ON POSITIVISM AND ITS CRITIQUES: AN ENQUIRY WITH SPECIAL REFERENCE TO FEMINIST EPISTEMOLOGIES

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DECLARATION

I declare that the dissertation entitled '**On Positivism and Its Critiques: An Enquiry With Special Reference to Feminist Epistemologies**' submitted by me in partial fulfillment of the requirements for the award of the degree of Master of Philosophy of Jawaharlal Nehru University is my own work. This dissertation has not been submitted for any other degree of this university or any other institution.

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CERTIFICATE

We recommend that this dissertation be placed before the examiners for evaluation.

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Preface

The roots of my interest in questions of women and the sciences were laid in a course on gender and society that I studied as part of my Master of Arts course. Sociology had always seemed to me to provide a unique insight not only into the social world in general, but my own world in particular. It gave me a new, and I felt, better, way of looking at my own life – at myself, my family, friends, classmates, the choices that were open to me, the decisions I had taken. The course on gender seemed to add a new dimension to this perspective. I felt that I was suddenly in a position to better understand many more things that I saw around myself – the derision with which some of my classmates spoke of a girl who was wearing revealing clothing; the insistence of one of my male friends on escorting me back to my hostel after a late-night study session in the library; the problems faced by the women in the physics class (three out of a class of thirty) in visiting the laboratory at night, as their male counterparts did. Yet I did not feel that other female classmates, also in that class, studying the same theories and concepts that I was studying, were as affected by it as I was. I did not feel that it was my business to convince them of what I felt was the day-to-day reality and immediacy of the concepts that we were studying, their manifestations in our own lives. More importantly, I did not think that I was equipped to convince anyone of anything. For my opinion on these matters was just that – my opinion, no better or worse than anyone else's – and therefore, not in possession of authority to question or dictate anyone else's.

This experience has led me to think about the kind of knowledge that one can use to convince other people: knowledge that is fact, and not opinion, that communicates something that is true, something that exists in reality and not only within my own mind. Looking around myself, I felt that the only form of knowledge that seemed to fulfil these requirements was scientific knowledge. Unlike sociologists, who were forever in argument about basics, scientists seemed to know what they were talking about. Scientists appeared to be dealing in the objective reality that I wanted to talk about, appeared to have the certainty that I wanted to be able to speak with. Yet it appeared that to be scientific, I needed to look at the world without biases that I had in my mind – which included the insights that had been generated through my study of

gender. These were preconceptions that would give me an incorrect view of reality. I, on the other hand, thought they were *reality. Then I was told that objectivity was impossible because everyone spoke from some (subjective) location. This served merely to confuse me further, and to make me less sure of whether the insights I had were, or could be, meaningful for anyone else.*

This confusion had led me to this particular topic, a sort of tying together of my two main interests. Hopefully someday I will generate more answers with them than I do at present; but until then, I am grateful that the process of trying to understand these issues is an interesting one, and rewarding in itself.

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—INTRODUCTION—

My attempt in this dissertation is to try to understand the positivist methodology in light of the various critiques that have been raised against it in the twentieth century. Positivist methodology has been a major influence upon both the natural and social sciences, and the critiques of positivism have also had a large role in shaping discussions of methodology. Post-positivist critiques have challenged some of the basic assumptions of the positivism, some of the basic grounds upon which positivist knowledge claims were based. Feminist epistemologies can be seen as part of the post-positivist critique of the sciences yet go beyond them, questioning some of those facets of positivist epistemology that other post-positivist scholars leave untouched.

Positivism as epistemology and methodology is conceptualised as a form of knowledge that bases itself on a certain dualism – between the subject and object of knowledge, between man and nature, fact and value. This form of knowledge has been conceptualised as unique in terms of the valid knowledge it offers us. Feminist epistemologies, emerging in the twentieth century, have done much to challenge these assumptions. Feminist epistemologies emerge from an attempt to look at epistemology – questions of the nature of knowledge, of its reliability and validity, of the grounds for knowledge – not from the perspective of a detached observer, but from the perspective of women. Thus the basic challenge that feminist epistemologies place before positivist epistemology is that of the idea that an interested (as opposed to disinterested) knower can have better knowledge of the natural and social world. This argument is particularly important if we accept that detachment is not possible – that we are always in some kind of relationship to our object of knowledge. Nowhere is this plainer than in the social sciences.

In this dissertation, my attempt is to begin by tracing the development of positivist science, starting from its beginnings in the 16^{th}-17^{th} centuries in Western Europe. This new science involved a radically different cosmology, a new set of tools and techniques (that is, methods), and above all a new methodology for doing science.

Steven Shapin has described this 'Scientific Revolution' in terms of four major changes in the scientific outlook. Firstly, the mechanisation of nature: the process whereby nature came to be seen as a machine, a system of inter-related parts functioning in a manner similar to clockwork. Secondly, the depersonalisation of nature, the 'growing separation between human subjects and the natural objects of their knowledge....' The third point made is of the growing mechanisation of knowledge-making: the creation of rules of method which, if adhered to, would allow the researcher's work to be devoid of the influence of his own interests and passions. Fourthly, the new science, being 'benign, powerful and...disinterested', could be deployed for social and political ends.[1]

The idea that science – either as a body of knowledge or as a method of enquiry – can be used for the purpose of leading us to or creating a better society is reflected in the work of Auguste Comte. Comte coined the term 'positivism' to refer to, amongst other things, a theory which argued that the only true knowledge available to mankind was that of 'science, grounded in observation'. The phrase 'grounded in observation' is important here: the hallmark of this mode of scientific enquiry is its claim to be based upon empirically observable facts. According to Peter Halfpenny, within Comte's positivist mode of thought, "reason [is] subjugated to reality."[2] Knowledge claims, to be deemed valid, would need to be tested against empirical reality. They could not be based upon a priori deductions or principles: this would lead to a realm of pure speculation, whereas the positivist mode of scientific enquiry would allow researchers to remain grounded squarely in the world of facts. Reasoning from facts would allow the generation of laws (in Comte's case, of society) similar to the laws of any other positive science. Comte's attempt was to integrate the methods of the natural sciences into the study of society and social life, scientific thought being the paradigm of all valid knowledge.

Basing one's knowledge claims upon that which can be empirically observed also allows one to limit oneself to the realm of facts: statements about reality, about things which actually exist in the real world. It allows the researcher to claim an objective position with regard to the natural world that is the object of study, and to hold that any statements made about the nature of this reality derive from reality itself. Any

[1] Shapin 1996: 13
[2] Halfpenny 1982: 16

thoughts or insights that generate from within researcher – say, his or her own personal opinions or beliefs – are deemed to be subjective and thus have no place within the research process. A strict adherence to positivist methodology, through its emphasis upon empirical verification, is expected to help in eliminating biases deriving from the researcher's own subjective position with regard to his or her work.

* * *

The scientific methodology that we have elucidated above has various dimensions – rationality, objectivity, value-neutrality, its propensity for self-correction, its social value.

These themes have been treated in various ways by post-positivist scholars. The incentive to examine scientific methodology, to accept various parts of it and reject or reformulate others, has been driven often by the perception of a gap between the tenets of methodology and actual scientific practice, or a comparison between actual methodology and an ideal scientific methodology, or simply the perception of the inadequacies of methodology. For example, Karl Popper's critique of the inductive methodology of the logical positivists rests upon the idea that induction can never yield certain knowledge. Paul Feyerabend argues that scientific methodology is inherently restrictive – that adhering to a strict set of methodological prescriptions will not allow one to do any science worth its name.

Another major reason for the reconsideration of scientific methodology is the idea that some of the extremely harmful outcomes and results of science and technology are directly related to scientific methodology. For example, Vandana Shiva directly links environmental degradation to ideas of scientific farming and forestry that are informed by a science that is highly reductionist, that looks at only parts of systems and not wholes.[3] Another major event which has led to the questioning of the value of science for society, is the use of nuclear weapons during the second world war. For many scholars, that event is a horrifying example of the excesses that a science divorced from values becomes capable of. It also leads us to question the ramifications that scientific rationality can have, not only within the sciences but also for the rest of society.

[3] Shiva 1988: 14-37

The study of scientific methodology, then, involves an examination of the dialectical relationship between science and society. Various questions are raised here: how are science and its institutions organised? How are they funded? Who occupies positions of authority within them? Who can participate in the process of the generation of scientific knowledge? What is the import of scientific pronouncements upon society, and conversely, how do social structures, institutions, values, and norms impact the content of science?

The feminist critique of science is a good way of understanding the idea of the dialectic of science and society. Science that is generated in a society that is patriarchal, in which the distribution of power is skewed towards men, in which women are considered to have either inferior, or 'different' intellectual capacities, will reflect these social features. Conversely, it will produce accounts of the natural world that support notions of the physical, intellectual or emotional inferiority of women. (Or any other oppressed group – thus a racist society will both restrict racial minorities from doing science, and produce scientific arguments to justify this restriction.) The content and context of science are intimately linked. Thus the feminist critique of science may begin from a position where it demands that women have equal access to learning, teaching and research in the sciences, but quickly moves beyond this to the content of science – including scientific methodology.

Feminist scholars have been critical of the representations of women in and by the sciences. Thus many feminist scientists have worked towards undermining flawed and biased accounts, replacing them with accounts that are unbiased and are therefore better science. However, other scholars have argued that positivist epistemology is in itself masculinist – that it represents a particularly male outlook upon the world. In this case, the induction of more women into the sciences would not change matters, so long as women continued to be trained into a masculinist scientific tradition. Thus a feminist epistemology is needed, one that can counter the masculinist leanings of current scientific practice. What this epistemology is to be, what form it is to take, is of course a matter of debate.

Chapterisation:

In the first chapter, we will trace the development of positivist science, the beginnings of which can be seen in Europe in the sixteenth and seventeenth centuries. We will analyse the genesis of some of the dualistic categories through which positivist thought came to organise itself, and also examine the ideas of objectivity, value-neutrality, rationality and progress that we will trace in the later chapters.

In the second chapter, we will look at the post-positivist critiques offered by Karl Popper, Thomas Kuhn, and Paul Feyerabend. Popper's lasting contribution to the critique of positivist science is the concept of falsification. Through this concept, he has challenged the idea of conclusively verified knowledge. His commitment to science is nonetheless unquestionable as in his definition, science is equated with rationality. Kuhn, though equally committed, has inspired some of the most radical interpretations of scientific activity. His idea of science as paradigm-driven challenges conventional notions of scientific progress, objectivity, and rationality. Feyerabend, in contrast to Popper and Kuhn, denies science any privileged place amongst all the ways of knowing the world. He also argues that adherence to a singular scientific methodology is impossible, that the sciences have not and cannot develop thus. In this chapter we will also look at some of the ethical issues surrounding modern science that have been raised by various Indian scholars, like Ashis Nandy and J.P.S. Uberoi, particularly around the issue of science and violence. Through this chapter we will demonstrate some of the internal limitations of positivist science, both epistemological and social (in terms of its application).

The third chapter examines the feminist engagement with positivist science. Here we examine the empiricist, standpoint, and postmodern feminist epistemologies, and explore their engagements with the ideas of objectivity, rationality, and value-neutrality. We will also look at Hilary Rose's ideas for a transformed science – for a socialist feminist, ethical scientific practice. Though feminist epistemologies are deeply varied, they have all significantly engaged with various dimensions of positivist science, to revaluate and reinterpret the tools it offers with a view to developing an improved feminist epistemology.

—CHAPTER ONE—

The Emergence of Positivist Science

What do we mean by positivism? The term itself has meant many different things to different people during the course of the history of modern Europe. For example, for Auguste Comte, the term referred not only to a way of knowing the world or a theory of knowledge, but also to an entire religion, a secular religion devoted to the worship of humanity. For Herbert Spencer, positivism meant a mode of historical development whereby the growth of knowledge was seen as the driving force of history and the basis of the progress and development of society. For scholars like JPS Uberoi, positivism is a method of science, and as a method of science it is a manifestation of a particular worldview that became ascendant in Europe in the mid-seventeenth century.

For our purposes, we are interested in positivism as a theory of scientific enquiry into the natural world, into natural phenomena. Here it is important to keep in mind that there are many different opinions of what constitutes valid knowledge of the natural world, all of which may be considered to be positivistic. For example, in listing types of positivisms, Peter Halfpenny includes both the inductive method of enquiry advocated by Francis Bacon, as well as the hypothetico-deductive method of Karl Popper.[1] Uberoi speaks of how, within the positivist method, scientific laws can either be based upon 'theoretical deduction (rationalism)' or upon 'observation, experience and induction (empiricism)'.[2] Thus the positivist method of scientific enquiry is clearly not narrowly prescriptive, in the sense that it does not lay down a specific procedure for conducting scientific research. The purpose of this enquiry, then, is to attempt to isolate the features of what may be called a positivist methodology, its underlying theoretical and methodological principles (principles which allow for a fair amount of diversity in actual scientific research). Thus, what we need to ask ourselves is: how, through the positivist methodology, do we approach our object of study? What is the nature of the relationship this method of enquiry posits between the

[1] Halfpenny 1982: 115
[2] Uberoi 1978: 19

knower and the object of study? What are the tools for analysis that are placed at his or her disposal? What kind of knowledge does this methodology consider to be valid? What are the applications of the knowledge produced by this methodology?

According to Uberoi, the fundamental feature of the positivist method is its essentially dualist character. Dualism itself refers to the practice wherein a fundamental distinction is made between two things, such that they are held to be essentially different from one another. These could be two ideas, two substances, two beings. The positivist method rests upon various dualisms: of fact and value, of subject and object, of truth and reality. Operating through these dualistic categories allows the positivist method to construct a form of knowledge of the natural world that derives validity through the ideas of objectivity and value-neutrality. The basic premise here is that a student's detachment from his or her object of study produces knowledge of that object which is more correct than any knowledge derived from a student who lacks this necessary distance from the object.

This view is itself based upon the assumption that such a distance between the observer and the observed is indeed possible.[3] In the case of the positivist philosophy of science, this would entail conceptualising nature as an entity that the human subject may be detached from, so as to be able to observe it from a kind of Archimedean point: a conceptualisation that is radically different from many other descriptions of and analogies for nature. Many scholars would argue that this is the kind of conceptualisation of nature that came into being in Europe in the mid-sixteenth century, during the time of the scientific revolution.

