuhn was working, was chanelling establishment dictates to him to strengthen the image and standing of science after scientific controversies such as the atomic bomb. The context of Kuhn's work therefore matters a great deal: the US of the 1950s was characterised by the officially directed financial and strategic intertwining of science, industry and the military; the growing professionalisation and institutional consolidation of science accompanying exploding military research and investment, and the strengthening of universities as a crucial linchpin in the 'triple helix' of state-industry-university (ibid.: 106-7). Kuhn is shown to have taken Conant's challenge to bend science education to establishment needs. He is shown up for not only giving a helping hand to an uncritical usage of his position and expertise but also for relinquishing reflexivity arising out of a self-application of his own social constructivist and historicist tenets in doing so, making him not only a politically compromised scholar but also an essentially bad one who fails his own test.

Fuller turns the tables: the portrayal of Kuhn's *Structure* as a milestone in establishing historicism in HPS is erased and now it stands as a work that slayed a genuine historicist impulse (Fuller 2000b: 13). Kuhn now appears as an uncritical science populariser, a lackey of higher interest, a conservative and with all its contextual circumstances and resulting effects *Structure* is now treated as an exemplary Cold War document (ibid.: 5) displaying its mentality and what is worse, serving its ideological purposes.

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scholarship. In this vain, the new 'discipline' of innovation studies could be considered an extension of that skewed focus, exemplifying a striving continuation of the Kuhnian legacy.

Although such contentious insights into the socially constructed nature of Kuhn's life and work may be useful, Fuller seems to freely mix polemics with scholarly argument while showering Kuhn with a myriad criticisms. This may well serve the purposes of radically and comprehensively reconstructing the standard evaluation of Kuhn, even more of the purpose of an outright 'war' with the influence of Kuhn's legacy, but it at least distracts from Fuller's most important central thesis: Kuhn has contributed to a closure rather than an opening of critical possibilities within Science Studies, pushing scholarly work away from engagement with political issues vis-à-vis science.

Fuller doesn't so much show how Kuhn is strongly implicated in developing uncritical directions and trends (although if Fuller's rhetoric is fully accepted, then he IS implicated), but rather articulates in details how uncritical directions function to pre-empt wider critical questions of accountability, responsibility and masking of relationships of interest, and how Kuhn's works do nothing to either allay such an uncritical direction or help in any way to spawn critical insights. But there are good arguments in Fuller (1992) as to how Kuhn was not just a neutral by-stander oblivious to wider democratic or moral imperatives or undecided as to which way his own judgment would sway him. There is some evidence that important undercurrents in Kuhn's teaching were influenced by growing criticism towards science and that he actively wanted to influence the way science was viewed and 'managed', giving it more independence without outside accountability and freedom from legitimate scrutiny. This way, even though some of Fuller's contentions either weaken each other or become 'too much protest' without very solid evidence, his

fuller excavation of underlying connections make it highly plausible that Kuhn and his work were more of an active hindrance to progressive, open and critical approaches and directions in both HPS and STS than a contribution to them. Kuhn's dogged unresponsiveness to calls for clarification and refusal to either distance himself from conservative and ideological interpretations of his thought or embrace any normatively based developments offered up for comment, all seem to circumstantially support Fuller's claims. On the other hand, if Fuller's claims are somehow all false, then Kuhn must have been an extremely unresponsive pawn in someone else's game, which is probably an even less appealing picture to entertain and throws up all kinds of further questions that when answered according to evidence in Fuller (1992, 2000 etc.) will end up posing Kuhn in very similar light: as a key characted in the development of HPS and Science Studies who consciously or unwittingly, to a larger or smaller degree, contributed to the closure of critical directions and definitively did nothing to help steer that trajectory towards more critical engagement.

Two undeclared conceptual tools helped Kuhn achieve this closure (or lack of opening) and they also contributed to an easy popularisation of what Fuller calls his 'didactic macrohistory of science'. These two perhaps partially contradictory 'achievements' were his extreme universalisation and extreme relativisation. By describing the scientific process as 'essentially the same whenever and wherever it occurs' (Fuller 1992: 273) Kuhn universalises scientific phenomena (and perhaps does a disservice to history of science which seeks to understand the regional and local variations in phenomena). Relativisation occurs between paradigmatic historical periods that remain incommensurate to each other. While Kuhn has

seemingly liberated the field by erasing the idea of a monolithic progress through scientific change in time, instead he has instituted a relativistic universe with no benchmark criteria for judgments or decisions pertaining to phenomena in different paradigmatic periods which are relative to each other. Even if relativism within Kuhn's 'universe' does not rule supreme, it is an important aspect that can be evoked in isolation from other contradictory aspects, and it is also one that Fuller claims SSK has inherited (Fuller 1992: 273). Perhaps Kuhn's interdisciplinary standing obscures the contradiction, but epistemologically it is hard to defend both directions at once. On the other hand, such a double-sided epistemological stance could prove politically very useful and also help popularise Kuhn's legacy to different disciplines in different guises. What it does not facilitate is the development of a view of science that compels STSers to ask critical questions about interest, transparency, responsibility and accountability.

Another important aspect of Kuhn's work helps keep the investigator's gaze on internal matters cognitively separated from 'external' concerns, and that is an overriding internalism inherited from early 20$^{th}$ century philosophy of science. This stance proclaims an abiding lack of interest in issues and perspectives not originating from within scientific work in studying and accounting for science. They may be studied as such, but their effect will remain at best neutral, and at worst 'interference' with pure scientific reality. So while Kuhn is allowing group processes, in effect social psychology, to enter the sphere of paradigm-shaping, his social constructivism is effectively disallowed to enter the inner sanctum of science: the formation of actual knowledge, where rationality has to remain the prevailing force without which realism may start slipping away. There are obvious

philosophical contradictions here and a large chunk of Kuhn's legacy is about the painstaking re-examination of cognitivist resolution strategies between these, effectively retaining a large part of Kuhn's thought to pure logic and internalist philosophy of science, possibly demonstrating just how much affinity Kuhn's work retained with this branch. Although in the process of opening up philosophy of science towards the history and sociology of science, ie. starting to occupy the interdisciplinary space of STS, Kuhn does start viewing scientists as social beings, he is also adamant on holding onto an internalist, even cognitivist view of science that separates out 'external' phenomena as not relevant to the study of scientific work proper. In this universe scientists have become humanised (and this is applauded), but more critical sociological and political questions are as impossible (or meaningless) to pose as before.

Methodological and epistemological internalism in turn reinforce political boundaries too: internalist questions become the legitimate questions for scholarly engagement, but in this process they become proscriptive politically too and delineate what questions ought to be asked and what the field of 'reference' should be. In this regard internalism is not just a neutral scholarly choice, but also a potentially political one with real-life implications to the way science is organised, funded and directed, sustaining effects well beyond the everyday internal life of scientists[45]. The study and governance of science are linked through conceptual underpinnings and claims to unawareness of this could hardly exempt scholars from

[45] Interestingly Popper and his followers have picked up on the 'closure' within Kuhn, detecting logical positivist undertones in 'normal science' (Fuller 1992: 246). They objected to the conceptual delimiting of science as a critical enterprise (and an 'open society') to the brief periods of 'revolutionary science' (ibid). This picture of science seemed to work towards fashioning science according to a 'closed inquiry' not an open one and therefore fostering a 'closed political model' of science.

related responsibility, just like lack of awareness would not exempt participants from the actual effects of the governance of science.

The critical and genuinely 'anti-hegemonic' thesis within Fuller's judgment of Kuhn's legacy points to outside of Kuhn too while not letting go of him as a potential culprit: the course of the development of Science Studies has assumed a very uncritical route that can only partly be attributed to Kuhn's legacy; that science policy making was effected by Kuhn's ideas and as a consequence shifted from a normative-based to a more evaluation-centred approach; and that Kuhn's internalist-cognitivist approach, although may have fitted in with contemporary philosophy of science very well, has spilled over to Science Studies and strengthened an internalist trend that until today fails to meaningfully engage with 'external' non-cognitivist issues. In this regard Kuhn may not be the 'single-handed' influence to peg a pivotal turning-point on within a grand historical reconstruction of the closure of STS theorising, but it would be equally hard to relinquish the idea that having gained influence he did not bear responsibility to his own legacy that failed to develop a critical dimension.

# Chapter 6

# Critical Theory of technology: Andrew Feenberg

## The necessity of Critical Theory

Analysis of Kuhn's effects on the field of Science Studies has shown that his overall legacy is a negative one for the field. Although his theory has opened up the field to the possibility of using social constructivism this is dwarfed by his negative influence on the trajectory of the field as a whole. Kuhn promoted scientism and the notion that mature fields operate with one paradigm only and this greatly helped to suppress the sociological impulse in Science Studies. He pushed for a descriptivist and internalist approach to the study of science, ignored calls for critical scholarship and strongly contributed to the colonisation of STS by HPS. Overall his scholarship is part of a long lineage of theories that stretch to SSK and ANT today, one that created the imbalance, the confusion and the political divisiveness in Science Studies that endures until today.

I worked 'backwards' through Science Studies theories, through SSK and ANT, Science Wars and finally to Kuhn, in my search for the elusive opening for critical possibilities. None of these approaches have been able to capture and understand the full spectrum of descriptions of the cultural values of science and technology that is offered by HPS and STS, and none of them have been able to point a way forward to

the field. Because of this I was left with the task of reaching to those parts of Critical Theory proper that the majority of STS scholarship continues to ignore. It is with the work of Andrew Feenberg and Jürgen Habermas that I have finally found the critical scholarly energy that a renewed Science Studies so badly needs. Their approaches have not yet been brought together for the benefit of a wider Science Studies and doing this will help enrich the field and rectify the theoretical problems that have been plaguing it for too long.

In these last two chapters, I will turn my attention towards two important theoretical threads in critical sociology of science and technology that are able to bring theoretical clarity to the study of both science and technology as interrelated yet culturally different practices. First I will look at the work of Andrew Feenberg who has established a solid line of research in the Critical Theory of technology and whose work has the potential to re-invigorate a critical line of STS research.

In Chapter 7 I will turn to the work of Jürgen Habermas who has established a critical theory of science that could pave the way for a future HPS that actively stays in dialogue with STS, rather than colonising it or suppressing it. Together, Feenberg's and Habermas's work represent a critical direction that covers both science and technology, yet they end up offering differing analyses in response to their separate subject matter: Feenberg's scholarly values remain closer to that of sociology and his scholarship remains on the STS side, while Habermas uses more philosophical tools that place him in HPS. They both offer up a strong and viable social constructivism that places science and technology within society and

normatively situates them as the subject of a wider societal scrutiny and democratic oversight.

Both theorists operate with a Critical Theory framework that takes as its task the development of an emancipatory understanding of science and technology. Critical Theory was originally a Marxist-oriented research institute in Germany that developed a multidisciplinary research project and set out to 'construct a systematic, comprehensive social theory that can confront the key social and political problems of the day' (Kellner 1989: 1). Critical Theory provides criticisms and alternatives to more traditional social theories and is motivated by an interest to relate theory to politics (ibid.).

Related to these commitments is Critical Theory's strong investment in an emancipatory interest which underpins the theories of both Feenberg and Habermas. Emancipatory interest is born out of an impulse to reflect on our self-understanding, human potential and individual/collective autonomy (Benton & Craib 2001: 114). It aims at liberating human beings from relations of force, from previously unrecognised constraints and dependence on powers (Bohman 1999: 57). In a Critical Theory inspired Science Studies this emancipatory interest can be expressed at two important levels: an expression of human emancipatory interest in relation to science and technology, and the summoning up of emancipatory interest in order to bring the whole field of Science Studies into a higher level of self-understanding. The first of these guarantees that a Critical Theory of science and technology would serve a wider democratic interest in reflecting on the autonomy of science, on societal interests as they manifest or could manifest in science and technology, on

the hitherto uncovered constraints that prevent this from happening and the deliberate exploration of future technological alternatives. The second, the expression of emancipatory interest in the field itself shows the commitment of Critical Theory to the project of reflexively transforming the self-understanding of Science Studies.