The Scientific Revolution

The term 'scientific revolution' is used to denote a period of European history which saw rapid and drastic changes in the nature of scientific activity: rapid, drastic changes in which lay the origins of modern science. We have already spoken of reconceptualisations of nature; to these corresponded changes in the methods and methodologies of science. The emergence of a 'scientific mentality' is also associated with this period: the mind that is driven by a spirit of enquiry, which does not accept answers based upon tradition or authority but which is sceptical, believing in scientific

[3] Uberoi would contrast this with other methods of science that would not recognise or would seek to collapse such a distinction: for example, his formulation of the semiological method.

investigation (howsoever 'scientific' is described – with reference to the evidence of the senses, for example).

In *The Scientific Revolution*, Marcus Hellyer presents a 'usual' picture of this event.[4] Such an account usually begins with the fifteenth century, with an account of Copernicus's heliocentric view of the universe (published in his *De Revolutionibus Orbium Coelestium* in 1543). It then moves onto Johannes Kepler, who argued that the orbits of the planets as they revolved around the sun were not perfect circles but were instead elliptical. Kepler published his findings in the *Astronomia Nova* in 1609. The next figure to appear is Galileo, who published the results of his examination of the heavens through his telescope in 1610, thereby furthering the heliocentric picture of the universe. The account of the scientific revolution usually concludes with Isaac Newton in the seventeenth century, with his discovery of the law of gravitation and of the three laws of motion. This marks the end of what Hellyer refers to as the 'cosmic relay race' of the scientific revolution. This narrative of the scientific revolution thus gives a straightforward account of the development of modern science: a history of the development of the modern scientific method since its origins. The sum total of this method is a science which, according to the historian Reijer Hooykaas, has the following features[5]:

1. It "acknowledges no authorities...other than those of nature itself". These authorities may be internal to or external to science itself: for example, a dominant theory or school of thought within a scientific discipline, or a religious authority like the Catholic Church. The scientific revolution contains examples of scientists' opposition to both types of authorities: for example, in accounts of scientists like Galileo and Copernicus presenting their heliocentric theories in as rejections of Aristotelian and Ptolemaic geocentric models of the universe, or in the Catholic Church's opposition to Galilean astronomy. The third authority that is not recognised is that of "reason itself": the evidence of nature is to take precedence over the preconceptions and rationalisations of the researcher.

[4] Hellyer 2003
[5] Hooykaas 2003: 21-22

2. It is experimental, basing itself not only upon observation of nature but also upon the manipulation of nature.

3. It "favours a mechanistic world picture, explaining natural phenomena as much as possible by analogy with a mechanism".

4. It tries to explain the natural world in mathematical terms and tries to "quantify qualities".

Contemporary scholarship in the area of the history of science, however, has rejected the idea of a single, monolithic, overarching revolution in science, for a variety of reasons. The scientific revolution of the sixteenth and seventeenth centuries seems to have been limited to the sciences that are now subsumed under the field of physics: astronomy and mechanics. Other fields, like chemistry or natural history, were not revolutionised at this time: to quote Hellyer, natural history had to "wait until the nineteenth century for Darwin."[6] Steven Shapin points out that a single method of doing science did not emerge even within the field of physics.[7] He refers to sixteenth and seventeenth century science as a "diverse array of cultural practices...each with different characteristics and each experiencing different modes of change."[8] This is far from being the single, coherent picture of science put forth by the traditional narrative of the scientific revolution. Herbert Butterfield had spoken of the scientific revolution as giving rise to the 'modern mentality' - yet Shapin also argues that the ideas of the natural world, or of how best one could know the natural world, held by the ordinary people of these times themselves were not revolutionised and that most people, even those who were educated, did not share the beliefs of the scientific practitioners. Thus the notion of the scientific revolution carries much less weight today than it did during the first half of the twentieth century – in fact, it has been undermined to the extent that some scholars have suggested abandoning it entirely.

In their essay '*De-centring the "Big Picture": The Origins of Modern Science and the Modern Origins of Science*',[9] Andrew Cunningham and Perry Williams point out that the popular narrative of the scientific revolution came into being in the 1930s, through

[6] Hellyer 2003: 4
[7] Shapin 1996
[8] Shapin 1996: 3
[9] Cunningham and Perry 2003

the work of scholars like Alexandre Koyre and Herbert Butterfield, scholars who were trying to formulate a picture of the origins of science of a particular kind.

According to Cunningham and Williams, for these scholars, science was seen in essentially three ways. Firstly, it was seen in philosophical terms as a method of investigation of nature, one which aimed at the formulation of precise laws of nature, preferably those which were or which could be stated in mathematical form. This way of understanding science, which was the "legacy of nineteenth-century positivism", was manifested best in twentieth-century logical positivism.

The second way to look at science was to understand it as a moral system: to see it as encapsulating the basic values of truth, rationality, goodness and progress. It was generally believed that modern rational thought, once widely disseminated amongst the population, would put an end to much misunderstanding and conflict, prejudice and superstition.

Thirdly, science was seen as "a universal...activity." It was understood to be a manifestation of an innate human curiosity – something that was part of human nature and therefore to be found in all people everywhere. The spirit of inquiry upon which science was based, therefore, was an integral part of all societies. Thus the scientific practitioners of the seventeenth century could be seen as doing essentially the same thing as the scientific practitioners of Aristotle's time, or of other societies that were contemporaneous with their own (the significant difference being, of course, that they had discovered the correct method by which the investigation of nature was to be carried out). Similarly, a line of continuity could be drawn from the seventeenth century to the twentieth – the period in which the idea of the scientific revolution gained the most currency.

The Scientific Revolution, thus, is seen by these authors as the invention of twentieth-century historians, who read into the seventeenth century the origins of twentieth-century science. The method followed was roughly to define the science of the twentieth century as science as it had always been, and then trace its pedigree to the sixteenth and seventeenth centuries. The latter centuries then came to be understood as that period of time when the modern scientific method was discovered and firmly established – a history that is not borne out by contemporary scholarship on the subject. The picture of the scientific revolution as a major, cataclysmic event in the

history of science is, for many contemporary scholars, certainly untrue. Nonetheless, this does not mean that no changes took place in the sciences at all in this time – the changes were simply of a different order than is revealed by this account.[10] Thus though many of the features of modern science that are mentioned above can be traced to this period, they were not as rapid and comprehensive as they have been made out to be.[11] Rather, their impact in the area of modern science has been significant, but gradual and irregular.

One of the major changes that Steven Shapin discusses in his work is that of the "mechanisation of the natural world". This refers essentially to the use of a mechanical analogy to explain the natural world. Nature here is seen as a machine, consisting of discrete parts which work in tandem, like clockwork. In fact, for the seventeenth century natural philosophers, the clock was the most important metaphor for nature. A clock was a set of discrete parts, arranged in a particular order and set into motion. The various parts of the clock themselves lacked volition and awareness, yet each part performed its function and the clock itself worked smoothly. The manner in which a clock functioned could then be seen as a model that could be applied to the natural world, to explain phenomena ranging from bodily functions like respiration or locomotion to the motions of the planets. Thus in 1605 Johannes Kepler wrote that his "aim [was] to show that the celestial machine [was] to be likened not to a divine organism but to a clockwork".[12] In the 1630s, René Descartes drew analogies between the movements of clocks and natural bodies; Robert Boyle, in the 1660s, said that the natural world was "a great piece of clock-work."[13]

The machine itself was an artificial device, created by a human being, but working in such a way that one may have been mistaken into thinking that it had some volition or idea of its purpose. We say mistaken, because the parts in question were not actually considered to have any agency. The mechanical philosophy stood in opposition to those philosophies that would imbue nature with agency. Shapin's most important example in this regard is Aristotelian physics (particularly as it was this which early mechanical philosophers consciously worked towards undermining), but a number of

[10] After all, even though Shapin declares that there was no such thing as the scientific revolution, he still writes a book upon the subject, and titles it 'The Scientific Revolution'
[11] An example might be Hooykaas's characterisation of modern science as experimental or mechanistic.
[12] Shapin 1996: 129
[13] Robert Boyle, quoted in Shapin 1996: 34

other philosophical systems would look at nature as alive, and would ascribe vital forces to it.

In her work *The Death of Nature*, Carolyn Merchant speaks of various cosmological systems that were undermined and negated by the mechanical philosophy. The significant difference between these cosmologies and that of the mechanical philosophy was that the former were organic in nature, that is to say, they conceptualised the earth and nature as living things. The dominant metaphor used to describe the earth in these cosmological systems was an organism, and in particular, a female organism. The pre-modern world (to quote Merchant, the "world we have lost") was an organic one: where "the root metaphor binding together the self, society and the cosmos was that of an organism."[14] Merchant gives various examples of such cosmologies: from Plato, who "endowed the whole world with life and likened it to an animal", to the Neo-Platonism of the Renaissance that conceptualised the world as "enlivened by the female soul."[15] As an organic being, the world contained within itself the impetus for change and evolution: for example, in renaissance naturalism, change occurred through the action of contrary principles like heat and cold. The most "radical analysis" of matter and motion, for Merchant, was the vitalism of Paracelsus in the fifteenth century. Vitalism considered matter and spirit to be unified into a single substance, one that was therefore inherently active. Even schools of thought which did not subscribe to this extreme notion of the unity of matter and spirit, still considered both to be part of the same natural world – the world spirit, for example, was still a part of nature and not something external to it.

How does this compare to mechanistic philosophy? Let us consider again the metaphor of the clock. As we have said above, the parts of the clock themselves are not imbued with any agency or volition. Each part is arranged in a particular way in relation to the whole by the person who makes the clock, and functions in the way in which it does because it is so arranged. The clock is also set into motion by the clockmaker – it does not have any inherent capacity for motion. The force that set the mechanism into motion, then, need not be a part of the mechanism itself. The impetus towards change, too, would not originate from within the machine, but would result from force externally applied. For Merchant, this constitutes a dualism: between dead,

[14] Merchant 1980: 1
[15] Merchant 1980: 11

inert matter, and motion. By the seventeenth century, it was this dualistic model of the natural world that was gaining ascendance.

The dualistic picture of the natural extended to human beings themselves. The best-known theory on this regard is that of the mind-body dualism of Descartes.

In Cartesian philosophy, a substance has one, and only one, principal attribute: that is, a property that constitutes its essence. A substance cannot have, say, two principal attributes. To argue that it can, would be akin to saying that it could have two natures, which for Descartes, "implies a contradiction".[16] It is the principal attribute which would make the substance "a being in its own right".[17]

The body, as a material object, has the attribute of extension – the property of taking up physical space in such a way as to exclude other bodies from the same space. The body cannot, for Descartes, be thought of except as an extended substance. The mind, on the other hand, cannot be thought of as an extended substance (it is "denied real extension"),[18] as it cannot have the same principal attribute as another substance (in this case the body). The principal attribute of the mind is instead *thought*. To think of the mind is to think of it as a thinking thing, in the same way that to think of the body is to think of it as an extended thing – it is in this manner that the principal attribute defines the substance.

Thought itself was of various kinds. Descartes considered three such forms: intellection, imagination, and sensation. Of the three, it was only the first – intellection – that could be considered to be pure thought. The faculties of sensation and imagination involved the body as well, drawing upon physical stimulus – pure intellectual activity did not. Of course imagination and sensation also contained an intellectual component, but they also consisted of something else, something which was derived from a union with the body, and as such they were impure forms of thought. Intellect thus was the essence of the mind,[19] and sensation and imagination

[16] Rozemond 1998
[17] Rozemond 1998: 12
[18] Rozemond 1998: 13
[19] Rozemond 1998: 39

were not. Descartes could "clearly and distinctly understand himself without them"[20] but without thought would "cease to exist."[21]

Descartes recognised that, nonetheless, our sense perceptions have a tremendous impact and authority in determining what we made of the natural world, and that we see a correspondence between the information we derive from our senses and the real world. Thus for example, if we feel that fire is hot, we assume that fire possesses the quality of heat. For Descartes, this is an erroneous assumption. Instead, the only qualities that we can say with certainty that bodies possess are mechanical qualities: length, volume, position, depth, and so on. Our explanations of natural phenomena thus must be based entirely upon mechanical qualities, and not the sensible qualities that natural objects do not actually have.

It is important to note that here, natural objects also included the category of animals. The behaviour of human beings was informed by thought, since the human body contained a mind as well as sheer matter. Animals, on the other hand, lacked minds (which Descartes equated with souls) and therefore the ability to reason. The behaviour of animals could be adequately accounted for by mechanistic explanations. In this regard they were similar to machines, which also acted in certain ways not because of their knowledge but instead because of the "dispositions of their organs".[22]

What were the implications of such a perspective? Firstly, it ranked various ways of obtaining knowledge of the natural world in terms of their purity, with purity defined in terms of distance from the physical body. The information that we derive of the natural world from our senses was necessarily deceptive: we could not say that the natural world is the way we perceive it to be. Real knowledge, then, was to be derived through the 'cold, hard light of reason'. This is not to equate the new ways of knowing with purely deductive systems of thought and logic: rather, it is to say that natural philosophy had to employ reason (pure, unbiased and valid) to arrive at the objective facts of nature. These are those facts which correspond to the real world, to the way that things really are, and not to individual opinions and perspectives which, like our sense-perceptions, give us an incomplete and inherently flawed view of nature.

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[20] Rozemond 1998: 53
[21] Rozemond 1998: 46
[22] Rozemond 1998: 42

Secondly, this distinction between objective reality and subjective perceptions corresponded to a distinction between facts and values. Facts here represented statements of reality, corresponding to the real world, while values were judgements. Like sensory data, judgements could also corrupt the scientific enterprise. Values in this sense were seen in terms of biases and prejudices, and in this capacity could play an important part in determining what facts were to be accepted as valid, or rejected. In a science which recognised only two authorities – reason and evidence – values and preconceptions had no role to play. Thus the scientific method had necessarily to weed out values and create a value-neutral approach to the study of nature.

Thirdly, this perspective also implied a changed relationship between man and nature. We have already said that within the mechanistic framework, nature was dead and inert, merely acted upon by forces. With the conceptualisation of nature as pure matter, the idea that nature had a soul was also done away with. Humans were considered to differ from animals because animals lacked the capacity for abstract thought. The faculty for reason thus gave man a unique position of power over the natural world.

Objectivity and Subjectivity

Objectivity can be seen in two ways: ontological objectivity and epistemological objectivity. Attempts to understand objectivity as a concept also necessarily entail an analysis of the concept of subjectivity.

Ontological objectivity has to do with what actually and concretely exists in the real world, independent of human perceptions. Thus for example trees and rocks, atoms and molecules, comets and meteors, are all objects which exist in the real world. They exist even if there is no one to observe them. Other things on the other hand exist only if there is someone to observe them: for example we can say that certain *qualities* have no ontological objectivity. Thus when we say that water is tasteless, we mean that water is tasteless to us. Taste is a quality that exists only in relation to the observing subject, and is therefore subjective; other qualities, like density, have an objective existence outside of the mind of the observer.

Epistemological objectivity has to do with the reasons for which we accept statements to be valid descriptions of reality. To be objective is to put aside all "idiosyncratic

predilections and parochial preferences"[23] in the process of forming opinions. It is to be impartial, to disregard one's own preconceptions. Subjective opinions, on the other hand, are justified on grounds of preconceptions that have nothing to do with pure reason. Objective reasons for a particular belief cannot include personal preferences: subjective reasons are constituted by such preferences. Objectivity is then to be achieved by taking recourse to reason and rationality to justify (or fail to justify) arguments.

We see evidence of both of these varieties of objectivity in the works of the natural scientists of the sixteenth and seventeenth centuries. Perhaps we could say that the seed of these ideas was planted around the time.

The notions of ontological objectivity and subjectivity are reflected in the Cartesian notion of primary and secondary qualities of objects. We have already noted that for Descartes, the only real qualities that an object possessed were its mechanical qualities. Within Cartesian physics objects possessed two types of qualities: primary and secondary. Primary qualities are those which properly belong to material objects: they correspond to mechanical qualities, which represent what objects are 'really like'. Secondary qualities are those which exist only within the minds of observers, for example, sensible qualities. The only real qualities are mechanical ones. This has significant methodological consequences: for the purposes of conducting scientific research, we need to enquire only into the mechanical properties of any object or system of objects. For Descartes, only mechanical qualities could be spoken of with certainty: it is this that distinguished them from sensible qualities. Thus idea of what could be known with certainty was limited to a very small area of actual human experience of the natural world.

The second dimension of objectivity has to do with *impartial* knowledge and with the rejection of any prior epistemological and personal commitments. According to John Henry, the opinion that science is the supreme provider of impersonal and objective knowledge originated amongst English Baconian philosophers. Bacon's method of science was inductive, proceeding from the collection of facts. Experimental methods of investigation, he held, "confirmed what one already believed."[24] The inductive

[23] Rescher 1997: 3
[24] Henry 2004: 17

method, however, used the facts collected to generate explanations of natural phenomena, and thus eliminated the space for preconceptions. Baconian scientists then could "claim to be dealing only with matters of fact". The Royal Society was described in 1667 as pursuing the Baconian method and "wholly omitting doctrines,"[25] in this case, religious and sectarian doctrine. Objectivity in this sense could be seen in the sense of maintaining a certain distance from the object of enquiry – having an impersonal stance towards it.[26]

There is another sense in which objectivity can be seen. This is to look at it as a 'view from nowhere'. When we physically look at any object, we do so from a certain position, a certain perspective. From that position, it appears to us in one specific way and we simultaneously fail to see the other ways in which it could appear, from other perspectives. Thus we derive only a partial view of that object. An objective view, in this scenario, would be one that incorporated all possible perspectives, thereby cancelling out the errors of each individual one. This is what has come to be known as a 'God's eye view', or 'Archimedean point' from which to view the world. Of course, no such point exists: according to Nicholas Rescher, "whatever we can judge we must judge from the vantage point of a position in space, time, and cultural context".[27]

Nonetheless, for Rescher, this does not mean that objectivity is impossible, but that the 'view from nowhere' definition of objectivity is flawed. Objectivity is tied to reason; it is to work within the "dictates of impartial reason."[28] It is to employ reason and rationality, and to reject the subjective elements that influence thought (biases and prejudices, prior loyalties, ideological commitments and so on). The correspondence between objectivity and reason makes it universal: this is because rationality is, according to Rescher, 'circumstantially universal'. This is to say that rationality means doing what any rational person would do within a given set of circumstances. Of course, different people do different things within the same set of circumstances. How then do we determine which of the paths of action taken within a particular situation was the rational one? Actions are rational when people have cogent grounds for

[25] Henry 2004: 18

[26] For example, Auguste Comte writes: "It is worthy of remark that the most general and simple phenomena are the furthest removed from man's ordinary sphere, and must thereby be studied in a calmer and more rational frame of mind than those in which he is more nearly implicated...". See Comte 1989: 38

[27] Rescher 1997: 8

[28] Rescher 1997: 3

believing what they believe or doing what they do (cogent grounds for belief and action being subject to objective standards), and when they follow 'circumstantially appropriate objectives':

> Aligning one's beliefs with the available evidence
>
> Making one's evaluations appropriately (valuing things in line with their true worth: getting one's prizings and priorities right)
>
> Adopting meritorious goals
>
> Maintaining consistency within one's beliefs and within one's evaluations
>
> Keeping one's goals in proper alignment with one's beliefs and evaluations
>
> Pursuing one's goals intelligently (i.e., effectively and efficiently).[29]

Rationality is that which is logically consistent and in line with the above goals. Such rationality is objective because there is "nothing idiosyncratic about any of the principles at work. What is evidence for one will have to count as evidence for another, what is an ignoble goal for you is an ignoble goal for me, and so on".[30]

The formulation 'circumstantially universal' is of particular interest here. What it means is that the circumstances within which thought and action take place vary, and that we must take context into account when determining whether particular people are rational and objective or not. For example, the level of technology a group possesses may determine what evidence it has about the natural world – thus we cannot claim that people who lived before the invention of the microscope were irrational because they did not attribute the cause of some diseases to microorganisms. This, then, is the 'circumstantial' part of Rescher's delightful oxymoron. What of the 'universal'? Rationality is universal because if people are rational, they will behave according to the same set of rational principals in any circumstance. To be rational is to do what rational people would do in the situation that one is in. Thus for us *now* to refuse to

[29] Rescher 1997: 9
[30] Rescher 1997: 10

accept that microorganisms cause diseases would be irrational: rational people would clearly accept the evidence for such a belief.[31]

'Circumstantially universal' does not imply relativism: it does not mean that 'rationality' itself differs from one situation to another and is equally valid in each situation. On the other hand, we are able to judge acts to be rational or not precisely because we all share the same concept of rationality. Peter Schouls quotes Descartes as saying that "reason is naturally equal in all men", and that wherever the faculty of reason is found, it works in the same way. Schouls also points out that John Locke shared a similar opinion, quoting him as saying that "the intellectual faculties are made, and operate alike in most men".[32] Why was this? Reasoning, it was argued, was an activity carried out by the "universal [or divine] reason present in each individual", and introspection "[was] taken to provide knowledge of the universal sameness of reason's mode of operation".[33] Thus the consequences of the operation of reason should also be the same.

Notions of objectivity and subjectivity in the sciences thus have a major role to play in shaping modern science – from constituting the objects of study to determining which methods of investigation were valid. In the ontological sense, objectivity required a certain degree of distrust of one's own senses – one had to accept that what one saw, heard, smelled, felt or tasted was not representative of how the world actually was. After all, our senses told us (and still tell us) that the sun rises every day: and the rebuttal of this 'fact' was one of the milestones of the 'scientific revolution'. And though reason produced the same results for all human beings, sense perception did not. Epistemologically, the idea of objectivity necessitated the maintenance of a certain distance between the student and the object of study. One's biases, opinions, beliefs and so on could only contaminate the research enterprise. Just as one could no longer trust one's senses, one could no longer trust one's mind to give a true picture of the way things really were.

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[31] Objectivity itself has in places been defined in a similar manner: as 'accepting statements on the basis of good reasons and evidence'. The author however does not offer an explanation as to what constitutes good evidence. See Brown 2001:102

[32] Schouls 2004: 36

[33] Schouls 2004: 37

Fact and Value

The difference between a fact and a value is sometimes seen as the difference between 'is' and 'ought': between saying what is or is not, and saying what ought to or ought not to be. In the second case, we make a judgement, we form an opinion. In the first, we merely make statement of reality as it is: a statement of reality independent of the observer. According to Uberoi, within the positivist conception of science, facts are "precise and discrete and observed or in principle observable externally in space and time".[34]

The concepts of fact and value are also linked to concepts of objectivity and subjectivity. The status of being factual can be granted only to that which really exists: that which has an objective existence. Values, which involve judgements, are therefore subjective, being linked to what one believes ought to be the case. Values may also not always be overt and explicit: they may take the form of abstract principles held more or less unconsciously by a researcher, nonetheless influencing his or her work. For example, political commitments may be seen as values – as fairly obvious judgements of how things ought to be – which may have a tremendous impact upon, say, one's opinion of the kind of welfare measures the state should adopt. In this way, values are subjective elements impinging upon one's outlook, and therefore clouding the true picture of reality. Seen in this way, there is no room for values in scientific research, as values serve only to obscure reality: clarity and certainty can only be achieved when we deal with facts. This is, however, an overly simple picture of facts and values.

Facts and values appear to be dualistic when defined in certain ways. For example, Hilary Putnam argues that the Humean distinction between fact and value rested upon the notion that whatever was factual was 'picturable': capable of being represented (visually or through the other senses).[35] To quote Putnam, "the Humean notion of a fact is simply something of which there can be a sensible 'impression.'"[36] 'Virtue and vice' did not produce such sensations – thus there was nothing factual about them. Also, according to Hume, it was impossible to derive an 'ought' from an 'is': that is, one could not say what ought to be on grounds of what is.

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[34] Uberoi 1978:19
[35] Putnam 2003:15
[36] Putnam 2003: 21

Later definitions of facts had to take into account the host of objects and ideas that made no 'impressions' but were nonetheless deemed to exist – for example, bacteria, electrons and protons, 'curved space-time'. Twentieth-century logical positivists responded to these changes by defining factual statements as those which were either observation terms or were reducible to observation terms: according to Putnam, an equally unsatisfactory definition.[37]

The problem with such conceptualisations, Putnam argues, is that they hinge upon a very narrow idea of what facts may be, and then define values in opposition to facts. Secondly, it is an error to consider values as pertaining only to ethics and morals there are other types of values judgements as well. Putnam's own argument is that actual words cannot be neatly divided into the categories of fact and value: that even the terms we take to be factual have an evaluative content without which they cannot be properly understood. He uses examples to make his point, arguing that terms like 'cruel' and 'rude' cannot be seen as either descriptive or ethical, but must be seen as both.

Putnam also makes a distinction between ethical or moral values and *epistemic* values. When we consider science to be a value-free enterprise, or say that researchers should not bring their values into play during the course of research, we mean that we should not bring, for example, our moral principles to bear upon our research. However there is a range of other values that *do* enter into research – for example, a prescription that theories be consistent and coherent upholds consistency and coherence as values. The four components that Robert Merton argued comprised the 'scientific ethos' – disinterestedness, communism, organised scepticism, and universalism – are also values in the sense that they prescribe what science ought to be like. Simplicity may be a value for some scientists; objectivity itself is a value. Science is therefore not value-free. Nonetheless it could be argued that there is a difference between allowing such epistemic values to operate within science, and other non-epistemic values to be a part of the scientific process. Saying that 'theories should be verifiable' is one thing; saying 'the explanations that theories offer should be consistent with the principles of Vedic science/creation science' is another. The first value allows us to do good science: it

[37] Putnam 2003: 22-24

"contributes to the growth of objective knowledge".[38] The second set of values obscures the truth that science should help us to achieve. The ideal of a completely value-free science may therefore be a myth, but if we accept that values necessarily are a part of the scientific method, we can consciously choose which values to include and which to exclude: and we can then include those which are epistemically useful for us.

This position, then, still maintains distinctions between objective facts and subjective values, holding that the latter produce bad science because they obscure the former. In this way it creates a second set of dichotomies: epistemic values, which are good for science, and non-epistemic ones, which are not. It allows us to recognise that science is value-laden, but in such a way that we can still lay the charge of irrationality against the creation scientist. We seem to have taken a different route and come back to the same place.

Man and Nature

The mechanistic framework became prominent in the sixteenth century did not entirely displace all previous metaphors. Some of the pre-modern imagery used to describe nature continued to be employed.

As we have said above, the dominant pre-modern way of looking at nature was to see it as an organism: in particular, a female organism. According to Carolyn Merchant, nature as female was presented mainly in two ways: either as a mother, or as a witch. As a mother, nature was benevolent and nurturing, whereas the image of the witch represented its violent, dangerous, unpredictable dimensions. The 'nature as mother' image was to be eroded during the sixteenth and seventeenth centuries, but the image of nature as disorder was to persist – providing, as Merchant says, one of the main justifications for domination over and exploitation of nature.

For Merchant, "descriptive statements can presuppose the normative: they are then ethic-laden. A statement's normative function lies in the use of itself as description".[39] Any image of nature is then an ethical system in and of itself. If the image is that of nature as living, or as sentient, or as a mother, then the ethical constraints upon human

[38] Brown 2001:106
[39] Merchant 1980 p 4

beings will be greater. If human beings consider themselves to be organically bound up with nature, as part of nature, then ethical considerations are even greater: one cannot injure nature without injuring oneself.

Within the mechanistic framework, on the other hand, nature was neither alive nor sentient. It was instead composed of dead particles acting without knowledge or purpose, inert but for the external forces that had put them into motion. With nature now dead, the ethical obligations that human beings had towards it were also diminished, and the exploitation of nature was possible. Simultaneously, the idea of nature as a wild, unpredictable woman gave men grounds to attempt to control her. In fact, the idea of nature as a woman in itself gave men the ability to be increasingly invasive in their methods of investigation. Merchant argues that the writings of the natural philosophers of the sixteenth and seventeenth centuries contain violent and highly sexualised language to describe the process of investigating nature. For example, she quotes Francis Bacon as saying that nature must be "hounded in her wanderings", "bound into service" and "made a slave", that "nature exhibits herself more clearly under the trials and vexations of art then when left to herself" and that one must have "no scruples [about] entering and penetrating" the "holes and corners" of nature.[40] Merchant argues that it is precisely because nature is seen as female that such language and imagery is possible.

The process of knowing nature would also enable man to control her, as nature could not "be commanded except by being obeyed."[41] In order to manipulate nature, one had to know how nature functioned – one had to know the laws of nature. Thus investigating nature was an act of simultaneously gaining knowledge and power. If we are to see this as reflective of the changing relationship between man and nature, the relationship was now developing into one of man's domination over nature.

* * *

We have seen above that many different methods of investigation of nature have all been considered positivist. What is common to these, apart from the issues of objectivity and value-freedom? According to Uberoi, the aim of the positivist method is to discover and understand the laws of nature: "statements or laws of invariable

[40] Merchant 1980: 168-169
[41] Francis Bacon quoted in Merchant 1980: 172

regular sequences and correlations obtaining between phenomena of the world and their objective conditions."[42] These laws are ideally expressed in mathematical or statistical form.