The theories of Feenberg and Habermas share a common framework of understanding of the values and commitments of a Critical Theory oriented Science Studies, and of the need to understand and capture science and technology in their social setting. They also share the understanding that science and technology need to be studied in terms of a full spectrum of human values, that the distinct approaches of philosophy and sociology of science are complementary and that they need to establish a dialogue. This shared understanding provides the basis for an HPS-STS dialogue, yet the two theorists also offer different interpretations of their differing subject matter: Feenberg's theory captures the social values of technology and how these values can be unmasked and strategically negotiated, while Habermas's theory understands science in terms of the basic human interests vested in its internal processes and provides an understanding of both science and technology in terms of the balance of human interests within societal subsystems, of which science and technology are one. These distinct evaluations of the cultural values of science prevent Feenberg and Habermas from collapsing into each other's methods and framework. Together they form a strong and balanced mix of scholarship and emancipatory insight that could bring back the scholarly balance and critical dialogue the field of Science Studies badly needs.

The work of Andrew Feenberg is a formidable contribution towards this aim in the area of Critical Theory of technology, providing a rich set of conceptual resources and theoretical strategies subversively connected through a strong commitment to the progressive humanist values of Critical Theory. These humanist values are human dignity, autonomy, freedom, rationality, ethics, commitment to better self-understanding, to democracy and the open exploration of better alternative human futures (Herrick 2005).

## Critical Theory of technology

Feenberg's critical theory of technology rests on a strong original commitment to Critical Theory itself, rather than just a tangential interest developed from a preoccupation with technology alone. This makes his hold on critical ideas much stronger and more comprehensive than most others' working in Science Studies. In analysing the main characteristics and interrelated components of his project I want to see what makes his approach so attractive, in fact necessary for the study of technology, and a cut above STS theorising discussed so far. I also aim to show what kind of critical STS research programmes his ideas can foster and the potent actual real-life promises these harbour, making his approach at once a re-negotiation of social theorising about technology and a practical-pragmatic extension of theorising into the real world. This double-sided nature of his work in effect closely corresponds to the theory-praxis connection in Critical Theory proper which stipulates the importance of this basic link from theory to practice.

In the second half of this chapter I will discuss the similarities and differences with Habermas's theory of science. I will show the theoretical common ground between Feenberg and Habermas as well as the important differences. It is on the basis of these shared theoretical values and scholarly philosophy that the STS-HPS dialogue can be renewed and maintained. On the other hand, it is their essential differences in studying their differing subject matter, technology and science that safeguard the scholarly balance between STS and HPS in this Critical Theory framework and ensure that neither of them is again going to attempt to subsume the other.

## Feenberg's scholarly context and the development of his theory

Feenberg is very aware of his own position in a wider theoretical (also political and historical) context and what distinguishes his approach from others, including cultural studies of science, ANT, instrumental policy analysis etc. The main distinction he draws involves instrumental and substantive theories of technology (Feenberg 2002: 5-8). The former views technology as a neutral tool unconnected to values of any sort and considers it a vehicle for efficiency, and therefore to reside in the realm of pure instrumentality. Traditional policy analysis operates within this understanding. Substantive theories, on the other hand, assign more-or-less fixed pre-given values to technology that end up becoming a way of life eventually dehumanising its users. For Feenberg, the latter is fatalistic and incapable of defending its moral viewpoint because the only solution it can advocate is a full-scale withdrawal from technology. The former, instrumentalist view, on the other

hand, leaves no space for values or ethical considerations. What is missing from both is the progressive transformative view of relationship with technology in which it's neither an oppressor nor a mere value-free tool, where human agency is not reduced to simple choices of uncritical acceptance versus outright rejection and it becomes possible to engage with technology in a more complex way. There is space between high spiritual hopes and one-dimensional practicality, between theory and practice, determinism and random contingency, and also beyond positivist rationality and post-Enlightenment diffusion: a space for Critical Theory. In the field of Science Studies this is a rather special space that has not been treaded much; the vast majority of STS scholarship operates beyond its edges.

Feenberg has been working towards defining that space for the study and critique of technology for more than two decades now. However, as I have been considering theories of the whole field of STS in my thesis and want to extend Critical Theory insights to the study of science as well, the issue of how to extend or connect Feenberg's analysis to this area inevitably comes up. But before arriving to the task of evaluation for STS I need to present his ideas for discussion. I will start with the wealth of philosophical resources that Feenberg brings to the task of forming a Critical Theory of technology.

Perhaps the deepest moral philosophical resource is embodied in the concept of human potentialities that informs Feenberg's critical view of technology: the realm of the yet-unrealised that could extend the possibilities of humanity while ideally underpinning its perhaps so far unfulfilled transcendental needs. Critical Theory's emancipatory imperative impels Feenberg to locate his Critical Theory of

technology 'between resignation and Utopia', beyond the aggregate binds identified with the substantive and the instrumental views. Resignation is avoided by rejecting a technologically determinist position that squeezes out human agency and leaves no hope rooted in the realisation of human capacities. Utopia remains an unattainable ideal of a perfect social world, the ultimate unfurling of unrealized potentialities that can act as a yardstick for measuring achievement and also a basis for aspiration. In-between spreads the conceptual space for human potentialities and of emancipation, both being intimately tied to a humanist vision informing a Critical Theory outlook.

Another equally strong circle of ideas in Critical Theory comes directly from Marxism proper: an unwavering commitment to progressive social theory[46] operating with the tools of radical critique[47], anchored in normativity and pointing towards democratisation as its practical logical extension. These are directly connected to the former notions of emancipation and potentialities: the whole raison d'être of radical critique is derived from human emancipation while human potentialities form the limits of normativity (extending as far as the full spectrum of societal interests allows), both being cornerstones of any democratic setup. The task of radical social theory is partially based on Marx and one of its most important subtasks is the unmasking of interests assumed to be operating, in this case, behind technical imperatives (Feenberg 2002: 37). However, for Feenberg, as for the present generation(s) of Critical Theorists, the ultimate goal does not extend to a revolu-tionary overthrowing of the whole social order, rather the aim is to instigate

[46] I use the word 'progressive' here in the sense of favouring and promoting human advancement and pushing for progress in human conditions generally.
[47] It is radical in the sense of being highly critical and in the sense of advocating for strong and possibly extensive social change.

for an inner transformation of existing social orders towards general human emancipation inside democratic societies.

Beyond unmasking of actual presentations of ideology Feenberg theorises for many constructive real life strategies: alternative pathways of democratisation from direct electoral interventions in technological decision making to the contestation of technical order through the progressive democratization of public technical institutions (Feenberg 1999b: 140-7).

Feenberg examines the failings of the Marxist tradition of thought and considers carefully what elements he can retain for the critique and politicisation of technology. While he finds merit in Marcuse's theory of a one-dimensional society and Foucault's critique of technological rationality he also notes that neither of them managed to develop a viable alternative vision for society. However, if the whole picture of Critical Theory and technology had such simplistic failures at its heart there would be little sense in re-examining it again and again for deeper insights. Fortunately the unfolding picture is more intricate and intriguing and the project of the Frankfurt School remains relevant. This is because theorists of Critical Theory amongst them have captured such important conceptual constellations of analysis (if not philosophical 'constants') underlying technology that make their insights indispensable for any critical re-examination of technology.

Feenberg goes back to an analysis of Marx's writings to grapple with the conceptual sites for a critique of technology. He lines up 3 such possibilities: in the process of working with technology, in the details of its application and in the design process.

All 3 seem to be viable at first, but descending into the abstract details of logic and design seems to be most amenable to yielding useful insights in the Critical Theory vein. The reason for this is that deeper critical issues emerge here about means and ends, implicit and explicit qualities associated with the workings of technology; not just issues of sheer efficiency and pragmatics of different technical configurations of divisions of labour, but also underlying interests and power relations.

Feenberg turns to conceive of an instrumentalist theory of technology, but finds that the act of critiquing an instrumentalist technological setup can lead to the use of instrumental categories, turning intended transformation into a mere paradox. He wants to propel Critical Theory beyond this traditional Marxist contradiction (Feenberg 2002: 63) that he sees reflected in both the impossibility of top-down 'post-industrial' management techniques for the creation of real social transformation and similarly pseudo-transformative efforts in authoritarian socialism. It is Feenberg's commitment to the Critical Theory idea of translating theoretical insights into potential practical recommendations and thereby meaningfully contributing to a progressive politics that compels him to find alternatives for technological transformation.

Marx's substantive theory of technology is deemed to offer insufficient conceptual space for redemption, unless the third site for a critique of technology is developed: the design critique, in which values are not rigidly embodied in technology independently of context, but connect particular technological design and social hegemony. Marcuse and Foucault prove relevant here: 'They treated technology as an expression of the historical development of the dominant paradigm of rationality,

and re-conceptualised social conflict as the result of internal tensions in that paradigm (Feenberg 2002: 64)'. Both theorists are found inadequate, but good starting points.

In Marcuse the prevailing technology is not free of social values, the underlying rationality is amenable to critique as it 'constitutes the basis for elite control of society' (Feenberg 2002: 66) by codifying unequal social relations in its logic of operation. The supposedly value-neutral concept of efficiency, when applied with unarticulated and suppressed background assumptions such as worker resistance in the face of unequal ownership structures, becomes ideological in its application, linking supposedly neutral technological rationality with private interest. 'These interests are overlooked because they are not expressed through orders or commands, but are technically embodied, for example, in apparently neutral management rules or technical designs (ibid: 66)'. In Marcuse's one-dimensional society technological rationality becomes a legitimating force for social domination and part of a 'neutral' discourse that underpins everyday problem definition, invisibly embodying a dominant function. Ideological saturation squeezes critical consciousness out of existence, or at least to the very margins of society, diminishing the resources even for utopian thinking. *One Dimensional Man* closes with the vision of destructive politics riding on the back of technological rationality, a 'catastrophe of liberation' (Marcuse 1974). The only meaningful alternative seems to lead through a transcendence of the existing limits of technological rationality to a stage where 'scientific project itself would be free for trans-utilitarian ends, and free for the "art of living" beyond the necessities and luxuries of domination. In other words, the completion of the technological reality would be not only the

prerequisite, but also the rationale for transcending the technological society' (Marcuse 1974: 181). There is a dystopian closing of the horizon of technological development but paradoxically it's the very rationality underpinning its existence that may propel it towards a decisive qualitative change.

Even though Foucault's work lacks this dialectical quality of Marcuse's it too provides some similar points of reference for technologically oriented rationality but conceived in a post-structural framework. His thought attracts great interest within sociology, cultural studies and surrounding disciplines in recent years and therefore its details are well-known in these circles. Yet it may still be worthwhile to recapture some relevant aspects here. Foucault draws attention to pervasive practices based on institutionalised forms of rationality through which power and control is organized, exercised and legitimated. His examples span wide and include measurement, examination, surveillance, discipline in settings such as schools, prisons, factories, armies, hospitals and so on. There are technological innovations and tools implicated in each, many specifically developed or altered for the specific institution and its 'rational' practices. In each instance special forms of knowledge, technology and social control come together at the point where power is exercised. 'Truth' has no independence from power and knowledge and is embodied in the normalising regimes made up of rationalised chains of practices. Where the objects of these investigations and control are human beings there is no social neutrality.