According to Carolyn Merchant, "The mechanical method that evolved during the seventeenth century operated by breaking down a problem into its component parts, isolating it from its environment, and solving each portion independently."[43] A system would not be studied in its entirety, but instead as a set of discrete parts. Perhaps the trend towards specialisation in various academic disciplines can be seen along these lines. Uberoi argues that the "strategy of the positivist methodology [is] to prefer the study of the part over the study of the whole at every point of the system and so redefine it",[44] with the modern scientist believing that his work should proceed from part to whole. Uberoi also argues that the positivist method arranges various sciences in a hierarchy such that the phenomena studied by one may be explained by that which precedes it, but not by one which follows it on the hierarchy.[45] Many of these features can be seen in Auguste Comte's formulation of positivism.

Auguste Comte

The term 'positivism' itself was coined by Auguste Comte in 1839. Comte's positivism was not only a method, but also a religion of humanity. In Comte's conceptualisation of positivism, we see a kind of synthesis of various aspects of the sixteenth and seventeenth century science that we have examined above.

Comte argued that the history of thought in any branch of knowledge passed successively through three stages, the theological, the metaphysical, and the positive, each representing a different way of philosophising.

The positive philosophy "[regarded] all phenomena as subject to invariable natural laws" and saw as the purpose of scientific investigation the "discovery of these laws, with a view to reducing them to the smallest possible number".[46] The model to be

[42] Uberoi 1978: 19
[43] Merchant 1980: 182
[44] Uberoi 1978: 44
[45] For example, one may seek biological explanations of human social behavior.
[46] Comte 1989: 38

emulated was the law of gravitation – a single, simple law that could explain a wide variety of natural phenomena. However, positive philosophy was not limited to the natural sciences but included the study of society, hence the formulation that *all* phenomena are subject to laws, not only natural phenomena.

The positive method, with its enquiry into natural laws, rejected the enquiry into "first and final causes" that marked the theological stage of society. Within this stage, what was sought was absolute knowledge – hence the emphasis upon causes. In the positive stage, however, we realise that the study of causes is speculative and therefore in vain. Thus we do not try to understand *why* there is such a thing as gravity, and instead turn our attention to *how* it operates.

Positive philosophy linked all branches of knowledge into a single hierarchy, united by their common methodology. The science at the bottom of the hierarchy was that which had reached the positive stage first: that which was the most general, simple, and independent of other sciences. For Comte, this was the science of astronomy: astronomical phenomena were "the most general, simple, and abstract of all."[47] From astronomy, sciences proceeded thus in the order of least to most general and simple: astronomy, physics, chemistry, physiology, and social physics. A science could progress to the positive stage only when the science before it on the hierarchy became positive, as every science depended upon "knowledge provided by the simpler sciences."[48] For example, the science of social physics depended upon a knowledge of physiology, although it was not limited to it: "social conditions [modified] the operation of physiological laws". Thus each successive science, while dependent upon the previous one, was an independent science in its own right.

Once sociology – the positive science of man – had been established, the positivist system would be complete, embracing all disciplines and areas of knowledge. All ideas would be "scientific and therefore homogeneous."[49] Sociological insight would be provided by the study of social facts, of the study of society as a *thing*. The tools of sociological analysis were to be observation, experimentation, and comparison. Since direct experimentation as in the case of the natural sciences was not possible,

[47] Comte 1989: 46-47
[48] Pickering 2003:14
[49] Pickering 2003: 14

sociological experimentation was to involve studying society in its pathological states so as to arrive at a better understanding of it in its normalcy.

The insight sociology provided into the functioning of society would allow for more effective control over society, through the formulation of effective social policies. This would be possible because the homogeneity of positivist thought would allow people to agree on basic intellectual and moral principles.

Comte's positivism thus incorporates a view of the scientific enterprise as a rational, systematic progression from lesser to greater levels of knowledge of the world. Not only that, it also views the scientific enterprise as itself progressive and beneficial for humanity. Mary Pickering argues that despite this, Comte doubted the "regenerative powers of the purely scientific spirit...whose specialisation, egoism, and social indifference caused immeasurable moral harm".[50] For this reason Pickering holds that Comte's positivism is not as narrowly scientistic as is commonly believed.

Nonetheless, as far as positivism as a method is concerned, Comte's does approach the impersonal, objective, rational method that we saw growing out of the sixteenth and seventeenth century natural philosophy. Perhaps the additional moral dimension that, according to Comte, would need to be added to the positive method to make it a suitable tool for a scientific social progress, reflects some inadequacy of this method itself.

* * *

In this chapter, we have seen the development of certain themes that are part of positivist epistemology. We have seen the development of a scientific epistemology that was based upon the idea of rational, objective knowledge. Though the new science incorporated both rationalist and empiricist methods, the underlying epistemology was based exclusively on the ability of the knower to reason. Other ways of knowing like intuition and empathy could not be a part of science. And also, as we shall see, these ways of knowing were associated as specifically women's ways of knowing.

Another very significant part of this new epistemology was objectivity. The object of knowledge was constituted as separate to and divorced from the subject of knowledge,

[50] Pickering 2003: 19

the knower. The properties of the natural world that were appropriate for study were its objective properties; and to study these, the knower needed to make use of only his objective faculties. The possibility of seeing nature as an object made it possible to exploit nature on an unprecedented scale.

In the next two chapters, we will be looking at these trends in greater detail, and examining the various ways in which later scholars have engaged with positivist knowledge.

—CHAPTER TWO—

Post-Positivist Critiques of Science

In the previous chapter, we attempted to trace the development of positivist scientific methodology. Science is seen as a continuously evolving, and continuously progressive activity, one that gives us a unique insight into the natural world as a result of a method that is rational, is able to discern the facts as they are (stripped of all prejudice, superstition, and speculation), and provides an objective, clear picture of the natural world. Science, both as method and as a body of knowledge, also claims to have an ability to correct itself, to identify and eliminate its own flaws. It thus is also a good and appropriate worldview: a scientific attitude eliminates prejudice, superstition, and a number of other ills of the pre-scientific, irrational world.

Every part of the above formulation has been critiqued, has been subject to revision. In the following chapter, we will be examining the views of certain authors who have criticised and/or reformulated ideas of uniqueness, the rationality, and the objectivity of science, the tendency of science to progress, its ability to correct itself, and it's social worth. This has been done by various scholars, writing from their own distinct perspectives.

Karl Popper's philosophy of science rests upon the assumption that no body of knowledge, not even science, can claim to have access to the truth. He argues that we have no access to *certain* knowledge: therefore, no access to the truth about the natural world. Science, like other fields, can only make conjectures about the truth, about the nature of reality. Put like this, Popper appears to be striking a blow to science, to be undermining its legitimacy. However, his reformulation of scientific methodology – from induction to falsification – gives science unique access to, if not the truth, then at least to empirical reality. (And as we shall see, Popper does not demolish the Truth quite as completely as he appears to want to.) The major revision of scientific methodology that Popper has offered is to replace induction, thought to be the correct method of the sciences, with the method of falsification and refutation.

Thomas Kuhn has made a significant contribution to the history, philosophy and sociology of science with his concept of a 'paradigm'. He argues that the sciences are paradigm-driven, that they proceed by exhausting the potential of one paradigm and then replace the paradigm by another. His work thus raises major questions of the progressive nature of science, as well as of its rationality. We say 'his work' and not 'he', deliberately, as his work can be seen as leading in directions far more radical than Kuhn himself would wish it to.

Paul Feyerabend's anarchic theory of knowledge is more radical still. Feyerabend seeks to dissolve the idea of a unique scientific methodology itself, arguing that there never has been a single methodology of the sciences, nor should there be. A single, monolithic methodology of the sciences is bad for science, bad for democracy, and bad for humanity.

Another strand of criticism that we look at is that which forms an ethical critique of the sciences. This highlights the negative consequences of the applied sciences, arguing that the natural sciences have a violence in their application that can be traced to their methods and metaphysics. It thus raises questions of the desirability of science as a means of either knowing the world, or of acting in it.

Karl Popper: Science as Critical Rationality

Karl Popper's philosophy of science rests upon various interrelated and interlinked concepts: those of falsifiability, testability, criticisability, and rationality. He invokes these to explain his ideas on topics ranging from what he terms the demarcation problem[1] to his conception of the methodology of science.

[1] Popper's demarcation criterion – the idea of falsifiability, used to demarcate science from non-science – developed through his experience of Marxism, Freudian psychoanalysis, and Adlerian psychology. These were all theories that constantly looked for verification: thus as Popper later said, every statement in a newspaper, even every omission made by the newspaper, could be interpreted by a Marxist as proof of Marxist theory. A similar incident involved Adler, who interpreted a case related by Popper in light of his (Adler's) theory, on grounds of his "thousandfold experience." Yet what this meant was only that the case could be interpreted in light of Alder's theory, which meant little, since every case could be interpreted thus. This was very different from Einstein's theory, which could actually be disproved by certain empirical phenomena. Popper states that what is impressive is the risk involved in making a theory which can be refuted. Here we can see, then, the genesis of the demarcation criterion. (Popper 1963: 35-36)

The concept of falsifiability is dealt with at great length in Popper's first major work, *The Logic of Scientific Discovery*.[2] Falsifiability is used as a tool to distinguish non-scientific from scientific theories, being, in Popper's opinion, a characteristic of empirical science. Falsifiability is a property that a theory will possess if it is an empirical scientific theory: it will be possible to lay out the conditions that would prove the theory false. To quote Popper's example, the statement 'all swans are white' is equivalent to the statement 'no swan is non-white': and this latter statement can be easily refuted by finding a single non-white swan. A statement which cannot be refuted, on the other hand, lacks empirical content: for example, the statement 'it may or may not rain tomorrow' will be verified regardless of whether or not it actually rains. The solution to the demarcation problem, that is, the problem of distinguishing between empirical science on the one hand and 'mathematics and logic, as well as metaphysical statements on the other', lies in falsifiability.

How does one go about falsifying a theory? Theories are to be falsified by subjecting them to empirical tests, by attempting to refute them. A theory which is not refuted by tests is not held to be confirmed (as it may be refuted by other tests which are as of yet unavailable) but is held to be corroborated. Refutability, like falsifiability, becomes a demarcation criterion between science and non-science. The testing of a theory is an attempt to refute it,[3] and in order to be tested, a theory must be *testable*: there should be some hypothetical criteria which if observed would constitute the refutation of the theory. Testing a theory is pointless if *any* outcome of that test could be seen as proof of the veracity of the theory. As Popper says, a theory is to be considered scientific only if it makes assertions that may clash with observations.[4] Thus we see the

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Another significant influence was the logical positivism of the Vienna Circle. Popper critiqued the verificationist and inductionist tendencies of logical positivism, which he felt failed to make a distinction between science and metaphysics. The correct demarcation criterion, of course, was falsifiability. Thus, like psychoanalysis, logical positivism provided inspiration in its refutation.

[2] First published in German in 1934; first English translation published in 1959.

[3] Within Popper's schema, theories are not tested with a view to proving them, as he holds that it is impossible to conclusively prove any theory. His critique of induction is precisely this: that we cannot derive a universal law from particular statements. We may find any number of white swans but cannot conclude that all swans are white. Thus any empirical finding cannot be taken as proof of a universal law. However, empirical findings that contradict our theories can be taken as evidence that our theories may be false. Hence the need for the empirical testing of theories.

[4] Popper 1963:256. However, Popper does not require that the theory have actually been tested. For example, a theory may exist, which has a possible refutation, but whose test requires technological apparatus that is more sophisticated than what is available. In such a situation we still consider the theory to be scientific.

demarcation problem solved through the interrelated concepts of falsifiability, refutability and testability.[5]

For Popper, this view of science – which sees science as resting upon falsification and testability – "takes its critical approach to be its most important characteristic".[6] The critical approach, in Popper's sense of the term, is a critical attitude towards one's beliefs and opinions and theories: a readiness to evaluate them, to subject them to thorough examination, and if necessary, a preparedness to either modify them or to give them up. The rationality of the scientific enterprise lies in the critical approach: Popper describes the scientific approach as one of 'critical rationality'. Thus, working through the demarcation problem, Popper arrives at his conceptualisation of the scientific method: that of critical rationality.

The concept of science as critically rational presupposes a certain model of the development of science. The inductive model of the natural sciences that Popper criticises holds that the process of scientific research begins with the observation of facts. Popper critiques this on two grounds: firstly, that it is not possible to make a 'pure' observation, one that is not, to some degree, theory-laden[7]; and secondly, that the actual process of scientific research does not and cannot proceed in this way. Research cannot begin with an injunction to observe: one must at the very least be told what to observe. And a mere list of random observations would be of little scientific importance or even interest: for example, Popper states that if one went through life recording all of one's observations in a notebook, the notebook could at best be "[preserved] as a curiosity, but decidedly not as a source of knowledge" and would "most likely end up on a rubbish heap".[8]

According to Popper, scientific research begins not with observations but with a *problem*. The source of the problem may lie anywhere: one may arrive at it through the perusal of the literature of one's field, or it may even come to one in a dream. The

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[5] To quote Popper: "*...the criterion of the scientific status of a theory is its falsifiability, or refutability, or testability*". Popper 1963: 37, italics in original.

[6] Popper 1963: 256

[7] For example, Popper says: "Observation is always selective. It needs a chosen object, a definite task, an interest, a point of view, a problem. And its description presupposes a descriptive language, with property words; it presupposes similarity and classification, which in its turn presupposes interests, points of view, and problems." Popper 1963: 46

[8] Popper 1963: 128

source of the problem is irrelevant.[9] What is important that the problem be interesting, and that it be significant within the *problem situation* of a discipline: the areas of contention, of disagreement.[10]

Having selected the problem, one proceeds by proposing a theory that explains it, and the theory is then subject to critical examination. Critical analysis takes the form of proposing an explanation for the phenomenon (or analysing the existing explanation of the phenomenon), and attempting to refute it, to find flaws in it, to uncover its shortcomings: in other words, attempting to falsify it. The successful theory is that which is able to resist attempts at falsification. Nonetheless, even if our theory is falsified, the process of critical discussion throws up new problems, thus contributing to the growth of our knowledge. Popper summarises his model of the scientific method thus:

> 1. We select some *problem* – perhaps by stumbling over it.
>
> 2. We try to solve it by proposing a *theory* as a tentative solution.
>
> 3. Through the *critical discussion of our theories* our knowledge grows by the elimination of some of our errors, and in this way we learn to understand our problems, and our theories, and the need for new solutions.
>
> 4. The critical discussion of even our best theories always reveals new problems.
>
> Or to put these four steps into four words: *problems – theories – criticisms – new problems.*[11]

The method of the empirical sciences, then, is one of trial and error – or rather, of continuous conjecture and refutation. In the absence of any methodology that allows us to achieve certain knowledge in the empirical sciences, this is for Popper the most rational method of scientific research that we can possibly follow.[12] This is also a

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[9]See for example section 2, titled 'Elimination of Psychologism', in Popper 1959: 31-32. Popper here makes a distinction, though he does not use the same phrases, between the context of discovery and the context of justification of a theory: the former being the process through which one arrived at the theory, and the latter being the manner by which one proves it. For Popper, only the latter is amenable to logical analysis.

[10] See Popper 1963: 129, and Popper 1994: 55

[11] Popper 1994: 159

[12]The method of the natural sciences which derives from falsification must be contrasted with the inductive method, whose aim is verification: searching for ways to justify our knowledge. Here

method that leads us to successively better and better theories, as the criticism of theories, and even their refutation, leads to increases in our stock of knowledge. To quote Popper: "...it is not the accumulation of observations which I have in mind when I speak of the growth of scientific knowledge, but the repeated overthrow of scientific theories and their replacement by better or more satisfactory ones".[13]

We see that a description of Popper's view of scientific methodology leads us to a discussion of empirical science as necessarily (and continuously) progressive. This is because the notion of progress is built into Popper's scientific methodology: each successive conjecture and refutation is an improvement upon the last, and represents an advance in our knowledge. Thus "...continued growth is essential to the rational and empirical character of scientific knowledge...if science ceases to grow it must lose that character".[14]

* * *

Popper's methodology of science is part of his larger understanding of human knowledge and of epistemology. In his essay titled 'On the Sources of Knowledge and of Ignorance'[15] he invokes the history of the Enlightenment, which he argues was inspired by an "unparalleled epistemological optimism"[16] – an optimism based upon the doctrine that the *truth is manifest.*

> Truth may perhaps be veiled. But it may reveal itself. And if it does not reveal itself, it may be revealed by us. Removing the veil may not be easy. But once the naked truth stands revealed before our eyes, we have the power to see it, to distinguish it from falsehood, and to know that it *is* truth.[17]

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experience is seen as being capable of verifying our theories: a condition that Popper explicitly rejects. As we have seen before, Popper does not agree that experience can verify theories. In this context he speaks of what he terms the 'trilemma': to avoid dogmatism we must justify our beliefs, but induction only leads us to an infinite regress as through it we can never conclusively justify our beliefs. The only way to avoid both dogmatism and infinite regression is to take recourse in psychologism, by claiming that statements can be justified by perceptual experience – hardly a conclusion that Popper would accept. The solution to this trilemma is simply to circumvent the problem of induction, and of epistemologies that seek to verify theories. This solution, of course, entails relinquishing our claims to certain knowledge. (See Popper K. (1959) *The Logic of Scientific Discovery.* London: Routledge and Kegan Paul. pp 93-94).

[13] Popper 1963: 215
[14] Popper 1963: 215
[15] Popper 1963: 3-30
[16] Popper 1963: 5
[17] Popper 1963: 5, italics in original

> Thus truth, if it does not reveal itself, has only to be unveiled, or discovered. Once this is done, there is no need for further argument. We have been given eyes to see the truth, and the 'natural light' of reason to see it by.[18]

According to Popper, the main spokespersons of this optimistic epistemology were Bacon and Descartes, who argued that there was no need for men to submit to any authorities in their search for knowledge, as they carried within themselves the sources of knowledge – in Bacon's case, their sense-perceptions, which may be used for the observation of nature, and in Descartes', intellectual intuition, which allowed one to "distinguish truth from falsehood by refusing to accept any idea which is not clearly and distinctly perceived by the intellect".[19]

The doctrine that truth is manifest is however a myth. For, according to Popper, the fact remains that the truth is hard to come by and may even be lost again; moreover, even if we do believe that we have come across the truth, we have no way of being sure of this belief: "There is no criterion of truth at our disposal".[20] Nor are reason or experience authoritative *sources of knowledge* – they are unreliable, in that they may mislead us, and therefore they are always open to question.

Where does this leave us? According to Popper: "What we should do, I suggest, is to give up the idea of ultimate sources of knowledge, and admit that all knowledge is human, that it is mixed with our errors, our prejudices, our dreams, and our hopes; that all we can do is to grope for truth even though it be beyond our reach."[21]

In his discussion of Bacon and Descartes, Popper argues that whereas they began by seeking to liberate men from authorities, they ended by appealing to new authorities: those of reason and the senses. Thus they "failed to solve the great problem: How can we admit that our knowledge is a human – an all too human – affair, without at the same time implying that it is all individual whim and arbitrariness?"[22] In denying the authority of both reason and the senses, Popper has led us back to this very same point. Once again, we must ask ourselves – in the absence of our established intellectual

[18] Popper 1963: 7
[19] Popper 1963: 5
[20] Popper 1963: 28
[21] Popper 1963: 30
[22] Popper 1963: 16

authorities, is certain knowledge possible? Is scientific activity possible, and if so, how? And how are we to proceed with it?

For Popper, scientific activity *is* possible, and is possible because it does not seek final answers or final resolutions to questions. Truth may be beyond our reach; but this does not mean that it is unattainable. For though we have no criteria of truth, we do have criteria of falsehood or error. The very idea of error itself implies that there is an objective reality, for only if there is an objective reality can our representation of it be incorrect.[23] If there were no objective reality, then any representation would be as right or wrong as any other. And while we have no criteria of truth, we do have criteria of error: "...we do possess criteria which, *if we are lucky*, may allow us to recognise error and falsity. Clarity and distinctness are not criteria of truth, but such things as obscurity or confusion may indicate error. Similarly coherence cannot establish truth, but incoherence and inconsistency do establish falsehood."[24] Thus scientific activity can still be rationally pursued, even in the absence of criteria of truth, if we accept that though we may not know when we are right, we do know when we are wrong. Thus we must approach our problem by asking how we can "hope to detect and eliminate error".[25] And the correct answer to this question is: "by *criticising* the theories and guesses of others and – if we can train ourselves to do so – by *criticising* our own theories and guesses."[26] This, according to Popper, sums up his position of critical rationalism.

Rationality: We have already spoken of how Popper's concept of rationality is linked with criticisability, and of how he equates the rational and the critical attitudes.[27] He similarly equates the critical attitude with the scientific attitude. If we ask ourselves, 'what is it to be scientific', the answer as per Popper is 'to be critical, to be rational'. But the rational attitude is not limited to the natural sciences. Rationality is an attitude that can be adopted in any sphere of life. Rationality is to be seen in the context of a given *problem-situation* – "every rational theory is rational in so far as it tries to *solve certain problems*" – and the problem-situation is not necessarily empirical. Even a

[23] Popper 1963: 226: "The very idea of error, or of doubt...implies the idea of an objective truth which we may fail to reach."
[24] Popper 1963: 28, italics in original
[25] Popper 1963: 25
[26] Popper 1963: 26, italics in original
[27] Popper 1959: 16

metaphysical topic, then, can be rationally discussed.[28] This appears to open the door to a kind of relativism: for if theories are solutions or instruments, then they are rational or irrational only within a particular context, and discussions of rationality are not possible outside of the context. Yet Popper is critical of relativism, which he feels is the outcome of an assumption that the purpose of rational discussion is to justify our knowledge.[29]

In 'Utopia and Violence'[30] Popper defines rationality in terms of a relationship between means and ends, in that an action is deemed rational if it makes the best use of available means to reach the desired ends. The ends themselves cannot be scientifically determined. Interestingly, this observation is made in an essay on politics and not on the philosophy or methodology of science as such: thus the ends being considered are violence and (rational) argument. What if we recast this question in terms of the means and ends of science itself? In Popper's view, the advantage of his methodology is that is presents us with the only way to carry out science as an empirical exercise. This may be true: but it gives us no reason for preferring empirical science to any other form of science – for example, an essentialist or instrumentalist science. Nonetheless Popper does reject these two: the former, because it deals with ultimate explanations, and the latter because it is irrefutable.[31] By the tenets of means-end rationality as spelled out above, however, there is no rational ground for rejection.

Popper himself has pointed out that metaphysical elements do exist within empirical science, has pointed out their possible advantages, and has also freely admitted that his own methodological prescriptions have been influenced by values and predilections.[32] But perhaps, within the Popperian schema, this is irrelevant – after all, as we have seen above, values and biases are permitted with certain spheres of scientific activity, that of locating our problem[33]. *Justifying* our beliefs should proceed on entirely logical grounds – which is how Popper attempts to justify his methodological schema.

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[28] Popper 1963: 199. Popper lists questions that we can ask of even a non-empirical, irrefutable theory: "...Does it solve the problem? Does it solve it better than other theories? Has it perhaps merely shifted the problem? Is the solution simple? Is it fruitful?" and so on.
[29] Popper 1994: 60
[30] Popper 1963: 355-375
[31] See 'Three Views Concerning Human Knowledge' in Popper 1963: 97-119
[32] Popper 1959: 38
[33] This is the context of discovery mentioned above.

Yet convincing ourselves of Popper's justification requires a commitment to Popper's own prior intellectual commitments.[34] The distinction between discovery and justification is not as sharp as we are given to believe. For, to be convinced that Popper's methodological schema is rational, we need to see it in the context of his own intellectual commitments – for example, we need to admit that truth is not indeed manifest. It is only then that all the pieces will begin to fall into place.

Another question can be raised here. Popper has argued that a search for truth is futile, because we will never know if we have found it. Yet we do have criteria of error. Through this route we arrive at the possibility of objective knowledge: for we can only consider ourselves wrong if we have some idea of what is right. Thus, "clarity and distinctness are not criteria of truth, but such things as obscurity or confusion *may* indicate error. Similarly coherence cannot establish truth, but incoherence and inconsistency do establish falsehood".[35] This is a paradoxical position. If we have an idea of reality at the back of our minds, that lets us know when we are wrong, why does it not also let us know when we are right? An inconsistent argument gives us a wrong picture of reality only if we assume that reality is consistent. If we have no way of knowing the truth, why should we make this assumption?

Popper's critique of scientific method, thus, is limited to induction. Though he admits to, say, the irrationality of scientists, the contributions of the scientific community to scientific knowledge, or the difficulty in claiming to have certain knowledge, he does so in ways which make them seem peripheral to actual scientific knowledge and research. The rational, objective, progressive core of science remains intact.

Thomas Kuhn: An Unintentional Revolutionary

Thomas Kuhn's major work on scientific method, *The Structure of Scientific Revolutions*, was published in 1962. This work contains his conceptualisation of science as a paradigm-driven activity. Kuhn's picture of science as a paradigm-driven, occasionally revolutionary activity, has had major consequences for the philosophy

[34] Thus Popper says that despite the presence of values in his work, he hopes that it will still be acceptable to those who value logical rigour and freedom from dogmatism, who are attracted not only by the practical applicability but also by the adventure of science. See Popper 1959: 38

[35] Popper 1963: 28

and sociology of science. It has challenged the ideas of the universality of scientific knowledge, the rationality of the scientific method, and the superiority of the scientific method in explaining the natural world. If Karl Popper's aim was to provide a demarcation criterion between science and non-science, Kuhn's work has provided tools for demolishing this very distinction. Kuhn's work has provided tools for an analysis of science as an entirely social activity: an analysis with which he himself would perhaps not entirely agree.

Kuhn's work draws upon the history of science. Here he traces a kind of cyclical growth pattern of sciences. In his reconstruction, all natural sciences have started out as pre-paradigmatic, and have at some point in time acquired a paradigm and become paradigmatic.[36] Once a paradigm is acquired, the discipline enters a phase of what Kuhn terms 'normal science', that is, a phase of problem-solving using the paradigm as a guide. Normal science basically involves attempts to fit nature into the paradigm.[37] Eventually, however, a stage approaches when anomalies arise: it becomes clear that some elements of nature cannot be explained by the paradigm. This leads to a period of crisis, a period where the fundamentals of the paradigm are examined. Eventually the crisis is resolved by the emergence of a new paradigm, and thus the cycle begins anew.

What exactly is a paradigm? *The Structure of Scientific Revolutions* is notoriously vague about the exact nature of a paradigm: so vague that in her essay 'The Nature of a Paradigm' Margaret Masterman lists no less than twenty-one ways in which the term is used in the book.[38] These include, amongst others: a universally recognised

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[36] The acquisition of a paradigm also allows a science to progress. In a pre-paradigmatic stage science is basically directionless: there is no agreement on the fundamentals of the discipline, over which questions science need answer, over what a scientific answer should be, and so on. There are a number of competing schools of thought, each "[deriving] strength from its relation to some particular metaphysic" (Kuhn 1962: 12), each committed to the significance of certain facts, each capable of explaining certain phenomena but not others. The fact of there being several competing schools leads to a constant examination of and debate over the fundamentals of the discipline. Scientists are caught up in these debates, and therefore science does not progress.

[37] The concept of normal science entails a rejection of Popper's theory of science as comprising of a series of conjectures and refutations. Popper's science is permanently revolutionary; Kuhn's only periodically. Normal science requires the explication of a paradigm, not it's attempted overthrow.
During the period of normal science, the failure to solve a problem would be seen as a failure of the individual scientist, and not a sign of the inadequacy of the theory or paradigm. Kuhn also rejects Popper's concept of falsification. He argues that scientists do not reject theories until they have potential alternatives in sight, and that anomalous evidence can always be explained away using ad hoc hypotheses.

[38] Masterman 1970: 59-89. Masterman points out that there could possibly be more definitions of the term within the book.

scientific achievement, a myth, a tradition or model, an analogy, a general epistemological viewpoint, a new way of seeing. In his later work, Kuhn admitted to the vagueness surrounding this concept, and provided two other concepts that would serve in its place: disciplinary matrices and exemplars.[39] Yet references to Kuhn's work still routinely employ the term 'paradigm'.

A paradigm, in the sense in which it is used in *The Structure of Scientific Revolutions*, is a blanket term used to signify the methodological tools (theories and concepts) and standards of validity that are employed by a discipline; it includes models that are considered to be exemplary problem-solutions or illustrations of the principles of the paradigm. In addition to this, it also refers to the sum of epistemological values subscribed to by practitioners, as well as their metaphysical commitments. All of these are transmitted to students during the course of training. Thus it gives to students a certain conceptual framework that is used to identify problems, the tools for solving them, and the key to what an appropriate solution to the problem would be. The term is an all-encompassing one, seeming to refer to an entire outlook or worldview.