> […] power/knowledge is a web of social forces and tensions in which everyone is caught as both subject and object. This web is constructed around techniques, some of them

> materialized in machines, architecture or other devices, others embodied in standardized forms of behaviour that do not so much coerce and suppress the individuals as guide them toward the most productive use of their bodies. […] On this account, technology is just one among many similar mechanisms of social control, all based on pretensions to neutral knowledge, all having asymmetrical effects on social power. This explains why the social imperatives of capitalism are experienced as technical constraints rather than as political coercion (Feenberg 2002: 68-69).

For Foucault the spaces of resistance lie within an individual's subversive capacity, but as in Marcuse there is little sense that these could ever have an impact beyond the marginal. Activating identity-based politics that primarily involve the personal sphere may bring back agency (or a sense of agency) into the personal sphere but it does so 'at a level that leaves technocratic structures untouched' (Feenberg 1999a: 3). And when Foucault so devastatingly demystified knowledge, power and technology, there is little redeeming validity left in them that could be harnessed for imagining and building viable social alternatives.

# Subversive rationalisation and the technical code

Marcuse and Foucault both give rather closed and dystopian accounts of technology and therefore are unable to offer an alternative path to redemption or a democratic transformation of technology. But Feenberg sees a double opening for effective change and the kernel of this partly lies within the work of Marcuse. Firstly, a conceptual loophole emerges within the plurality of forms of rationality making a critical alternative rationality at least theoretically viable. The second is a more directly tangible opening and concerns the underdetermination or ambivalence of technology that opens up the possibility of social change through technological change. The first conceptual move gives rise to the idea of subversive rationalisation while the second one harnesses social constructivism for the practical emancipatory project of Critical Theory and develops the idea of the technical code. Together they represent the most powerful kernel of Feenberg's theory put into work in the interest of a democratic society in which technology operates.

The first of these draws on the idea that rationality is neither monolithic nor unequivocally negative in its ultimate consequences. When seeking alternatives to one type of technological rationality that may be strongly linked to a negative definition or social outcome there are other options apart from irrationality or lack of rationality. Feenberg develops the idea of a subversive rationalisation that does not seek to erase technology's inherent rationality, but wants to reconfigure it and put it to new uses and aims. This way technology can be redefined and invested with new values strengthening rather than weakening overall human freedom.

Feenberg traces the negative all-encompassing concept of rationality to Weber's theory of rationalisation. In this framework modernity is best characterised by the continuous extension of calculation and control in social life eventually leading to the 'iron cage' of bureaucracy, a scenario in which human beings are enslaved by the rational order of bureaucracy and become objects of technical control. This oppressive 'iron cage' turns industrial democracy into a dystopian setting. The process of modernisation is described as a shift from substantive rationality that posits a positive value first and only then finds means to achieve it with, to formal rationality that is value neutral but demonstrates the rationality of means in a supreme form (Feenberg 1999a: 2). Weber's scheme envisages the latter prevailing, a tyranny of more and more rational means that becomes institutionalised in markets and bureaucracies. The pursuit of values gives way to the primary preoccupation with means that in turn become the goal in itself. This is a thoroughly dystopian picture in which technical means drown out the Enlightenment values of freedom, autonomy, ethics and the possibility of progressive transformation.

If this wasn't enough Heidegger shifts the focus squarely onto technology which now becomes the crystallisation of efficiency. Feenberg finds that Weber's pessimism sinks to a new nadir: 'Heidegger argues that reality is fundamentally restructured by this technoscience in a way that strips it completely of its intrinsic potentialities and exposes it to domination in service to subjective ends. The overall effect of this process is to destroy both man and nature. A world "enframed" by technology is radically alien and hostile' (Feenberg 1999a: 2). On the one hand technology is an empty shell that can be easily put to ideological means, on the other

it is a de-humanising force in itself turning humans into raw material devoid of any special significance: a material and immaterial destruction in one.

For Feenberg both Heidegger and Weber[48] have walked down the garden path of assuming technology to be both neutral and autonomous, losing sight of its social creation materially, socially and philosophically, that gives technology its material shape, its social application, distribution and organisation and also its meaning. These dystopian modernist theories of technology have at least one major deficiency: they leave no space for constructive engagement, any logical conclusion from their assumptions would have to lead to an escape back into pre-modernity, spiritual renewal or hopeless despair. The usual instrumentally rational alternative given to such dystopian theorising leads back through the value neutrality and autonomy of technology again, simply accepting technological rationalisation without change, most often leading to technological determinism and an uncritical acceptance of existing technology and the way it is socially arranged.

Here comes the second opening in Feenberg's work inspired by social constructivist ideas. The only way out of the above predicament is by facing up to the conclusion that technology has no true independence of the social world and is socially constructed at every level. Numerous empirically based STS studies in the last 30 years have shown the effects of social constructedness in the path of technology development (especially Bijker et al (eds) 1987, Bijker & Law (eds) 1992, and Bijker (ed) 1997)[49]. Feenberg's scheme shows the real edge of 'critical

[48] One could also add the quintessentially dystopian theorist, Jacques Ellul.
[49] Pinch and Bijker, constructivist sociologists of technology, are cited more than any other in Feenberg's work. Their empirically and historically grounded illustrations of the social

constructivism' in what it can achieve conceptually and in reality[50]. Critical constructivism refers to a type of analysis and critique that does not have to stop at the more traditional level of only considering the social costructedness of technology at the stage of implemen-tation. Although the critique of technology can be very valuable on this level too, it can also be made to penetrate deeper, right into the design process. This is exactly what 'design critique' does as it is a tool for inquiring into the values and interests that have shaped the 'realization of technical principles' (Feenberg 1996: 2), whether these interests be market-oriented or related to the power of a specific social group. This is most definitely not a deconstructionist exercise, although to a certain extent this teasing apart of analytic layers may be seen to share an element with decon-structivism inasmuch as it involves the demystification of the constructedness of its subject. But what Feenberg is really interested in is not so much riding out the power trip of analytic demolition for its own sake. He aims to tease out the values and norms 'objectified' in devices and technologically mediated practices in order to gain conceptual access to these sites of 'bias' and learn to appropriate them for other non-hegemonic interests capable of serving a larger segment of society. In Feenberg's understanding such a critique is complementary to the critique of rationality and the two can be employed together for a more complete critical analysis of any piece of technology (Feenberg 1996: 12).

Feenberg's normative constructivist analysis probes right into the very heart of technology and exerts its potential emancipatory force in the normatively shaped

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constructedness of technology are widely valued and well-known in at least STS and HPS circles (one such reference in Feenberg is 1995: 7).

[50] 'Critical constructivism' is Feenberg's terminological reconfiguration of social constructionism, assumedly to differentiate it from relativist versions of constructionism.

conceptual core of it: the technical code. The technical code is therefore the site within technology where power and knowledge come together to form a potent, but also mostly invisible, kernel. This kernel configures the roles, possibilities and general functioning of the final piece of technology, normatively animating its actions and shaping its possible uses. A critical theory of technology has the task of identifying this technical code and making this visible. The aim is not to deconstruct technology as postmodern approaches have done so, or to eliminate it as techno-phobic theories might have it or as interpretations of Marcuse may suggest. The Critical Theory aim of Feenberg's analysis is to identify this technical code which then can be collectively manipulated, renewed, altered or redirected, or otherwise appropriated for so far unrepresented democratic interests. Feenberg uses this critical analysis of technical code in order to normatively re-configure technology.

In more technical detail Feenberg describes the technical code as having two major signifiers: firstly 'a rule that simultaneously (1) classifies activities as permitted or forbidden; and (2) associates them with a certain meaning or purpose which explains (1). […] Technical manuals are full of similar codes that determine the rule under which operations are to be performed in service to a variety of ends such as reliability, strength, human factors, cost efficiency, etc.' (Feenberg 1991: 80). Secondly, this code is also implicitly manifest in behaviour and attitudes that may signify a wider range of related values, in which case interpretation is needed to extract the original code. The technical code 'is most essentially the rule under which technical choices are made in view of preserving operational autonomy (ie. the freedom to make similar choices in the future) (ibid.)'. The goal of operational autonomy serves to maintain the capacity to continue making technical decisions

that in themselves will serve that goal and so on, it is a built-in device that perpetuates the existing setup.

The technical code is an aspect of technology that enables it to embody social norms and power. In turn, those become near invisible operational aspects of technology, which is perhaps why technology can seem autonomous or an active agent in itself. Because of the in-built and self-perpetuating qualities technical code is then central to the workings of technology under a capitalist regime in which it becomes the tool for the reproduction of relations of production that in turn underpin existing power relations. It is the operational autonomy that serves to extend that function of reproduction into the technical details of technology which then as a 'side-effect' of its continued operation also reproduces the original 'in-built' capacity for domination, control etc., in other words a tool for the general maintenance of existing social relations.

In any given piece of technology technical principles and their material realisation come together as 'technical elements', such as an electric circuit or a spring. Several technical elements are stringed together as components of any technology like words in a sentence. The original elements are themselves more-or-less decontextualised and neutral but once they are constructed into a piece of technology several layers of decisions are made which themselves carry norms and values, like meaning in a sentence. 'The process of invention is not purely technical: the abstract technical elements must be integrated into a context of constraints defined by their social environment' (Feenberg 1991: 81). Social determinants inform the specifics of this construction at every level, social criteria of purpose, cost etc. become built in but

mostly hidden aspects and once a piece of technology is constructed these can be traced with appropriate knowledge of the specific contextual details of its creation. The technical code then is a mule, a hidden hybrid inside technology condensing technical and social aspects that become all but inseparable. Feenberg goes into the trouble of unravelling such details to demystify and make obvious this otherwise invisible process that becomes pivotal for his critique.

The technical code can theoretically serve a wide range of interests, but under capitalism it assumes the asymmetrical power relations that inform its creation. Wider societal logic becomes encoded within the technical code and the technical configurations of technology come to reflect back wider societal configurations of power. Technology becomes 'strategically encoded'.

Fortunately the technical code can be changed to serve a different kind of instrumental reason and help create new technological designs that may be in line with environmentally sound principles or serve new human interests (Feenberg 1996: 2) bringing Marcuse's vision of technological transformation into reality and perhaps making his dystopian considerations fade. In practice this is not an entirely new concept as environmentalists and social movements have been pushing for technological change since at least the 1970s. Feenberg himself has looked at empirical studies in detail such as the social movement of AIDS activists, to analyse how such grass-roots movements contest and sometimes achieve meaningful transformation of technology. He traces the technical mediation of social interest, how the most radical of patient activism has to politically mobilise, wrestle for authority and use that to penetrate right into the technical code of clinical research in

order to re-negotiate institutional protocols, ethical guidelines and even the practice of medicine. In the case of AIDS patients they have managed to re-negotiate their right to affect changes in treatment regimes and experimental ethics in order to speed up trials and institute experimental treatment for patients with advanced disease. This is seen then as proof for the viability and necessity of democratic interventions (amongst them potentially grass-roots or 'direct' ones) into technology and a demonstration of technology as the scene of 'potentially pluralistic social mediation' (Feenberg 1995: 109) rather than just a simplistic tool in a rigid production framework or a piece of consumer good to be churned out, marketed and sold. It is the double opening of forms of rationality and of the social construction of the inner aspects of technology that make possible both a critical analysis of actual technology and related insights into practical democratic technological change.