Paradigms are also *incommensurable.* What does this mean? Firstly, the standards or definitions of science are not the same for different paradigms: that is to say, a scientific problem for one paradigm may be a metaphysical problem for another. Secondly, elements of one paradigm, when used in another, are used in a different sense than before. To quote Kuhn, "within the new paradigm, old terms, concepts and experiments fall into different relationships with each other."[40] Thirdly, "the proponents of competing paradigms practice their trades in different worlds"[41] – worlds that are literally populated by different sorts of things. Thus to use Kuhn's example, within one paradigm space is flat, and in others curved. These are not minor differences that may be resolved by pointing to evidence. To change one's opinion on these matters is like a gestalt switch: it is a sudden and complete transformation of one's outlook. One cannot be *persuaded* – one must be *converted* to another paradigm.

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[39] A 'disciplinary matrix' has three components: symbolic generalisations, beliefs in particular models (which determine acceptable explanations and puzzle-solutions), and values. 'Exemplars' are the "concrete problem-solutions that students encounter from the start of their scientific education, whether in laboratories, on examinations, or at the ends of chapters in science texts." (Kuhn 1962: 187)

[40] Kuhn 1962: 149

[41] Kuhn 1962: 150

Science then progresses by means of a series of such gestalt switches. The natural sciences thus proceed not by accretion, nor by falsification, but through revolutions which involve a complete overhaul of scientific knowledge.

* * *

We have said above that the picture of science presented in *The Structure of Scientific Revolutions* has challenged the claims of science to be universal, progressive, and superior to other ways of knowing the natural world. We will examine this in greater detail below.

Universality: The findings of natural science have been held to be universal in the sense of applying to the entire natural world. Thus water has a molecular structure that is represented by the formulation H_2O; and this is valid for all water, at all times. Seen through the lens of *The Structure of Scientific Revolutions*, however, believing that 'water = H_2O' is only possible if we commit to a paradigm that employs this formulation, that believes that it is a true representation of reality. If we do not commit to the idea of molecules, atoms, or chemical formulae for that matter, then any chemical formula is meaningless to us. To say 'water = H_2O' requires that we agree that such things as elements actually exist in nature, that they can combine to form compounds, and that these compounds can be symbolically represented in this matter: it is therefore the outcome of a certain paradigm. However, within another paradigm, water itself may be seen as an element – an irreducible building-block of nature – as would fire, earth or ether. The definition of 'element' itself is paradigm-dependant. Thus when we use terms and concepts, we use them in the context of, and derive their meaning from, a certain paradigm. What we take to be a universal scientific discourse is actually specific and particular, bounded by the paradigm which we employ.

Secondly, we can argue that we have no way of arbitrating between different paradigms. How are we to identify the paradigm that is closer to reality, to nature as it really is, if we can only approach nature through paradigms? Kuhn has stated that "the scientist can have no recourse above or beyond what he sees with his eyes or his instruments."[42] We are not in a position to judge between paradigms on grounds of veracity. This point leads us to a position of relativism. If we cannot state with

[42] Kuhn 1962: 114

certainty which paradigm is better, then we must concede that one is as good as any other.

The charge of relativism can be strengthened by referring to an analogy Kuhn draws between scientific revolutions and political revolutions. Both arise out of dissatisfaction with a state of affairs, whether political or intellectual; both involve the complete overthrow of an existing system. In politics, there is no way of knowing whether one political system is objectively better than any other. The choice between, say, democracy and totalitarianism, is based upon the values and premises of the actors in the situation. Extending this analogy to the scientific revolution, we find that we have few objective grounds for choosing between one paradigm and the next. To quote Kuhn, "as in political revolutions, so in paradigm choice – there is no standard higher than the assent of the relevant community."[43]

Thus the process of selecting the theories and practices that constitute science become essentially arbitrary, determined in the last instance not by the facts of nature but instead by the 'assent of the community'. This allows for the following interpretation: that science is, ultimately, what scientists say it is.[44]

Rationality: Imre Lakatos, commenting on scientific revolutions, argues that for Kuhn these are "*irrational, a matter for mob psychology*",[45] as each brings in its own standards of rationality, applicable only to itself. There are no standards of rationality that apply to all paradigms. Secondly, if science is in the last instance defined by the assent of the scientific community, then rationality within paradigms is also suspect: assent, consensus and the like seem to be too arbitrary to be rational.

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[43] Kuhn 1962: 94

[44] Popper has place within his theory for the 'assent of the scientific community' for example in the determination of basic statements, and for various values, prejudices and beliefs that do exist in scientists' minds. Yet these had a very distinct place in the scientific process: in the context of discovery, in that space where theories were generated. Those prejudices and biases that had no basis in fact would be weeded out of science during the testing of theories. Thus theories could ultimately be tested against nature. The model presented to us in *The Structure of Scientific Revolutions*, however, leaves no space within the scientific model that is independent of prior intellectual commitments, let alone biases and prejudices, where testing can take place. If our intellectual commitments are constitutive of our discipline, how are we to carve out a niche where we can test them independently of those commitments? And even if we do find such a niche, what purpose will it serve? "Paradigms are not corrigible by normal science at all." (Kuhn 1962: 122) We cannot correct a paradigm, we can only hope to develop it to the point where it reaches a state of crisis and is overthrown.

[45] Lakatos 1970. italics in original.

Science vs. Non-Science: If scientific knowledge is in the last instance determined by the premises, beliefs and values of scientists, and not on any kind of objective knowledge, then is it not at par with any other way of knowing nature? All modes of knowledge have certain basic metaphysical and ontological commitments, a certain conception of nature, and a stock of theories and concepts that are used to explain the natural world. If science has no privileged access to nature, then there is no argument for comparing any mode of knowledge to scientific knowledge to judge its veracity and validity. In fact, if we accept the notion of incommensurability, we have no grounds on which to make a comparison: every mode of knowledge can be judged only on its own terms.

This argument rests upon the assumption that all schools of thought which interrogate nature also create the object of their interrogation in some way: through what they categorise as nature, how they choose to study it, and so on. We have no way of knowing nature except through such categories.

Progress in Science: Perhaps one of the most radical implications of *The Structure of Scientific Revolutions* is the damage it does to the idea of scientific progress. Previously, whether one held that the sciences progressed by accretion, or by falsification, one inevitably believed that over time, they did in fact progress: empirical knowledge of the world expanded, theories were improved upon. The theories of progress by accumulation and by falsification presume a linear pattern of the development of science. Kuhn has replaced this linear pattern with a cyclical one, where periods of revolution follow periods of normal science. Normal science is cumulative: we do learn more and more about nature through our problem-solving. However scientific revolutions undermine much of what we have learned, forcing us to not only re-examine empirical data but also replacing our background assumptions. If we must periodically replace the foundations of our knowledge, without the means to be sure that what we are replacing them with are any better than what we had to begin with, how can we say that we have made any progress? For Kuhn, there are two grounds for saying that we progress. Firstly, the scientific community would not admit otherwise.[46] Secondly, the paradigm which replaces an existing paradigm must be able

[46] "Revolutions close with a total victory for one of the opposing camps. Will that group ever say that the result of its victory has been something less than progress? That would be rather like admitting that they had been wrong and their opponents right. To them, at least, the outcome of a revolution must be

to solve some of the anomalies that the latter generated, and also must at least promise to preserve a bulk of its problem-solving capacity. Thus it should be (at least potentially) more rewarding than the last.

In the last few pages of *The Structure of Scientific Revolutions*, Kuhn also sketches a different picture of progress itself. Changes in paradigm do not lead us closer and closer to the Truth. Progress, therefore, is not towards this goal. Rather progress must be seen as being the evolution of our ideas.

> We are all deeply accustomed to seeing science as the one enterprise that draws constantly nearer to some goal set by nature in advance.
>
> But need there be any such goal? Can we not account for both science's existence and its success in terms of evolution from the community's state of knowledge at any given time? Does it really help to imagine that there is one full, objective, true account of nature and that the proper measure of scientific achievement is the extent to which it brings us closer to that ultimate goal? If we can learn to substitute evolution-from-what-we-know for evolution-toward-what-we-wish-to-know, a number of vexing problems may vanish in the process.[47]

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In the above pages, I have constantly referred to ideas present in *The Structure of Scientific Revolutions*, and not the ideas of and arguments made by Thomas Kuhn himself. This is because the book provides tools for an interpretation of the nature of science that is so radical that Kuhn does not agree with it himself.

Here, a scientist approaches, not the natural world, but the world as provided by his paradigm. His work cannot claim to represent reality, but is paradigm-dependant. And the standards provided by the paradigm ultimately derive from the consensus of his peers. This is an extreme social constructivist position, where everything from facts to metaphysics is in the end a result of paradigmatic commitments.

The objectivity-subjectivity dualism is dissolved here. The concept of ontological objectivity becomes meaningless. Even if there is an objective reality, we have no

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progress, and they are in an excellent position to certain that future members of their community will see past history in the same way." (Kuhn 1962: 166)

[47] Kuhn 1962: 171

access to it except through a paradigm. And just as we cannot know what objectively constitutes the world, similarly, we cannot have objective ways of knowing the world. Rationality and reason are only tools we adopt because they are demanded of us by our epistemological paradigm; there is no other reason for adopting them. We use them and grant them validity because of our prior intellectual commitments. We use them because we think they are good: a subjective evaluation. Our science is then ridden with subjective elements. The subjective-objective debate now becomes meaningless, futile. Science then loses its unique ability to speak the truth about nature, and must yield to other forms of knowledge. Modern science, at the very least, must yield that it is one science amongst many.

Yet Kuhn's position is not relativistic. He declares that though all civilisations have had politics, art, and technology, only those that "descended from Hellenic Greece have possessed more than the most rudimentary science. The bulk of scientific knowledge is a product of Europe in the last four centuries."[48] And while he does say that paradigms are incommensurable, and that the assent of the community is above all, he does go on to say that there are in fact good reasons for choosing one paradigm over another. This last remark is made in a postscript to *The Structure of Scientific Revolutions*. In a later essay, he indicated what these reasons are: accuracy, consistency, scope, simplicity and fruitfulness. These are what a scientist looks for in a good theory, and these aid the choice between theories – they provide *the* shared basis for theory choice.[49] And one may argue that if Kuhn were adopting a social constructivist position wherein our view of nature was the outcome of a paradigm, how would he explain the anomalies that gave rise to crises – those dimensions of reality that contradict the paradigm?

It also must be noted that Kuhn does not refer to non-scientific factors as driving paradigm change. For example, when he speaks of values held by scientists, he is referring to values like reliability, validity and so forth, which would generally be considered by scientists as values worth possessing. He is not speaking of what in the previous chapter we referred to as non-epistemic values, which may also play a part in science. Thus power is a significant value, something that the participants in a research enterprise might aspire to have (and feel they ought to have), which may contribute to

[48] Kuhn 1962: 168
[49] Kuhn 1977: 322

the nature and outcome of their research. Yet this, or other similar values, finds no mention in Kuhn's work. Also, his is an entirely internalist view of science.[50] There is no mention of sociological factors, such as the composition of the scientific community. The history that he draws upon is the internal history of science, referring only to significant scientists, theories and experiments. In his elucidation of a disciplinary matrix, he speaks of its metaphysical component: the shared commitment of the scientific community to such beliefs as "heat is the kinetic energy of the constituent parts of bodies";[51] not such beliefs as 'God does not play dice with the universe'.

Kuhn thus backs away from the more radical interpretations of his own work, and in later essays reinstates some of the traditional characteristics of science. (For example the five criteria of theory choice re-establish rationality and objectivity. Science is only a modern European product, and thus again has a special status with regard to non-science.) Nonetheless, and perhaps sadly for him, the more radical interpretation of his work has the greater currency.

Paul Feyerabend: Anarchy as Method

Paul Feyerabend describes his theory of science as an anarchistic theory of knowledge. Anarchistic, because it boils down to the statement that 'anything goes'. It contains no detailed prescriptions of the correct method to be followed. One the contrary, it rejects any such methodological schema, arguing that while it is possible to lay down a strict set of rules of method, whose neglect causes results to be invalid, it is not desirable to do so. Firstly, the world is an "unknown entity", and we have no way of proving that our method provides the best way of understanding that unknown entity. Secondly, a dogmatic scientific education "cannot be reconciled with a humanitarian attitude. It is in conflict with the 'cultivation of individuality which alone produces, or can produce, well-developed human beings'".[52] We will be examining these two aspects – methodological and humanitarian – in turn.

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[50] See Restivo 1988
[51] Kuhn 1962: 184
[52] Feyerabend 1975: 20

A firm and dogmatic commitment to a specified set of methodological rules is neither descriptively nor prescriptively tenable. As far as the prescriptive dimension is concerned, Feyerabend argues that the violation of prescriptive rules is necessary for the progress of science.[53] The history of science shows us that many of the elements of scientific knowledge, many new developments, arose because scientists either deliberately or unknowingly violated methodological maxims. At the descriptive level, the history of science shows no such commitment: there are no rules, no matter however epistemologically sound, that are not violated. "[T]he idea of a fixed method or a fixed theory of rationality", Feyerabend argues, "rests upon too naive a view of man and his social surroundings".[54] We do not have fixed, distinct ideas that become the basis for action: on the contrary, we use words and theories and ideas that we do not fully understand, gaining an understanding of them through their use. We do not develop or change our opinions based upon arguments alone, but use and are influenced by propaganda and coercion. Thus the scientific process is not as mechanical as prescriptive methodology would have us believe, but is instead chaotic and confused. To impose rules upon this chaos is both impossible and unwise.

The process of scientific research must employ certain *counterrules* which are in opposition to the general rules of science. Feyerabend gives us two major counterrules: to develop hypotheses inconsistent with highly confirmed theories, and to develop hypotheses inconsistent with established facts. In doing so, we must reject two rules of science that he terms: 1. the consistency condition, which holds that new hypotheses must confirm with established theories, and 2. the assumption that facts exist, and are available whether or not one considers alternatives to the theory to be tested.[55]

The consistency condition holds that new theories must be logically consistent with the older, established theories in a field, even if the new theories satisfactorily explain the same phenomena that the older theories can explain.[56] Why, a scientist may argue, should one clutter one's field with a number of contradictory theories that have the same amount of (limited) empirical support? Also, replacing a theory is not easy:

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[53] Feyerabend also states that though he speaks of the progress of science, he does not define scientific progress. Instead, we are all free to define it in our own ways; but howsoever it is defined, anarchism will lead to progress. (Feyerabend 1975: 27)

[54] Feyerabend 1975: 27

[55] Feyerabend 1975: 35-38

[56] Thus, according to Feyerabend, a theory becomes the measure of the validity of all those that succeed it simply by having come into existence prior to them.

various technical, pedagogical, institutional changes also must take place. Why undertake this exercise, when instead of comparing theories, one should actually be seeking to extend the empirical scope of a theory as far as possible? For it is on grounds of empirical evidence, i.e., facts, that we will ultimately choose between competing theories.