## Ambivalence, subversion and the democratization of technology

All this could be described from a slightly different angle: using the social constructivist opening for social transformation can be seen as the harnessing of the 'ambivalence of technology'. This is a negatively defined but overall positive term here that refers to the practical consequence of the underdetermination of technology: namely that it is 'available for alternative developments with different social consequences' (Feenberg 1999a: 1). Activists opening up accepted institutional arrangements for the treatment of AIDS patients are not just randomly attacking the medical establishment demanding better care, but make use of the

ambivalence inherent in socially constructed medical regimes and push for their own values and interest to be incorporated into a reconstructed version of these.

> This 'indeterminism' of technology is then a political resource: In a society where determinism stands guard on the frontiers of democracy, indeterminism cannot be but political. If technology has many unexplored potentialities, no technological imperatives dictate the current social hierarchy. Rather, technology is a scene of social struggle, a "parliament of things", on which civilisational alternatives contend (Feenberg 1995: 8).

Whenever a new piece of technology is introduced into its intended social context there is a tendency for it to reinforce and reproduce the existing social hierarchy. Empirically-based historical and sociological studies have shown that technocratic strategies of modernisation reinforce this continuity. However, with each new technology there is also the possibility of using it 'to undermine the existing social hierarchy or to force it to meet needs it has ignored' (Feenberg 1999a: 1). Such subversive rationalisation injects new values into technology that serve interests harbouring those previously ignored or suppressed values. This is the strategy followed by unions and social movements, using technological initiatives to both try to undo the preservation of existing hegemonic relations mediated by technology and to reconfigure technology in order to advance their own needs. The latter is what those AIDS activists have carried out successfully.

Subversive rationalisation works with the existing rational framework that begot technology rather than turns away from the technological rationality it embodies and that way charts its path between uncritical acceptance of technological systems that has no bearing on social change and substantive resistance that rejects technological rationality in its entirety and therefore has to somehow reject modernity as a whole. Here Feenberg's views on an alternative rationality and the opening within technology come together: they are two sides of the same opening that allows him to negotiate a path between substantive dystopianism that offers no path to self-determination and authoritarian instrumentalism or the uncritical acceptance of technocracy that ends up celebrating hegemonic uses of technology.

An opening towards a democratisation of technology is then possible through these openings. They can also be thought of as useful resources that harbour normativity: critical alternative rationality can be actively used to challenge existing frameworks of thinking and new values and needs can inform the reconstruction of aspects of technology from the technical code up. In Feenberg's conception previously excluded values and interests brought into the (re)design of technology do not automatically interfere with the technical expertise of involved professional groups whose rationality and autonomy can be preserved through the renegotiation of technology. This may help to convey the legitimacy of democratic interventions to technical experts and show that values in technology are not necessarily a zero-sum game.

So this is Feenberg's politicised, normativity-driven answer within social theory to the tide of uncritical constructivist approaches and also to the seeming futility of a

substantive dystopian heritage. It unblocks both by breaking beyond each: 'I have reconstructed the dystopian critique of technology *inside* the constructivist approach' (Feenberg quoted in Durbin 2003: 8). With another reshuffling of terminology Feenberg rightly calls his work a critical constructivist approach using democratic rationalisation.

With those insights it is possible to see technology as an always political site: '[…] the notion that technology is apolitical is an illusion' (Feenberg 1999a: 2). Technology is never just a diffuse connection of actors and material entities as ANT may suggest or an autonomous agent on the rampage as technophobic theories might see it, but a site of social action and contention. Through the understanding and strategic transformation of its design and workings progressive social changes may be achieved.

## Critical Theory of technology for a renewed Science Studies

Social constructivism has been a strong part of Science Studies in the last 30 years, yet neither of its most prominent theoretical strains, SSK and ANT have been able to frame technology within a democratic framework or lead with a progressive social agenda that can be practically used in the real world. Yet here is Feenberg's Critical Theory inspired vision where technology is the site of social action where democratic interests can be renegotiated.

The reason why both SSK and ANT have been unable to leverage their social constructivism is because both have been intentionally blind to the sociological tasks of STS and have attempted to appropriate its sociological framework for philosophical purposes that belong to HPS. Both have been culpable in hijacking STS for the purposes of HPS, confusing the tasks of the field of Science Studies and incapacitating social constructivism. The field as a whole paid a high price for their failures: it is currently mired in theoretical confusion that cannot separate out STS and HPS and cannot establish a much needed dialogue between these sides. The Science Wars have been a symptom of this confusion and lack of dialogue. Dialogue is essential to clarify the tasks and values of the two sides, one sociological and one philosophical, and bringing their combined task of studying science and technology together but without obliterating each other in the process.

The two main theoretical programmes I discussed in Chapters 2 and 3, ANT and SSK, have both been pushing sociology away from Science Studies, disabling social theorising and thereby leading the field to an impasse. In ANT's theoretical framework actors and material entities came to form networks in which power was under-theorised and normativity was lost in a descriptive post-humanist scenario. In the case of SSK the focus shifted to science from technology, SSK's theory remained descriptivist and normativity remained a conceptual category to be attributed to actors evenly. This move effectively disabled both the conceptualisation of unequal real life forces in technological and scientific controversies and that of normatively charged theorising for Science Studies,

leaving SSK both useless for real life practical analyses of scientific phenomena and misleading sociology of science to a philosophical direction.

Substantive theories of technology, such as Heidegger's and Foucault's[51], came to see technology deterministically and as a force embodying values that cannot be altered or negotiated, blocking the path to meaningful action, hope and social transformation. SSK and ANT have done something else, they have pre-empted STS of sociological values and pushed for meta-philosophical and post-humanist/post-structural schemes in which the societal context of technology is irretrievably lost. They too are unable to theorise for social action and change because they have discarded the sociological and lost sight of its connection to their theoretical constructs. The important task of re-invigorating social constructivism and enabling STS theorising for social transformation came to Feenberg. His Critical Theory of technology possesses a progressive and critical constructivist edge that is able to unlock technology for social change using democratic rationalisation.

Feenberg's theory of technology amounts to nothing less than a critical re-conceptualisation of the relations between technology, rationality and democracy. It opens up the possibility of rethinking technological possibilities in light of human needs and instigates for a politics of technological transformation. Yet it is also a very useful theory for conceptualising, empirically studying and critically analysing technology in the real world.

[51] Marcuse should be mentioned here again too, though as previously seen Marcuse's work contains important dialectical elements that make it more complex, more ambiguous and also more useful.

# The STS-HPS divide: Feenberg and Habermas

I was looking to find the matching Critical Theory component for the HPS side of Science Studies, a theory of science that can complement Feenberg's theory from the philosophical side. The theory I found is that of Jürgen Habermas, another little known[52] yet robust and well-developed theory that is both rooted in a long tradition of theorising and is capable of providing the type of HPS theory that together with Feenberg's can establish a new direction for Science Studies. The scholarly work of Habermas is widely considered to be the most potent form of Critical Theory today and several of his works over the years covered the territory of science, yet little has been incorporated into HPS. This is most certainly overdue. Some of Habermas's writings are in direct dialogue with the work of Marcuse and all of them endeavour to bring into dialogue the philosophical legacy of Critical Theory with social theorising. I will discuss his theory of science in greater detail in Chapter 7.

Feenberg himself has admitted the need to bridge Critical Theory of technology with Modernity Theory, which in turn feeds into the question of how science fits into modern society and how it should be studied. This is an issue that goes right back to the larger question of the STS-HPS divide and how this divide is to be negotiated, now with the theories of Feenberg and Habermas on the two sides. In order to move forward and be able to establish common ground and dialogue between STS and HPS it is important to avoid both the negative legacy of ANT and SSK and go beyond the framework of traditional science policy research and allied positivist

[52] Little known in HPS and Science Studies generally, not so much in social theory, sociology and philosophy proper where Habermas is much better known.

studies of science. The latter simply considers science and technology phenomena that render themselves conceptually separable: science a purely knowledge based exercise and technology an applied practice, with little shared between them. This model is flawed because science and technology are inseparable in many instances of contemporary developments and because it denies the shared legacy of STS and HPS: both of whom want to understand and account for science and technology in their shared social context. ANT have 'solved' this issue of separation of subject matter by falling into a different trap: it has thrown science and technology into an indistinguishable blob of technoscience and together with SSK, has deliberately usurped the sociological side and melted it into the philosophical one, cannibalising STS and losing the STS-HPS differentiation altogether. Neither of these approaches has been fruitful as the STS-HPS divide is neither an impenetrable boundary dividing a field devoid of a shared task, nor a relationships that should be collapsed into one philosophically bent entity. The STS-HPS divide is one that needs to allow for both dialogue and separation.

Theories need to be selected for both sides that actively work on finding elements of a common path but ones that are also mindful of the subtle differences: STS needs to remain sociological while HPS needs to remain philosophical, both using their own methodological tools and epistemic outlook yet remaining conscious of a shared interest in a shared overall task. They need to be able to establish a common ground of tasks and norms: sharing the task of accounting for the complex phenomena of science and technology, illuminating each other's findings, using the tools of rational discourse and reasoned rigorous debate, consciously using an emancipatory vision to animate the pathway of theorising, and using social constructivism to the

advantage of the wider societal context of their subject matter by working on the democra-tization of science and technology.

As I have shown in this chapter Feenberg is more than capable of holding up the STS end of this scheme in his Critical Theory of technology. Habermas, as I will show in Chapter 7, is equally equipped to accomplish all of the above in his Critical Theory of science. His theory also consciously works with an emancipatory vision that sheds light on the workings of technological rationality and the societal subsystems that animate it. Habermas's theory digs deep and uncovers how the scientific endeavour as a civilisational force taps into two of the most basic constitutive human interests: the purposive-rational and the communicative interests. He also shows that science is different from technology in that it possesses a sturdy logical core that cannot be hacked apart with the tools of social constructivism. However, he also shows the pathway towards a comprehensive critique of science in society and this is where the common heritage of STS and HPS, Feenberg and Habermas, can be found.

# Chapter 7

# Critical Theory and Science Studies: Jürgen Habermas

## Introduction

Jürgen Habermas's Critical Theory of science complements very well the STS oriented, more sociological work of Andrew Feenberg. Habermas's work has also grown out of the German Critical Theory tradition. The basic scholarly framework of Habermas works with the same emancipatory vision for humanity as Feenberg's. Habermas is concerned with a deeper investigation into unarticulated background assumptions and normative layers of human phenomena, whether he writes about science or a variety of other areas of human life. However, Habermas's framework deals with both science than technology and as his work is strongly aligned with philosophy his Critical Theory of science is much closer to the framework of HPS than STS. Like Feenberg, Habermas too can be aligned with a broad social constructivist approach that sees science and technology as parts of society and as such sees the need to subject them to societal scrutiny and democratic oversight.

The work of Feenberg and Habermas on science and technology can be understood as complementary bits of Critical Theory that together help inform the theoretical basis for Science Studies: Feenberg's work on technology assuming the STS side while Habermas's work on science assuming the HPS side. The beauty of this

conception is that while they share the larger theoretical framework of Critical Theory, a commitment to societal emancipation and the task of studying science and technology from outside of these areas, they also differ somewhat in their scholarly approach to these tasks in terms of disciplinary orientation and methodology. Feenberg's theory of technology is strongly sociological in its outlook and methods, while Habermas's framework is more philosophical in its scope and intent. This difference guarantees that their approaches cannot be collapsed into each other as SSK and ANT have attempted with the HPS-STS divide and also that their theories can be easily matched onto STS and HPS respectively. I want to argue that the theories of Feenberg and Habermas together are able to maintain both the common vision and the slight separation of scholarly orientation that the HPS-STS divide requires. Together their theories can maintain the careful balance between a cooperation based on shared focus and a dialogue based on differing insights.

## Habermas's theory of science – and overview

It is difficult to partition Habermas's work on science and technology in a way that does not do injustice to his overarching systemic approach to the understanding of society. Nonetheless I decided to discuss his theory in two main parts in this chapter. The 'science-in-society' section will discuss Habermas's new epistemology of science that illuminates the nature of science by describing the elementary knowledge constitutive interests that were vested in them through human history. The 'science-in-society' section will focus more on the 'contextual view' of science and technology that assesses their role and effect in society today. Although the

former is more akin to philosophy of science in its pre-occupation and logic and the later more akin to sociology of science the same way, they evidently form a coherent whole in Habermas's thought without the suppression of internal tensions and contradictions. The strength of Habermas's scheme and its meta-level insight for the disciplinary constitution of Science Studies is to be found in the way Habermas combines an accepting awareness of the normative tensions that inform the workings of Science Studies and a ceaseless attempt at reconciling those same tensions within the horizon of social theory. Science Studies scholars may well take heart from the difficulty of embodying the guiding logic of dialectical imagination.

The 'society-in-science' view is where Habermas discovers the elementary civilisational kernel of basic human interests that underpin the endeavour of science. This is arguably the core of science that cannot be reconstituted without first completely transforming our civilisational and historical species interest, the most elementary types of human orientation towards the world that was shaped by our evolutionary and historical past. Because the core agenda of science gives expression to some of our most basic human values social constructivism is superfluous and unable to penetrate into this core. This core of science contains its most fundamental norms and values that cannot be stripped away, but can be illuminated with the help of Habermas's Critical Theory insights. On the other hand, the 'science-in-society' view operates with a different understanding of science, one in which social constructivism does have a hold and needs to exert its criticism: how science as a societal subsystem has been functioning, the complex societal effects of the development of technical reason and the legitimation of science.

In the rest of the chapter I will re-assess criticisms of Habermas in relation to Marcuse and show how the Habermasian view of science can be used for a contemporary criticism of science in society. The final part will connect back to the main issues of Science Studies as outlined in the thesis so far: the failure of recent theories to engage in sociological theorising, the neglected task of re-conceptualising the field so that its constituent parts, HPS and STS, can be brought into dialogue without collapsing one into the other, and the loss of direction in bringing science and technology into a societal critique and to democratic engagement. Finally I will recapitulate on how Feenberg's and Habermas's theory can be brought together into a dialogue.

## Scholarly origins

Jürgen Habermas is a second generation German Critical Theorist whose work is most commonly used in social theory and his is arguably the most well developed and respected theory today in the Frankfurt School tradition. His scholarship is extensive and has a high degree of contemporary relevance, which is why it is so fortuitous that his work also has a strong bearing on the study of science and technology. The reason why it has not been comprehensively brought into HPS theorising may lie in the large gap that these fields have between them: HPS theorists rarely venture over to social theory proper and social theorists rarely have an interest in science and technology. Despite these potential objections it is difficult to deny that Habermas's work on science can only benefit Science Studies.

The relevance of Habermas's work is largely due to not only building on a variety of traditions, from Marxism to German philosophy generally, to American and European sociology and hermeneutics, but also being in active dialogue with a wide range of scholarly areas and specialized literatures from philosophy of science to psychoanalysis, political science, psychology and linguistics (McCarthy 1984: ix). This is more than can be said for most philosophers of science. What makes him a formidable figure on the public intellectual scene in Germany and in the English speaking world is his breadth of scholarly expertise combined with a unity of perspective (ibid.), a commitment to developing a renewed Critical Theory capable of applying its resources to the conditions of contemporary capitalism and a readily exercised capacity to provide a substantive critical commentary on the condition of Western liberal democracy today (Edgar 2005: 1). His scope and focus, explicit moral-political intention and systematic articulation of agenda continue in his works that touch on science and technology: the most directly relevant to Science Studies are his 'Knowledge and Human Interest' (German 1968, English 1972), 'Science and Technology as Ideology' (within 'Towards a Rational Society' German 1969, English 1987), and 'On the Logic of the Social Sciences' (German 1970, English 1988). I will be using these works as well as extra resources by critics and commentators who provide further insight into and sometimes counterweight to Habermas's thought.

# Habermas and science: the 'society-in-science' view

Habermas's epistemological insights into science reach to a much wider philosophical base than is customary in Science Studies and take in both the Marxian and German Idealist heritage, as well as the Weberian line of thought and many of Herbert Marcuse's too, himself belonging to the Frankfurt School of social research a generation earlier. For many critics the Marxian and the German Idealist traditions are in direct and irresolvable tensions through Critical Theory itself and especially in Habermas's Knowledge and Human Interest (Vogel 1995); for others they are partially resolved by Habermas's work and the remaining tensions are part of the irresolvable dialectic of human development.

This supposedly ambivalent epistemological legacy of Critical Theory is based on its dual legacy of and tensions between the idealist lineage of German philosophy and Marxian historical materialism (Vogel 1995). This then is represented within the 'typical Western Marxist solution' that asserts a dualism between natural science and social theory (Vogel 1988: 329). In the former objectivity is right and proper as Nature is rightly understood in realist terms as truly independent, while in the latter knowledge formation takes on an entirely different character: subject and object interact, constitute each other and objective knowledge is impossible. Only capitalism, perhaps, could falsely make the social seem immutable, showing up ideology as an intrinsic aspect of its constitution. This supposedly unresolved contradiction between idealism and materialism, bequeathed by Hegel and Lukács, is handed down to Habermas. There is a lot at stake in these assertions: the epistemological validity of Critical Theory, its view of Nature, science and itself.

What also hangs in the balance is whether Critical Theory's view on science, nature and society can fit in with a general social constructivist direction in STS.

The dualist solution as expressed above proves to be an uneasy and unstable one. Lukács's radical conclusion that 'nature is a social category' and his attempts to extend the 'epistemological ideal' of social theory to the natural sciences brings into question the constitution of not only objective science (the fruits of which would be needed in a socialist or communist system too) but also the materialist basis of Marxist critique[53]. The conclusion would be self-contradictory and so this move is cut short leaving the original claims of positivist science untouched in the end (Vogel 1988: 329-30). If sociology of science was to go down this Lukácsian route it would have to abandon the project of critiquing science and concentrating on its social context instead. That practice though just leads back to the arguably more timid older style sociology of science that is careful to avoid meddling with internal matters of science and instead settles for research on the 'context of science'. Similar considerations may have contributed to a lack of a fully developed critical social research programme into contemporary natural sciences.

Habermas, according to Vogel, comes up with an ingenious way of trying to solve the conundrum and thereby retain the dualist conception. In order to preserve the legitimacy of science without succumbing to scientism Habermas has to develop a new epistemological account of natural science. Marcuse's solution to the dualist

[53] Perhaps later radical social constructivists of the 'cultural and reflexive turns' were re-creating some of this Lukácsian route in a weaker form by pushing social constructivism of reality (including nature) to its extreme point and losing sight of the material (including institutional, economical, political etc.) aspects. A major difference is that they have seemingly lost any philosophical (materialist or other) or political commitment and the only stop sign they noticed was 'futility'

contradiction was to allow for the reduction of scientific validity and to advocate a non-ideological non-objectivist New Science. Habermas instead places science on a new philosophical footing. Objectivism is stripped away as the foundational characteristic of natural science through the recognition of the contribution of the knowing subject. Habermas pairs fundamental modes of human action to specific forms of knowledge. Habermas shows how natural science produces empirical-analytical knowledge and how it operates with the basic human capacities of prediction and control of the external environment. These capacities are fundamentally tied to instrumental action which is labour. Social or human sciences, on the other hand produce historical-hermeneutic knowledge and they serve mutual understanding and interaction: communicative action. These two are mutually irreducible and are therefore elements of a basic system of human knowledge and interest. Natural science is not based on its view of external reality as objective and immutable but is tied to human instrumental action, shifting the focus from epistemological stance to practical human function.

Natural science is not attacked on its own territory but is presented through a differently constituted self-understanding. Nature becomes constituted not on the basis of a realist outlook as an independent material realm but as the context of human activity and interest constituted by us in the process of instrumental action. But materialism comes back into the picture because humans themselves are materially constituted and arose through the evolutionary process from nature. Their constitution brings up an ontological issue: there is a clear need to assert something about nature that preceded humans, begot them and indirectly their history,

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signalled by peers when their work has become self-referential to the point of irrelevance. It might be the irony of STS that the 'reflexive turn' has become blind to its own direction.

knowledge and interests. To this end Habermas differentiates 'nature in itself' and 'nature for us', the former being nature that gave rise to humans and the latter that humans can know through the instrumental action of science. Vogel thinks that it becomes impossible to have nature as both transcendental and contingent, or to hold onto both a phenomenological and a materialist conception of nature while at the same time the system of conceptually separating the two remains impossible to justify. Materialism and idealism, human ontology and natural ontology cannot be unproblematically subsumed under one seamless synthesis (Vogel 1988).

McCarthy accounts for this development in Habermas's thought in a much more sympathetic way. In his interpretation Habermas not only recognises and extensively acknowledges his 'dual' heritage of Marxian and German idealist thought that stand in opposition epistemologically, but he also offers solutions that at once resolve some of the underlying philosophical contradiction and also acknowledge the impossibility of a full synthesis. The epistemological conundrum underlying Habermas's conception of knowledge constitutive human interests is re-stated by McCarthy the following way:

> The notion of a nature that is such is "an abstraction which is a requisite for our thought". We construct this notion to take account of the moment of "facticity" or "contingency" in our experience. This has two sides. On the one side, the structure of inquiry attests to the independence of reality, its resistance to arbitrary interpretation. On the other side, reflection on the conditions of knowledge leads us back to certain "facts" about the subject of knowledge that define the initial

> conditions of its constitutive activity. Thus cognition appears to be bounded on both sides by contingent conditions (McCarthy 1984: 123).

Habermas's dual construction of 'Nature-in-itself' and 'Nature-for-us' is a logical necessity that cannot be overcome. 'Nature-in-itself' as an abstraction refuses to disattach from a transcendental framework while at the same time it has to remain the very ground for the possibility of thought. This intertwined philosophical dilemma cannot be dissolved (ibid: 125).

In order to comprehend the conception of the natural and social sciences and to transform the philosophical self-understanding of Science Studies it is necessary to understand Habermas's differentiation of the natural and social sciences. He sets them apart by describing how their distinct methodologies are rooted in their different knowledge constituting interests and logic of operation, which in turn helps to evaluate the cultural values of both. Habermas's analysis has a strong bearing both on how a critical Science Studies could intelligibly conceptualise the very nature of natural and social sciences, and on how Science Studies as a philosophically and sociologically (and to a lesser degree historically) rooted interdisciplinary area should constitute its epistemological and methodological self-understanding.

The natural sciences are 'monological' in nature, humans stand as individuals with nature, purposefully manipulating objects to achieve control, carrying out technical operations to ascertain underlying universal relations that can be used for prediction

and control. Therefore the natural sciences are empirical-analytic in nature and operate with a technical cognitive interest oriented towards purposive-rational action. Within this cluster scientific theories provide information that can be put to practical use but they are also the outcome of consensus building processes on truth by scientists (McCarthy 1984: 65). While technology is purely instrumental in its orientation science employs both technical-cognitive and communicative interest, although it remains primarily a monologic undertaking with a quasi-autonomous institutional operation in society. Social sciences, on the other hand, are inherently communicative and hermeneutic in character.