This last statement depends in turn upon the autonomy principle: on the autonomous existence of facts. This assumes that facts can be described independently of theories, a position which Feyerabend holds to be untenable.

> Not only is the description of every single fact dependent on *some* theory...but there also exist facts which cannot be unearthed except with the help of alternatives to the theory to be tested, and which become unavailable as soon as such alternatives are excluded.
>
> Both the relevance and the refuting character of decisive facts can be established only with the help of other theories which, though factually inadequate, are not in agreement with the view to be tested.[57]

Also, a theory which is successful and has empirical success, is not necessarily so because of a greater truth-value or correspondence with nature, but because it has been raised to the status of ideology: it was successful because theoretical alternatives were not permitted, and refuting facts were not unearthed. Thus "its 'success' *is entirely man-made.*"[58] It is successful because it is judged entirely on its own terms.[59]

Conversely, a theory may fail because it does not confirm to the facts – but is this the fault of the theory? For facts are not simply objective representations of reality, but are constituted through some theory. They are affected by sensory perceptions, made to fit theories by means of ad-hoc hypotheses, shaped by theory-laden observation terms.

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[57] Feyerabend 1975: 39, italics in original, and Feyerabend 1975: 41

[58] Feyerabend 1975: 43, italics in original.

[59] Empirical theories are thus in a sense circular: "empirical 'evidence' may be *created* by a procedure which quotes as its justification the very same evidence it has produced". In this case, an empirical theory is "indistinguishable from a second-rate myth". It is impossible to test a theory solely upon its own terms. (Feyerabend 1975: 44, emphasis in original)
What is interesting in Feyerabend's presentation is not just the insights that he has, but the results that he draws from them. Kuhn and Popper have both spoken of the contribution of the scientific community to scientific knowledge and method. However, they still maintain a kind of core of knowledge that is objective, valid, and rational. The subjective influence of the community, and of individual scientists, has its limits. Not so for Feyerabend, for whom science is shot through with the values, ideas and beliefs of the scientific community, as well as their standards of knowing and justification, to the extent that it forms a closed, self-referential system.

Thus if a theory does not fit the facts, the fault may lie on the side of the facts; as Feyerabend says, the evidence may be contaminated.

Feyerabend is suggesting a much more complex relationship between theories, facts, methods and metaphysical commitments than we have encountered previously. These may constitute each other, derive their validity from each other, contradict each other. A straightforward relationship does not obtain. And therefore, a straightforward methodology is also not possible.

The solution, then, is methodological pluralism. "A scientist who is interested in maximal empirical content, and who wants to understand as many aspects of his theory as possible" will not only examine his theory in the light of empirical facts and data, but also other theories. And he will not limit himself only to scientific theories, but will look to the history and philosophy of science, and to non-science also. This pluralistic methodology thus does away with the distinction between science, its history and philosophy, and non-science. It also blurs the line between rationality and irrationality.

Rationality demands that we be able, at the very least, to provide sound reasons and evidence for our arguments. Anarchism makes no such demands. Rather, if we have an idea that we think had potential, that we think will be fruitful in the future even if it is not so now, then we are well within our rights in retaining that idea until we find evidence to support it. We are also right in retaining it in the face of refuting evidence.[60] These appear to be irrational moves; but if they lead us to a theory that is fruitful, then so be it.[61] Our irrational means shall have to do until we find the facts and arguments that turn irrationality into knowledge.

Feyerabend has said that methodological pluralism allows for scientific progress, howsoever defined. How does he support this claim? There are two ways to answer this question. Firstly, if we believe that science ought to be rule-bound, pluralism will be useful because it will allow one to cope with the vast empirical experience that the

[60] Compare this with Popper's dictum that a single refuting instance is enough for us to declare our theory falsified. Feyerabend's arguments seem not only anarchistic, but even blasphemous. Of course, if anything goes, then blasphemy is permissible.

[61] According to Feyerabend, upon historical analysis, the separation between the contexts of discovery and justification which Popper alluded to also break down. Irrationality, which was supposed to be limited to the former, affects both: some scientific ideas that we consider the most essential today would not have survived had irrational elements not been permitted.

world has to offer. Secondly, if one does not believe the above (and Feyerabend does not), then anarchism leads to knowledge that is interesting, engaging, and gives scope to exercise all our faculties, and not just those that have been shaped by scientific education and training. It allows us to use all sorts of resources: facts, theories, metaphysics, superstition – anything. It requires that we be imaginative and creative.

If we are seeking the truth, anarchism will help us, because it allows us to cope with the chaos and complexity of the world better than adherence to a single method. But Feyerabend is not seeking the truth. It could be argued that he does not believe that there is any truth to seek. In explaining what he terms philosophical relativism, he argues that this is the doctrine that holds that all traditions and theories are equally true or false: a doctrine he disagrees with.[62] A theory, idea, or argument is only true from the perspective of a certain tradition; therefore, the statement 'all theories are true' is only true from the perspective of a certain tradition. Thus we cannot say whether any theory is objectively true.[63] And even if we could, should we be seeking the truth at all?

> For is it not possible that science as we know it today, or a 'search for the truth' in the style of the traditional philosophy, will create a monster? Is it not possible that it will harm man, turn him into a miserable, unfriendly, self-righteous mechanism without charm and humour? 'Is it not possible,' asks Kierkegaard, 'that my activity as an objective...observer of nature will weaken my strength as a human being?' I suspect the answer to all these questions must be affirmative and I believe that a reform of the sciences that makes them more anarchistic and more subjective (in Kierkegaard's sense) is urgently needed.[64]

For Feyerabend, one's method of investigation into the nature is not merely for the purpose of discovering the truth of nature, but is also a means of exercising one's creative faculties. A method that forces itself upon us, that constrains these faculties and that blinds us to the varied phenomena that the world has to offer, is undesirable.

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[62] Feyerabend 1982: 83

[63] Feyerabend 1982: 30. For Feyerabend, objectivity is as much of an illusion as truth. A statement becomes objective only because the subjective elements within it (references to the tradition that produced it, or the people who benefit from it) are removed. By this standard, Kuhn's normal science is entirely subjective because it springs from a particular tradition (a particular paradigm) and merely masquerades as objective by erasing references to its origin.

[64] Feyerabend 1975: 175

Particularly because, as we have seen above, the method has no "objective relevance" but exists on the strength of "the effort of the community of believers".

> This, I think, is the most decisive argument against any method that encourages uniformity, be it empirical or not. Any such method is, in the last resort, a method of deception. It enforces an unenlightened conformism, and speaks of truth; it leads to a deterioration of intellectual capabilities, of the power of imagination, and speaks of deep insight; it destroys the most precious gift of the young – their tremendous power of imagination, and speaks of education.[65]

Methodological pluralism is also a counter to the undemocratic nature of science. This lack of democracy is a result of the power of modern science, of modern scientific practitioners: the power to reject alternatives to themselves, and to enforce their own ways of knowing. This power is based on the assumption that modern science possesses the key to the truth, an assumption that Feyerabend rejects outright. But as a consequence of this power, scientists have a definite power in society. Individuals do not have a right to reject science, to choose freely between it and other forms of knowledge.[66] This is despite the wealth of insights that science derives from non-scientific material.

The rejection of an idea of the 'one correct method' is not just important for democracy, but also for human development. The person who is not force-fed a method of knowing the world will have to derive a method for himself, using all the resources at his disposal. He may choose modern science, too. But for Feyerabend, this would be acceptable, if it is the outcome of a considered choice.

Feyerabend does not hold modern science in any kind of exalted position. He does away with the distinction between science and non-science, firstly declaring that all insights, from any sources, have equal value in explaining this complex, chaotic world that we inhabit, and secondly rejecting the special status of modern science on grounds that all people, everywhere, have developed practical, intellectually stimulating, and socially useful forms of knowledge: forms of knowledge from which everyone, including scientists, can, do and should learn.

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[65] Feyerabend 1975: 45

[66] As Feyerabend says, in a democratic society one can freely choose to belong to any religion, or none; but one cannot choose to not be taught modern science at school.

By now we have some idea of what Feyerabend means when he argues that the anarchistic method is more humanitarian that the scientific. It is humanitarian because it allows us to develop as fully as possible, it does not restrict our intellectual or personal growth. It allows us to retain a sense of humour. It increases our liberty, and our chances of leading full and rewarding lives. Thus anarchism is not just an intellectual, but a moral imperative.

Science and Ethics

The scientific method has been critiqued not only on epistemological grounds, but also on grounds of ethics and morality. Here opinions are divided, with some scholars holding that the natural sciences provide a means of counteracting the forces of irrationality and violence within societies, and others arguing that violence is inherent within the scientific method itself. As we shall see, these arguments do not remain internal to science but also draw upon the relationship of science to society.

Karl Popper is one scholar for whom scientific reason and rationality are ethically desirable. For Popper, the application of the attitude of critical rationality (which is the hallmark of science) is not limited only to the sciences. Its application in the broader social sphere, particularly in politics, is not only possible but is in fact necessary. This is because the critical attitude is an alternative to violence: in fact, it is the only alternative. In the case of a conflict, or a disagreement over a course of action or an end to be reached,

> How can a decision be reached? There are, in the main, only two possible ways: argument (including arguments submitted to arbitration, for example to some international court of justice) and violence. Or, if it is interests that clash, the two alternatives are a reasonable compromise or an attempt to destroy the opposing interest.[67]

However, 'argument' as used above cannot be taken to mean any and all types of argument, taking place in any context. After all, as Popper says, propaganda also uses arguments. The difference lies in the attitude of the person doing the arguing: "in an

[67] Popper 1963:356

attitude of give and take, in a readiness not only to convince the other man but also possibly to be convinced by him". It therefore lies in an attitude of intellectual humility: from an acknowledgement of one's own fallibility. This is the attitude that Popper considers to be of reasonableness, of rationality.

Thus for Popper rationality and critical rationalism are necessary not only in the field of scientific investigation but are political imperatives. The rational attitude makes us less politically dogmatic, more mature and amenable to reason.[68] It puts us in a unique position to understand the arguments and points of view of our opponents: "For it is the method of science, the method of critical discussion, which makes it possible for us to transcend not only our culturally acquired but even our inborn frameworks."[69]

It is also, as we have said, the only alternative to violence. The rationalist abjures violence: he is a "man who attempts to reach decisions by argument and perhaps, in certain cases, by compromise, rather than by violence."[70] What kind of violence does Popper have in mind? Some examples he gives indicate physical violence: thus "you cannot have a rational discussion with a man who prefers shooting you to being convinced by you".[71] "You may not be able to argue with an admirer of violence. He has a way of answering an argument with a bullet if he is not kept under control by the threat of counter-violence."[72] An admirer of violence would also use force, intimidation and propaganda, while the rationalist would rather fail to convince you than take recourse to these methods. The rationalist thus has nothing but his power to convince you (or fail to convince you) by argument. Nonetheless, Popper's hope is that violence can still be brought under the control of reason.

The essay in which Popper presents these ideas was published in 1948, that is, shortly following the second world war. Perhaps the tremendous violence of that period – Nazism and fascism, the use of nuclear weapons in Hiroshima and Nagasaki, the cold

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[68] In 'Science: Conjectures and Refutations' Popper contrasts the critical attitude with the dogmatic attitude, equating the former with the scientific attitude, and the latter with the attitude of pseudo-science. The dogmatic attitude is an outcome of our "propensity to look out for regularities, and to impose laws upon nature". The dogmatic attitude is one that adheres strongly to beliefs; that is more concerned with verifying laws than seeking to refute them, even to the point of neglecting refutations. It therefore sticks to its presumptions even in the face of evidence that suggests that the time has come to abandon them – in fact, it may simply ignore such evidence. Popper links the dogmatic attitude with the attitudes of primitives and children, and even 'neurotics'.

[69] Popper 1994: 60

[70] Popper 1963: 356

[71] Popper 1963: 357

[72] Popper 1963: 359

war, the violence of the Stalinist regime – provided the impetus to write about violence. In his writings on the dogmatic attitude and on what he termed 'utopianism' he attempted to demonstrate the intellectual foundations on grounds of which extremely violent regimes sought to justify themselves and their policies, and also presented a critique of these arguments. His idea of critical rationality thus was not meant only to be an elaboration of the scientific method, but also his contribution towards making the world more reasonable and just, and also less violent.

However, Popper's analysis of the attitude of critical rationality as providing an alternative to violence is inadequate. He gives examples of direct, overt, physical violence and argues that the rational attitude cannot endorse such actions. He does not examine acts of grave physical violence made possible by the science informed by critical rationality: the biggest examples being the development of and use of nuclear weapons during the second world war. Of course, an attempt could be made to explain away such acts of violence as the outcomes of political decisions, as not reflecting upon the rationality of science itself. Popper does draw upon the argument that while science may provide one with the means to realise a particular end, it cannot rationally determine which end ought to be realised; and the deployment of nuclear weapons is a political and military decision, not a scientific one. Secondly, while Popper does illustrate the violence made possible by subscribing to the idea of utopianism, he does not turn to examine the violence made possible by the idea of critical rationality, or for that matter, of modern science. This does not refer only to the violence of, say, military technology, but the violence of a method in itself. Other scholars would argue that the method of modern science is inherently violent, in that it sanctions the use of violence as a tool for gaining knowledge.

* * *

The argument that science is itself value-neutral, that it serves merely to provide means while having no say with regard to ends, leads to the idea that science is a neutral tool that can be used or misused by the forces that control it. Therefore we have the following notions:

1. Science used well: science employed for ethically correct purposes (say, to produce drugs that prevent or cure disease, to increase human knowledge etcetera)

2. Science misused: science used for morally questionable ends (say, for nuclear or biological warfare)[73]

Related to these, we have:

3. Good science: science done well, conforming to rules of method (objective, reliable, valid, value-neutral, etcetera)

4. Bad science: science done badly, not following the tenets of method (say by including subjective elements like prejudices, by misrepresenting data or forging results, etcetera)

These distinctions leave us with the idea that science, if pursued with some degree of intellectual honesty, and not pressed into the service of morally questionable ends, gives us reliable knowledge that can be used for the greater good. A number of scholars have objections to various aspects of this formulation.