Vogel asserts that Habermas in 1968-69 still seems to be holding onto a description of the natural sciences' methods and knowledge production that was decisively rejected by post-empiricist philosophers of science around that time: the separation of theory and observation, language and data, method and 'fact' (Vogel 1988: 335). While Habermas' description seems somewhat positivist to Vogel, philosophers of science since the 1960s have modified their view of the natural sciences closer to the 'hermeneutic' model: scientists work in communities in which communication and interpersonal politics have a major role, language has a constitutive role in knowledge production, discursive rationality operates in tandem with rather than in separation from other types of rationality. Thomas Kuhn himself had a major role in popularising the view of science as a community enterprise to replace an older positivist individualist HPS model (as described in Chapter 5), even though he was far from being a hermeneutician.

Habermas's own position is very much a post-positivist development and he's been deeply engaged with Methodenstreit themes such as the philosophical category of Nature and how our own constructedness should influence epistemology. Vogel admits that Habermas is anything but blind to the insights of the linguistic turn: scientific facts do not exist without our interpretations: 'every empirical basis on which we can conceivably rely is mediated by implicit inferential interpretations. These inferences, no matter how rudimentary, are tied to representational signs. Consequently, even perceptions already occur in the dimension of semiotic representation' (Habermas 1978: 97-8). The solitary human manipulating nature cannot generate even scientific data without some mediated communicative element appearing inside her activity. Habermas links cognitive and discursive processes and shows that if scientific method comprised the only valuable resource for ascertaining what is true then reality would consist of a range of propositions only.

But natural scientific inquiry is more than the logical generation of propositions: beyond the logical structures and empirical conditions there is the subject who 'sustains the process of inquiry as a whole, that is with the community of investigators, who endeavour to perform their common task communicatively […]' (Habermas1978: 95). Habermas' view of science therefore involves aspects that in a strictly dichotomous system only the social sciences could claim to operate with: interpretation, communication, discursive action[54].

Here it is worthwhile to note that in a way Habermas's insights can be connected to the basic social constructivist tenet derived from philosophy: the underdetermination

[54] All this still largely precedes the 'linguistic' turn in both Habermas's work and in the wider scholarly discussion in social theory and philosophy.

or Duhem-Quine thesis. As I have mentioned in earlier chapters, this thesis holds that scientific theories are 'underdetermined' by empirical data, that there is no unambiguous, supremely logical direct translation of data to theory that can be produced without the involvement of human discourse. For Habermas though, the underdetermination thesis does not so much refer to a wider, more general social shaping that constructivist sociologists in STS hold onto as the extra determining influence, but to the more direct input of scientific discourse. This refers to scientists discursively constructing propositions, hypotheses and validity claims, subjecting empirical data to processes of theoretical classification and interpretation (Keane 1984: 211-2). Scientific work therefore is partially symbolically mediated inside a communicative framework and interpretation is heavily woven through it. This shows that there is an element of communicative interest and hermeneutics inside science, and that purposive rationality is not exclusive[55].

Habermas relies not on Kuhn but rather on Popper and Peirce for this insight asserting that it is their work that reveals just how irrefutably social the work of natural science is, how it is based on discursive agreements from the very start (Vogel 1988: 336, citing Habermas' The Positivist Dispute in German Sociology). Keane too points to the influence of Peirce's post-Kantian philosophy of science that emphasises the understanding that 'science is a self-reflexive, instrumental process of discovery' (Keane 1984: 212).

[55] According to Keane (1984: 212) this invokes the work of Apel in his 'The continuum of reason between science and ethics', and opens up the idea of less instrumentally directed communication among scientists, including perhaps dialogue with critical and ethical content. This might be seen as a tantalising prospect but Habermas's overall view of science largely dashes thinking in this direction.

However, this partial communicative interest does not transform the elementary purposive-rational nature of science. Scientific reasoning may be seen as self-reflexive in a Peircian fashion and scientific discourse as operating inter-subjectively through communication and interpretation, but the whole scientific system of activity is not communicative in nature, it remains both monologic (engaged with/fixated on Nature) and aimed at prediction and control that together guarantee the success of instrumental action (Keane 1984:212).

> For Habermas, discursive justification is thus a part of science, but only a part: the normative principles (the "values") that guide it, such as successful prediction and control, come from elsewhere – from the independent realm of monologic purposive-rational action where hermeneutic categories do not apply (Vogel 1988: 338).

There is contention as to where exactly Habermas's conception of science stands between positivist and relativist positions, and in relation to post-positivist HPS thinkers. For Vogel, Habermas seems to fall back onto an older conception of science in which the context of discovery, and of justification stand separate. It may not be positivist, but for him it is seen as pre-post-positivist! The 'normative principles'/'values' within science posited by Habermas above seem very similar to Kuhn's inasmuch as they too arise within the 'independent' scientific realm and assumedly only apply within its own sphere of internal purposive-rational actions. These are norms that arise and circulate inside an autonomously conceived scientific community.

For Vogel Habermas reserves a central 'core' of scientific activity where traditional social constructivism cannot reach, where the monologic character of science is untainted and where the actions of scientists are not amenable to external normative critique. This may seem like a cop-out or a fallback to older HPS theorising that tries to preserve the independence and autonomy of natural science by excluding the possibility of intelligent critique beyond the 'context' of science, but for Habermas this is neither a cop-out nor an effect that diminishes the strength of his argument, it is simply a logical insight that shows both the limit to social constructivism in philosophy of science and the limits of social critique.

Keane's description of Habermas's position seems to remain close to the intended meaning and intention. Habermas does aim to firstly provide an adequate description of science from inside, but this is far from uncritical. Keane seems to capture rather well Habermas's internal description of science as well as his position in relation to realism, rationalism, positivism. Habermas argues against a naïve realist conception, the 'commonplace objectivist self-understanding of post 17$^{th}$ century science' (Keane 1984: 210) that positivist HPS had once held onto: scientists cumulatively producing progressively refined objective knowledge of outer nature that explains its formerly concealed mechanisms and progressively reveals natural reality through closer and closer approximations of its true nature. His critique of positivism advances through the above described process of altering this understanding by introducing communicative, self-reflexive and interpretive elements as well as holding onto the basic instrumental, purposive-rational human interest that underscores the whole of science.

For Habermas science does not describe nature and is not the progressive discovery of truth revealing constant and law-like underlying structures. Instead, it is a 'discursively framed learning process, directed by the synthetic achievements of knowing subjects' (Keane 1984: 213). Scientific 'truth' only emerges in a public form and only when it is inter-subjectively affirmed with a consensus underscored by a lack of reasonable collective doubt. Not that doubt does not emerge, it is positively encouraged within a discursive process that also fosters attempts at falsification and vehement critical arguments, overall producing a highly contested intellectual atmosphere that helps achieve self-correction. Keane rightly points to some similarities with Popper's model of 'critical rationalism' and falsification as part of consensus formation. However, both of them reject reformulations of classical objectivism while for Habermas there is simply no fundamental convergence of final truth, ultimate facts or first principles (Keane 1984: 214). Habermas's position is beyond relativism and objectivist realism/positivism: science is not capable of exhaustively capturing natural reality but it also stands outside the boundaries of historical relativity.

Science is simply the rational accumulation of highly probably knowledge that it forms collectively and consensually. It does not approximate truth, but it successfully works towards greater technical insight and is instrumentally progressive. Its propositions about reality are valid within its horizon of conditions, controls and technical recommendations, however, its knowledge is never fully closed, but is reflexive and infinitely revisable.

Habermas's description of science could be understood as an immanent critique that aims to shift the self-understanding of science rather than critique scientific rationality and scientists themselves. He conceives of science as a quasi-autonomous sphere with a certain level of justified autonomy. However, this does not mean the Habermas is uncritical of the role and wider effects of this very same rationality, as the next section will show.

## Habermas and science: the 'science-in-society' view

Habermas also has a different and complementary side to his theory of science, the one that firmly sees science as a societal subsystem and a human endeavour that needs to be viewed and critiqued in its social context. This 'science-in-society' view is still systemic in scope and philosophical in its framework and as such is a good Critical Theory continuation of the HPS project. Yet it is also different from the 'society-in-science' view in that we see science here as amenable to social constructivist critique and potential societal control. In this sense the 'science-in-society' view mediates between the previous aspects of Habermas's work and Feenberg's thoroughly sociological theory. This is not really surprising as Habermas's theory carries the legacy of both German philosophy and sociology in the form of a legacy from both Marcuse and Weber.

The 'science-in-society' view of science is most strongly developed in Habermas's 'Technology and Science as "Ideology"'. This piece was part of a longer essay that became a Festschrift piece for Marcuse's 70$^{th}$ birthday. It starts out with a discussion

of Marcuse's extension of Weber's rationalization thesis into the realm of science and technology. Habermas outlines how the idea of progressive rationalization of society in Weber is linked to the institutionalization of scientific and technical development, both effectively operating through rational-purposive action. For Marcuse rationalization is not so much the realisation of rationality, but political control and domination under the guise of rationality. From the 19th century onwards science and technology gradually became a new means for legitimating this effect, removing decision-making from a wider social context of deliberation where specific social interests could be represented and debated. Legitimation then is transferred to the realm of technical control. In this guise political control becomes invisible and science and technology take on a legitimating role while at the same time also remain the means for the construction of that same control via their technical apparatus. Technical reason becomes indivisible from domination that extends beyond that of Nature to that of people too. However, this domination and control has become invisible partly because it is mediated through technical reason that appears neutral (legitimating proxy) and partly because that same rationality is pivotal in delivering human comfort through increased productivity that would be impossible without scientific and technical 'progress'. Although there is acknowledgment of the positive side of this wider dialectic of science and technology in society, the positive effects are not enough to mitigate the negative ones for Marcuse. Yet, therein lies the dialectical force of modern industrial production and consumption, the economic basis of advanced capitalism that is so thoroughly entwined with the development of science and technology.

Existing relations of production may be repressive in character but they also appear as the necessary organisational form of a rationalized society (Habermas 1971: 83). What is world-historically new according to Marcuse is that the exact form of this repressive relationship, instead of being the basis for a critique, now appears as its own legitimation. The particularly depressing aspect of Marcuse's thought here is that this substantive issue is considered to be programmed into the very rationality of science and technology, that it is a rationality of domination. The principles of modern science are structured to serve as conceptual instruments for practical productive control. 'Technological rationality […] protects rather than cancels the legitimacy of domination and the instrumentalist horizon of reason opens on a rationally totalitarian society' (Marcuse cited in Habermas 1971: 85). All this adds up to a very bleak and totalizing picture that Habermas wants to re-work.

Habermas finds a constructive entry point to enter a dialogue with Marcuse via immanent critique. Since science and technology, in the above analysis of Marcuse, are determined by a particular socio-historical situation and the existing class interest within, social emancipation can only progress via a revolutionary transformation of science and technology. Marcuse's New Science would have to sever the link to domination and operate with a different rationality, one that embodies liberating mastery instead of a repressive one. This would lead to new concepts, experimental context and potentially establish different facts. Technical control would be shunned in favour of preservation and the fostering of Nature's potentialities, as well as that of other humans.

This immanent critique first presents the reasoning that any alternative New Science would have to go together with an alternative New Technology. This however is not feasible because technology is essentially rooted in the anthropological-evolutionary path of the human species. In this, technology comes to substitute human senses (motor apparatus, energy production, sensory apparatus, and governing centre[56]) with technological solutions, practically and progressively 'outsourcing' basic human capabilities. Therefore the developmental path of technological innovation is rooted in human development. Habermas avoids being deterministic here but the end result seems to be that the basic technical aspects of the relationship between humans and Nature may have some constant features. Then there's the assumption that underscoring a New Technology would be a different attitude towards Nature, something more fraternal than exploitative, in which the subjectivity of animals and plants would be taken into consideration[57]. This implies a switch from purposive-rational action to symbolic interaction, ie. communication, but for Habermas, this makes it a universal human project rather than an epochal New Science for any given society. Therefore Marcuse's implied project becomes logically incompatible with previous statements that envisage New Technology as a more specific societal developmental project. However, as it turns out a bit later, Marcuse's imperative for such a universal humanistic project, that Habermas comes to share, does not have to

[56] These are the following for humans: 1) motor apparatus – hands and legs 2) energy production – of the whole human body 3) sensory apparatus – eyes, ears, and skin 4) functions of governing centre – brain (Habermas 1971: 87). Their equivalent in technological development would have to follow the same developmental order (my very generalised extrapolation here): 1) mechanical tools 2) energy production (fossil based, then later nuclear and most recently green energy sources; though this skips the use of animals for sheer energy in more primitive 'generators') 3) electronics, and finally 4) digital technology/ICTs or information and communication technologies (with the debated possibility of strong Artificial Intelligence versus less potentially autonomous systems for technical 'governance').

[57] But most definitely not in the terms of Bruno Latour whose works seems to imply both a thorough relativism and the idea of including Nature in the governance of the world, which is difficult to conceive of as a practical reality, especially when its details are as vague and nebulous as Latour's writing is.

be thrown out together with the (now unworkable) idea of a wholly reconstituted New Science and New Technology. It is also important to note that Habermas's later distinction between purposive-rational action and communicative action has already surfaced here. They imply very different value orientations and are applicable to analytically different spheres of human life: purposive-rational action harbours values relating to prediction and strategic control and corresponds to the sphere of work, while communicative action embraces consensual norms and corresponds to interaction.

It is the above purposive-rational norms that are inextricably bound to control and domination for Marcuse and that is why his radical re-hauling of science and/or technology had to envisage re-aligning them with communicative norms. This in turn would have taken away the norms that seem to make science and technology what they are. Another possibility for Marcuse would have been to retain existing standards of rationality but inject new values into technical and scientific projects taking them to new directions. This is exactly what Feenberg did via the technical code for technology. Habermas's insights are able to achieve something similar in the realm of science. In order to show this I will discuss his reformulation of rationalization and scientific-technical 'progress' as productive force and ideology.

Following Habermas's analysis, with the advent of capitalism there are two world-historically new scenarios. 1) Capitalist mode/system of production has now institutionalized self-sustaining economic growth. 2) The productive forces have reached a level of development that makes permanent the extension of subsystems of purposive-rational action, and traditional forms of the legitimation of power have

lost their currency. Instead, there are new systemic principles and new forces for legitimation. Bourgeois ideology of justice resurfaces through the principles of equivalent exchange at the market and reciprocity within the sphere of production[58], legitimating the existing order through the rationality of the market economy rather than on the basis of an older mythic, religious or metaphysical worldview. Traditional societal structures are taken over by complex purposive-rational subsystems operating with instrumental or strategic rationality, encompassing organisation of labour, trade, transportation, information, communication, institutions of private law, financial administration and state bureaucracy (Habermas 1971: 98). Such all-enveloping pressure for rationalization ties in with progressive secularization. Empirical science emerges as the substitute force for legitimation with a transcendental standpoint derived from a methodological frame of reference tied to universal technical control.

Building on Claus Offe's and Marcuse's work Habermas describes in detail the systemic changes in the relationship of productive forces, governance and the general population in late capitalist societies. This is important because these societal elements are not only the background setting for science and technology but also the 'medium' through which they unfold. This new macro-level societal constellation involves increased state intervention and growing interdependence of R & D leading to science becoming the leading production force and important source of new surplus value. Some of this is seized on by the growing military industry fuelled by world wars, the Cold War and later post-colonial military

[58] People/classes without ownership of the forces of production or capital 'exchange' their labour to 'equivalent' remuneration, supposedly underpinned by a principle of reciprocity. The 'exchange rate' and value of one's labour in turn is tied to fluctuations of the market. The supposed involvement of

conflicts. The military complex itself becomes a driving economic force and faithful 'client' of R & D.

Though science and technology are obviously socially shaped by the above interrelated societal systems of state and industry, they do not collapse into either and retain quasi-autonomy. However, there is an accompanying shift in the process of legitimation of power towards science which in turn becomes implicated:

> The quasi-autonomous progress of science and technology then appears as an independent variable on which the most important single system variable, namely economic growth, depends. Thus arises a perspective in which the development of the social system seems to be determined by the logic of scientific-technical progress. The immanent law of this progress seems to produce objective exigencies, which must be obeyed by any politics oriented towards functional needs. [These technocratic assumptions] can become a background ideology that penetrates into the consciousness of the depoliticized mass of the population, where it can take on legitimating power. It is a singular achievement of this ideology to detach society's self-understanding from the frame of reference of communicative action and from the concepts of symbolic interaction and replace it with a scientific model. (Habermas 1971: 105)'.

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'just' principles inside these processes of economic mediation between classes of actors in effect masks, cushions and legitimates existing power relations.

In this highly perceptive technocracy thesis of Habermas the originally quasi-autonomous role of science and technology in society becomes reified (social relations come to be treated as 'things' in themselves) and their inherent instrumental-rational interest becomes a wider legitimating force colonising communicative practical interest. The technocratic shift comes to efface the difference between purposive-rational and communicative-practical action, to the latter's detriment as technocratic logic is used by states to explain and legitimate the narrowing of decision-making to choices between technical means. This phenomenon lends science and technology a pivotal role in the shift towards 'substitute' governance by states, in which technical decision making squeezes out the essential 'practical interest' in its many forms: dialogue and deliberation on a wider set of human needs, values and social interests in democracy, the 'securing and expanding possibilities of mutual and self-understanding in the conduct of life' (McCarthy 1984:56).

Class antagonisms have become latent behind a compensatory distribution façade and behind the new 'mode' of ideology, derived from the sphere of science and technology. As a proxy ideology that is 'outsourced' this new 'mode' of ideology may seem inferior, but in effect it is powerful. Firstly because it diffusely operates in the background and as such reaches farther. Secondly it veils practical problems and therefore is not attached to any one class, and as a consequence it 'affects the human race's emancipatory interest as such' (Habermas 1971: 111), it is both more general and universal. Thirdly, it is less vulnerable to reflection because beyond being an ideology it is also a process of severing 'the criteria for justifying the organisation of social life from any normative regulation of interaction, thus depoliticizing them'

(ibid. p.112). Technocratic consciousness then represses "ethics" 'as a category of life', as it eliminates the distinction between the practical and the technical, making the practical interest in maintaining intersubjectivity of mutual understanding and in communication without domination disappear behind the interest in the expansion of our power of technical control.

This process goes hand in hand with the above described changes in governance towards a 'substitute program', where states re-direct themselves towards the solution of technical problems, 'eliminating' substantive issues that would require distortion-free communication and deliberation over ethical issues. Practical problems become purely technical ones and the mass population becomes depoliticised (Habermas 1971: 103-4). The 'substitute program' of governance is validated to the population through science and technology as ideology and in turn they continue to fuel economic growth and consumption that are institutionally set on permanent expansion. All that is solid… becomes a functional self-perpetuating part of the system[59].

Here we have perhaps the most potent contribution of Habermas to Critical Theory on science, an insight that brings together his epistemological framework from philosophy of science and extends it into sociology of science without washing together their different knowledge constitutive interests.

[59] Except perhaps non-renewable resources, most notably Nature itself, that is both arguably limited in its potential 'production' and is becoming 'lived up' and used up in the furious global accelerated production and consumption. Nature, of course, is not a dispensable item within this constellation, as humanity's entire existence is depended on it for the foreseeable future. Ecological issues are part of Critical Theory but I cannot expand much on them at this point.

This is the moment where Habermas's conceptual scheme of the different knowledge constitutive interests makes intelligible meta-level connections in Science Studies: HPS and STS are clearly seen as connected through their common interest in understanding the human forces that animate both science and technology and the dynamics that sustain them. At the same time both science and technology can be understood in their effects as societal subsystems whose technical interest can be ideologically used to pre-empt other practical democratic interests. In Habermas's scheme science and technology therefore can both be objectively analysed and understood in their wider historical and societal context, and can also be critiqued in terms of how their logic can be overextended to create an imbalance between instrumental-rational interest and technical rationality on the one hand, and communicative action and democratic interest on the other.

Yet empirical-analytic sciences do not only operate with technical cognitive interest oriented towards purposive-rational action and scientific theories do not only provide information that can be put to practical technical use. Scientific theories are also the outcome of consensus building processes on truth by scientists (McCarthy 1984: 65) and therefore science also has a communicative interest at its heart. While technology is purely instrumental in its orientation science employs both technical-cognitive and communicative interests, although it remains primarily a monologic undertaking with a quasi-autonomous operation as an institution. Viewed contextually as part of society, the instrumental-rational logic of science and technology come to colonise areas of life that operate with the logic of communicative-practical interest causing systemic imbalance in society.

The historical-hermeneutic sciences, such as philosophy and history, are governed by 'a "practical interest" in maintaining the type of open intersubjectivity and non-violent recognition on which communicative action depends' (McCarthy 1984: 73) including the skilful use of systematized interpretation that simultaneously utilises empirical and conceptual analysis.

The final category belongs to the emancipatory interest of Critical Theory itself which needs to be brought back into Science Studies proper so that it can possess again a more thorough critique of science and technology and provide practical pathways for society in how to better negotiate its technological future. As I have already argued in chapters 2 and 3, Science Studies in the time of SSK and ANT has been operating less and less as a historical-hermeneutic discipline. These two theoretical programmes attempted to cannibalise STS from the HPS side and they got very close to simply giving way to the technical, instrumental-rational logic of science and technology by assuming its logic of scientism within their own inquiry and by avoiding any direct criticism aimed at these. The work of Feenberg and Habermas on the other hand brings back the emancipatory interests of Critical Theory to the study of science and technology in openly facilitating the renegotiation of social values and interests at the heart of science and technology: Feenberg by injecting alternative social values into technology via the technical code, and Habermas by bringing back communicative practical interest into a more democratic governance of science.

In this fashion Science Studies as an interdisciplinary area has to take as its task both the systematic empirical and interpretive analysis of science for the purposes of

common understanding and communication (historical-hermeneutic interest), and the critical task of practical self-understanding and emancipation (McCarthy 1984: 88) towards a more general transformative social change (emancipatory interest of Critical Theory). Science Studies needs to accept its emancipatory task of reflecting on its own constitution. It needs to re-articulate the distinct tasks and values of its sub-disciplines, HPS and STS, while also holding onto their shared aims of capturing and understanding science and technology in the full spectrum of their cultural values. When this is done science and technology can be understood in full with the help of both the philosophical and the sociological sides. Then it can be seen that science is both a valuable and logical endeavour that produces valid knowledge about the world, a social enterprise in which scientists critically engage with each other and arrive at collective consensus, and an institution that needs to be critiqued for contributing to the imbalance between instrumental-technical and communicative rationality to the latter's detriment. Similarly, technology needs to be appraised and valued for its phenomenal success in helping to modify and manipulate our material world for human purposes, it needs to be valued for helping us create a better life, yet it also needs to be critiqued for contributing to a technocratic rationality that strongly underpins the reduction of democratic politics to narrow technical means.

Once Science Studies accepts the above emancipatory task SSK and ANT can be seen for their failures. SSK cannot capture science in its richness as it misses out on understanding the social processes at the heart of science. By emulating the objectivism of the natural sciences it also colonises the sociological values of STS. The ideas behind ANT are also fraught with issues. ANT tries to cling onto ontology

and pure theory without properly acknowledging its own philosophical assumptions and agenda and therefore it gets entangled in its own contradictions. ANT also tries to align itself with societal responsibility in the shape of a democratization of science, but this is not possible as it has thrown out the essential ingredients for such an exercise: the sociological values to understand science in its social context, a coherent emancipatory interest that could guide its self-understanding and the conscious alignment of theory and praxis:

> However, as long as philosophy remains caught in ontology, it is itself subject to an objectivism that disguises the connection of its knowledge with the human interest of autonomy and responsibility (Mundigkeit). There is only one way in which it can acquire the power that it vainly claims for itself in virtue of its seeming freedom from presuppositions: by acknowledging its dependence on this interest and turning against its own illusion of pure theory the critique it directs at the objectivism of the sciences (Habermas 1978: 311).

Habermas's scheme is based on elementary human interests that in turn are derived from nature and from the cultural break from nature, so they are quasi-transcendental in character. This scheme goes beyond and extends both the Marxian and Hegelian legacy by establishing an epistemological framework based on both the historical-material conditions of humanity and its transcendental cultural existence.

Habermas's theory of science and technology were expressed in 4 dense theses which operate on a philosophical level: the 'achievements of the transcendental subject have their basis in the natural history of the human species' (Habermas 1978: 312), that 'knowledge equally serves as an instrument and transcends mere self-preservation', that 'knowledge-constitutive interests take form in the medium of work, language, and power (both in ibid: 313)' and that 'in the power of self-reflection, knowledge and interest are one (ibid: 314)'.

Habermas's practical critique of science and technology on the other hand is expressed in a more sociological fashion: there is obviously no way of going back to an earlier phase of 'classical' bourgeois ideology or a pre-modern society relying on metaphysical legitimation and neither would these be desirable[60]. The Habermasian critique of science and technology is not an anti-scientific one, its main target of critique is neither the existence of science and technology, as these are bound to human development, nor the inherent attributes of science or technology, these embody basic human interests. 'There is no "more humane" substitute for the achievements of scientific-technical progress' (McCarthy 1984: 67):

> Technological development thus follows a logic that corresponds to the structure of purposive-rational action regulated by its own results, which is in the fact the structure of *work*. Realizing this, it is impossible to envisage how, as long as the organization of human nature does not change and as long therefore as we have to achieve self-preservation through social labour and with the aid of means that

> substitute for work, we could renounce technology, more particularly *our* technology, in favour of a qualitatively different one (Habermas 1971: 87).

The centre of critique instead pertains to how science and technology have gone beyond being merely efficient productive forces and have become legitimating forces for power in that instrumental-technical decisions have come to displace a more substantive democratic negotiation of values and possible action. This had the undesirable effect of shifting societal consciousness towards an exclusive preoccupation with scientific facts, technical and social imperatives, and these in turn have overshadowed public discussion and deliberation over what constitutes a 'good life'. Habermas's main critique is about how the supremely useful aspects of technocratic consciousness, that is prediction, control and production, are squeezing out of existence another essential type: the normative one. It is about how techne has cannibalised praxis, how purposive-instrumental rationality has appropriated communicative action capable of ethical arguments and judgement and how science and technology have been used to justify dominant social and political interest. His critique shows how the over-extension of technocratic consciousness has eclipsed the 'general human capacity for publicly organizing and choosing political norms. Technocratic consciousness is the cunning and cynical enemy of democracy' (Keane 1988: 218-9).

It is essential to hold onto normative consciousness that is capable of summoning up what a good life is. This is highly important because without it humanity is unable to

[60] Habermas definitively breaks with all previous critical substantive theoretical directions that saw potential redemption in returning to pre-industrial even pre-modern states of being and carried on

form an idea of why it is in existence, to what end it accomplishes its tasks, how it can evaluate its own condition and how it can formulate its collective and individual interest. Without this there is no sense in sheer technical control or scientific discovery, an important human element is lost, science and technology remain dehumanized forces losing their societal potential. When humans become detached from their normative system it becomes impossible to sustain meaningful communication and reflection over their own interest and judgement. This process fosters the 'self-objectification' of humans, who have found immense control and mastery through science and technology (of Nature but also of each other), but may eventually lose their 'humanity' in the end. Therefore this is not simply a shift in the ratio and importance of technocratic versus normative consciousness that may shift back and forth. Rather the over-extension of the former may permanently disable the action of the latter by rendering normative discussions obsolete, including one that aims to bring technocratic consciousness itself under immanent critique. Internal checks and balances become disabled, emancipatory human potential is lost and dehumanized life remains locked into its own dystopian predicament. This scenario is Habermas's negative utopia which needs to be countered by a matching emancipatory force that pushes back the existing imbalance.

To this end Habermas calls for nothing less than a re-engagement with the self-constituting process of humankind (Habermas 1972: 113). This lies in communicative interest as opposed to that of purposive-rational action[61]. The way of

with romantic idealisation of earlier times in this fashion… eg. Ellul.

[61] It is worth noting that as the social and natural sciences (or rather Geistes- vs. Naturwissenschaften) generally stand for these interests/action, there is an intensifying push in universities and research institutions to force technical rationality on the social sciences as the only legitimate criterion for assessment of worth and relevance. This effect often comes across to

bringing back into play communicative action and emancipatory intent at the levels of both governance and culture is through democracy, and within it, through the strengthening of the public sphere via fostering of undistorted communication.

Conceptually though, first Habermas wants to re-constitute the original Marxian framework of analysis operating with the concepts of forces of production (work) and relations of production (interaction) because the former, under present conditions, is no longer the basis for human emancipation. His analytic entities become institutional framework (interaction) and subsystems of purposive-rational action (work) instead. The latter level, which obviously includes science and technology, is where purposive rationality originates from, where this mode has to remain dominant and where it still has the potential to be liberating. At the institutional level rationalisation can only be liberating if it operates through the medium of symbolic interaction. Once purposive rationality infiltrates this level it becomes oppressive, therefore communication needs to be freed up. When unshackled this way communication becomes ideologically and systematically undistorted and 'furnishes members of society with the opportunity for further emancipation and progressive individuation' (Habermas 1972: 119).

"Good life" therefore does not equal the unfettered growth of productive forces, presently mostly aligned with technoscientific rationality, although these may contribute to it under more liberated conditions. Such conditions are primarily based on unrestricted communication focussing on the 'goals of life activity and conduct' and their primary scene is within the public sphere mediated through mass media.

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participants on the social sciences side as an encroaching of the operating logic of the natural sciences onto their differently constituted sphere of research and engagement.

Capitalism, however, puts up an organised resistance to such unrestricted communication that needs to be democratically countered, resulting in a new conflict zone between capitalism and democracy that replaces older class conflict. The task now is to unmask the systemic effacement of the difference between purposive-rational and communicative action, between progress within purposive-rational subsystems and emancipation at the level of institutional framework, between technical and practical problems. Another part of this task is to enable, foster and strengthen the theatres of communicative action within a democratic system that itself has to be procedurally and substantively strengthened. The task of continuously and consensually re-defining the guiding values of a "good life" can only be collectively carried out by an informed and active citizenry under conditions that maintain the vitality of a democratic public sphere. Within the Habermasian framework this could re-set the balance of communicative and purposive rationality and the latter, embedded within science and technology, could perhaps re-gain its own emancipatory potential by entering a dialogue with society and with policy makers about the consequences of scientific work and how societal interest can spawn new directions in research.

# Concluding remarks: normativity and synthesis

The reason why the scholarship of both Feenberg and Habermas are necessary for a reformed Science Studies is that they both operate with a Critical Theory framework that addresses the neglected tasks of the field. Together they successfully negotiate and articulate the HPS-STS divide, capitalise on the insights of both by placing them in a dialogue that allows for the recognition of their strength and limitations, and thereby bring the field to a renewed self-understanding.

Feenberg's Critical Theory of technology renews a rich social constructivism in the field and uses subversive rationalisation to analytically take apart technology and show the logical site for transformative action: how alternative social values can be used to animate technology via its technical code. Feenberg provides a transformative progressive outlook on technology and its relationship to rationality and democracy, yet does it in a way that is both empirically relevant and eminently useful. Unlike the currently favoured approach of ANT Feenberg's framework is transparent, deeply sociological and politically useful in the sense that it lends itself to the negotiation of values that go into technology development. Because of these Feenberg's approach is a much better candidate for renewing the STS side of Science Studies.

Habermas's Critical Theory of science is able to do for HPS what Feenberg's theory does for STS, albeit in a slightly different way as science is a system with different

cultural values from that of technology, which is why STS cannot be collapsed into HPS in the first place. Habermas built an epistemological understanding of science that sees science as a special societal subsystem that operates with a dominant set of purposive-rational, instrumental and technical rationality. His analysis is dialectical and breaks down to two complementary analytic categories.

The 'society-in-science' view discovers the elementary instrumental-rational kernel of science which cannot and should not be touched by social constructivism as this is the core of the scientific enterprise that makes science what it is: a successful, eminently useful and beautiful human endeavour. Yet Habermas also discovers the essentially social nature of science through the communicative interest that lies at the heart of science, without which there would be no exchange of ideas or consensus building. An immanent critique can illuminate the imperative of discovery, strengthen the communicative values within science, and support its overall intellectual autonomy.

The 'science-in-society' view on the other hand very much needs the critical edge of social constructivism. Here science is understood as a societal subsystem that inadvertently contributes to the imbalance between instrumental-technical rationality and communicative-practical interest, to the latter's detriment. Technocratic rationality becomes a legitimating force in politics and helps pre-empt a richer democratic dialogue via de-politicizing human choices and reducing them to narrow technical ones. The overbearing instrumental-technical values of science become an ideology that threaten the overall balance of human interests and therefore threaten democracy itself. It is the task of Critical Theory of science then to try to rehabilitate

science and address the existing societal imbalance. Communicative interest needs to be strengthened and science needs to be analysed in terms of its relationship to Nature so that domination and control can be substituted for dialogue and engagement. Alternative social norms need to be brought into scientific discussion and the negotiation of the pathway of technological development. Society needs to bring back the essential practical interest in the forms of a wider societal dialogue and deliberation on the broadest human needs, values and ethics that are beyond a narrow technocratic consciousness.

All that Critical Theory is about can be shown to unite the frameworks of Feenberg and Habermas: an essential emancipatory interest in studying science in society, bringing together theory and practice, a social constructivist outlook fortified with a progressive social agenda that is aimed at the democratisation of science and technology, and the transformation of normative input that can positively effect the imbalance between instrumental-technical and democratic norms. In both their visions these together could make way for alternative ways of engaging with Nature and a transformation of human relationships via changes in technology.

Neither theorist calls for a complete overhaul of the relationship between humanity and Nature as Marcuse's analysis implicated earlier, but neither do they get lost in self-reflexivity as SSK did, or operate with vague and confused conceptual layers transposed over post-structural confusion the way ANT does. Both Feenberg and Habermas are realistic yet engaging, comprehensive, empirically useful and illuminate science and technology in a way that produces insights highly relevant for

their democratisation. These are all qualities that have been sorely missing from Science Studies.

They differ in their analysis as much as their subject matter differs: science has a kernel of autonomy and intellectual rigour that needs to be preserved, while technology is a purely instrumental-technical undertaking without a similar communicative discourse-oriented core. Yet both yield to social constructivism and both need to be critiqued equally. Both can and need to be analysed with rigour and responsibility: science yielding to a more philosophical HPS-style analysis and technology more to a sociologically oriented STS-style one. Together they can finally form the unity of vision that Science Studies needs while also maintaining a separation in subject matter and scholarly values that need to underpin the STS-HPS divide. Finally, it is the Critical Theory core and its scholarly tools that ensure that common values are maintained between the two so that there is a strong common ground of values and orientation on which a new form of dialogue for Science Studies can begin.

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