In his introduction to the volume *Science, Hegemony and Violence*,[74] Ashis Nandy asks whether it is possible to move beyond the 'science used well/science misused' dichotomy and "scrutinize the popular culture and philosophy of modern science". The purpose of such an enquiry is to see whether the character of modern science is as neutral as it is made out to be, or whether the "sources of violence [may] not lie partly in the nature of science itself". What is it, he wonders, that makes science "a human enterprise particularly open to co-optation by the powerful and the wealthy?" Nandy's questions thus implicate science, violence, and power. For him, science (and technology, which is the most visible manifestation of science) is politics by other means.[75] Nandy refers to the question of the link between science and politics in India, taking as an example the secrecy surrounding the country's nuclear programme, the

[73] However, the following point is made by JPS Uberoi: "No scientist of my acquaintance, however, will accept the blame for what he will term the *bad* side of applied science....the scientist will argue and shift the responsibility for it on to varieties of nationalism, totalitarianism, or capitalism, the ruling class or human nature or what not. He will claim only the *good* side of applied science to be inherently related to his science." Uberoi 1978: 83, italics in original. The sense in which we use the ideas of science used well or badly correspond to Uberoi's good and bad sides of applied science.

[74] Nandy1988: 1-23

[75] In the Indian context, technology is also the form of politics preferred by the middle classes, for whom the "Brahminic purity" of technology permits an escape from the "dirtiness" of politics – or rather, of democratic politics. Thus, "...conspicuous technology has become gradually the official goal of science in India, as well as the main source of legitimacy for science amongst the Indian middle classes....They expect this technology to allow the country to tackle its basic political and social problems and thus ensure the continued political domination of an apolitical, that is technocratic, modern elite over the decision-making process, defying the democratic system." (Nandy 1988: 7)

inability to publicly scrutinise it; but the point that he raises is not limited to this context alone. His argument is rather that modern science has the capacity to be incompatible with democratic governance and with democratic rights.[76]

Where does this capacity lie? For some it lies in the philosophical roots of the discipline. According to Jatinder Bajaj, it can be traced to the philosophy of Francis Bacon, whose ideas were instrumental in establishing the relationship between science, power and ethics.[77] Bajaj argues that the inductive methodology specified by Bacon does not itself constitute a methodological revolution for the sciences,[78] but that the revolutionary dimensions of Bacon's methodology must be located elsewhere: "in his ideas about the organisation of science and society, about the objective of knowledge, in his ethics, and in his politics...".

According to Bajaj, Bacon's first step is to free knowledge from the "constraints of good and evil", criticising those "who tend to mix 'natural philosophy' with religion and faith". These two, he feels, belong to distinct spheres. However this does not amount to a distinction between facts and values. On the other hand it involves the association of knowledge with another value: power. Knowledge is now to be pursued for the power that it generates, for the control that it enables it's possessor to wield. Thus the older values of good and evil are replaced by the values of usefulness or uselessness: "that which is most useful in practice is most correct in theory". Bajaj argues that this reflects in the fact that the seats of learning shifted from the monasteries (i.e. the repositories of ethics), to the schools and universities established and/or funded by the king (i.e. by the secular state, the repository of power).

> In sum, then, the new ideal that makes Bacon the prophet of the scientific revolution was that *knowledge ought to be organised under the tutelage of the temporal authority for the exclusive*

[76] "In India at least the culture of modern science *has* built an inverse relationship with the culture of open politics and has begun to produce new forms of secrecy, centralization, disinformation and authoritarian organizational structures. Nuclear science in this respect has only been true to the overall cultural design of modern science and technology in the country." (Nandy 1988: 10, italics in original)

[77] Bajaj 1988: 24-67

[78] Bajaj argues that the methodological tools presented by Bacon – the listing of instances of the phenomenon to be studied in tables of existence/presence, proximity, absence etcetera, and then basing our conclusions on the data provided by these tables – are neither free from preconceived notions of the nature of that phenomenon, nor do they help free us from the 'idols of the mind'. Also, Bacon's rules for the tabulation of data may be considered to be a novel contribution to scientific method, but the inductive method he expounded was not new. Thus the formulation may have been new, but the method in itself was not.

> *purpose of gaining power without regard to the questions of good and evil.*[79]

This power is to be exercised over nature and over man as a part of nature. Therefore modern science has two aspects:

> Firstly, it was to be the study of nature, and of man as a component of nature, so as to reduce both to controllable and 'usable' entities. Secondly, this knowledge or control was to be regarded not merely as a human acquisition, but as the absolute truth about nature and man, in fact as a transcript of the mind of the creator of the universe.[80]

In sum,

> The Baconian project of orienting all knowledge towards a search for power, towards control over both man and nature, and at the same time insisting that this knowledge has some unique validity, is inherently violent.

And as violence inheres in the nature of science itself, it remains violent regardless of who uses it, and the use to which it is put.

For Bajaj, then, the violence of science lies in its capacity to objectify man and nature. Claude Alvares raises a similar point about modern scientific method.[81] For him, the violence of modern science emerges from the abstraction that lies at the centre of the scientific enterprise. Abstraction requires one to select for consideration certain features of the whole, and ignore others. To construct a scientific fact, then, the unique, historical features of the event or object under consideration need to be stripped away: we need to create what Alvares calls 'artificial' or 'perfect' nature. He uses the following example to illustrate his point. According to Aristotle, if one were to drop a stone and a feather from the same height, the stone would fall faster than the feather (and this holds true of our experience as well). According to Galileo, however, if all historical forces were to be removed they would both fall at the same speed, a

[79] Bajaj 1988: 47, italics in original.
[80] Ibid, pp 50-51. Bajaj adds the following: "...the notion that the proper objective of science is study of everything in the universe as a potentially usable object has not been seriously challenged... Nothing can be done about it, except achieving awareness of the dangers inherent in the situation. That seems to be the position of most people, including modern ecologists who harbour anxieties about the objectifying nature of the Baconian worldview. Bacon's epistemological axioms are thus accorded an ontological status..."
[81] Alvares 1988: 68-112

hypothesis proved by experiments conducted within vacuums. A vacuum is "total emptiness, zero experience": an emptiness not likely to be found within nature. Thus the fact Galileo has constructed is an artificial fact. And science does violence to nature when it applies these facts to real nature, when "'artificial' or 'perfect' nature is imposed upon 'natural' or 'imperfect' nature". This is the first source of violence within the scientific method: "In actual operation, both the method and its metaphysics require mutilation or vivisection as an integral part of science."

Secondly, the scientific method "vetoes or excludes compassion. Its postulates require the excision of values." Thus 'good science' is value-neutral; it can at the most be used for good ends. But if science is anything but value-neutral, it ceases to be modern science.

Thirdly, it is inherently undemocratic.

> The scientific worldview is a totalitarian worldview: it compels universal acceptance of its postulates, without providing an adequate 'scientific' argument for such acceptance... [It] has redefined the rational to mean only its own method, excluding all else. The implications for a democratic order are obvious.

Science is undemocratic because of the imbalance created between the scientist and the non-scientist. Scientific knowledge is deemed to be the only valid knowledge, and the non-scientist is supposed to receive it unquestioningly. The democratic right to judge for oneself what is valid and what is not is thus abrogated.

This picture of science is in stark contrast to the view of science as providing us the tools to release us from the burden of tradition and dogma. But according to Feyerabend, there is nothing in science that makes it inherently liberating. Like any other ideology, science can become dogmatic: one can oppose other traditions on grounds of science, but not contest science itself.[82]

For Feyerabend, the solution to the problem of the lack of democracy of science is firstly, to recognise it as one tradition amongst many, and to grant all traditions an equal rights and equal access to the centres of power. All traditions should have equal rights because they are all equally meaningful for the people who believe in them.

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[82] Feyerabend 1982: 75

Secondly, the sciences should be supervised by laymen. This supervision should extend from the allocation of funds to which theories should be taught in schools to the safety of nuclear reactors etcetera. Of course, for this to be possible, laymen would have to acquire the necessary scientific knowledge to be able to adequately oversee science. This knowledge, according to Feyerabend, is well within "the natural shrewdness of the human race".[83] Perhaps this would be one of the most significant steps in the democratisation of science: the democratisation of scientific knowledge, its reconceptualisation as not the esoteric knowledge understood only by the expert, but as well within the reach of the layman.

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What is the significance of asking questions about science and ethics, or science and violence?

Modern science is not merely an abstract body of knowledge, or a method of investigation. Any body of knowledge that seeks to explain nature, also acts as a tool for the manipulation of nature. We do not merely *have* knowledge, we also *use* it. The form that that use takes depends to an extent upon (for lack of a better term) our paradigm.[84] Thus when we speak of science as undemocratic, we mean that this lack of democracy is part not only of the body of knowledge of science, but also of applied science. It reflects in the relationship between a doctor and patient, between an agricultural expert and a farmer, between a nuclear scientist and an ordinary member of the public. The absence of values of compassion within the scientific method make vivisection possible – it is possible to consider it valid to gain knowledge by inflicting pain upon, and even killing, millions of laboratory animals. The abstraction and reduction at the heart of the scientific method, the replacement of 'real, imperfect nature' with an *abstracted* and perfect nature, does violence to nature by causing environmental pollution: by creating waste that it is incapable of coping with.

The question then becomes one of the desirability of modern science as a tool. Based upon the implications of and results of applied science, the scholars whose opinions

[83] Feyerabend 1982: 98

[84] For example, in the previous chapter, we encountered Carolyn Merchant's argument that the shift from an organic to a mechanical worldview enabled man to exploit nature in ways that had earlier not been possible.

we have encountered above consider the desirability of modern science to be limited, if not actually nil.

But is a tool that compels us to use it only a tool? A tool that declares itself to be the only tool that we can legitimately use, that is to use Alvares' words, totalitarian, is not merely a tool anymore. It is not an instrument amongst others that we may use as and when the situation demands, but the only instrument we have. It controls us as much as, if not more than, we control it.

> ...any and every kind of science, extant or possible, is and ought only to be the child and subordinate of a higher theory and practice. Science then can be said to be a good and true servant but a bad and false master of man and culture. The prevailing claim made on behalf of modern Western science that it possesses a whole philosophy and way of thought of its own is a false claim; and the further programme to found upon that science and philosophy a whole new way of life is still worse a delusion, an evil whereby the servant shall pretend to rule the master.[85]

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Perhaps the two most significant challenges that these critiques have presented to positivist methodology are, firstly, the challenge to the idea of certain knowledge being derived through the sciences, and secondly, the ethical critique of science.

Feyerabend and Kuhn have, one wittingly and the other unwittingly, introduced a strong critique of the idea of objectivity into the philosophy of science, while simultaneously introducing the idea of relativism and the difficulty in judging between different theories and explanations of the same phenomena. Even Popper, though not at all relativist, and still making a case for objectivity, maintains only a tenuous hold on the idea that we can know the truth. Yet even Feyerabend holds that science is still possible; his science may be anarchistic, but not chaotic. The possibility of a systematic enquiry into nature is never denied.

The form that this enquiry is to take, however, needs careful consideration. The purport of the ethical critiques is that our science permits us to look at nature in certain ways and not others. The impact of looking at the world through positivist lenses is such that it cannot be sustained. What is needed then, is a new way of doing science.

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[85] Uberoi 1978: 15-16

—CHAPTER THREE—

Feminist Epistemologies

At the outset, we should point out that there are many feminist critiques of the natural sciences, from different vantage points. The themes that we have examined in the previous chapters – of objectivity, rationality, value-neutrality, progress – have been looked at in various ways by feminists operating within different theoretical frameworks. Nonetheless, the common feature of all these analyses are the centrality they accord to women in theorising these issues – howsoever they define issues pertaining to women.

Why should feminists be interested in science? First, there are questions of equality/equity, deriving from the systematic exclusion of women from science. Second, feminists are interested in science because of the power and legitimacy of science in the modern world. Given the power of definition that modern science can claim feminists seek to ask questions such as: what do the sciences say about women? How, for example, is the female body understood within medicine? What consequences does this understanding have for actual women who visit doctors? Thirdly, feminists have shown an interest in the scientific method itself, as a method which supports certain ways of knowing the world over others, and have asked whether this method represents a particularly male way of looking at the world. Of course, though posed as three distinct questions, these represent issues that are actually interrelated – for example, an image of women as irrational and incapable of intellectual rigour may result in their being barred from formal education.

Exclusion from the Sciences

One of the starting-points for an analysis of women and the sciences is the problem of women *in* the sciences. Or rather, one could say that the problem is the absence of women in the sciences. The proportion of women who obtain an education in the

natural sciences (or in engineering) is lower as compared to men. There are fewer women doctorates, fewer women in research positions, and fewer women at higher levels of academic and administrative hierarchies. Feminists argue that these trends are the result not of the lack of capacity or ability of women, but because of various forms of discrimination. Some of these may be overt – for example, simply not admitting women to certain academic programmes of study, or refusing to hire qualified women candidates to fill research positions.

Other means of discrimination may not be as overt, but still as effective. For example, the absence of women may be explained by women simply being considered less capable, less creative, or less ambitious.[1] Simultaneously, the work that women do, and the insights that they have, may be considered less important or significant – that is to say, the actual work that women do may be devalued. Successes that they have may be imputed to others: thus men may get the credit for research done by a team comprising of men and women; or in the case of individual achievements, authorities may find it difficult to believe that women have worked out solutions to problems themselves.[2]

Other factors also affect career paths. For example, pressures of home and family may make it difficult for women to devote as much time to academics or research. Even if women are keen to not allow such pressures interfere with their research, the fact that other people anticipate that they will not be able to devote as much time may affect the projects that they are assigned to work on, or their chances for promotion. Thus women who are committed to their work, and do not allow their home lives to interfere with their work, may face challenges that originate within the workplace.[3]

Factors such as these serve to discourage women from entering into or remaining within the sciences. A feminist examination of this situation calls for an end to discrimination against women, for the provision to women of a level playing field where they can achieve successes commensurate with their ability. Thus the project to

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[1] Couture-Cherki 1976: 72

[2] Hilary Rose quotes an incident wherein Evelyn Fox Keller, upon solving a mathematical problem, was asked by her instructor who solved it for her, or where she got the solution from. (Rose 1994: 13)

[3] For example, a recent article in *The Hindu* spoke of a study of Indian women scientists which suggested that while popular perception was that balancing work and home lives was the significant factor that inhibited their careers, in actuality the major disadvantages were "systemic [biases] at the institutional level"- for example, a lack of job opportunities. See Gandhi 2010: 7.

include women within the sciences deals with issues of "access, employment and discrimination."[4]

The issues of exclusion and discrimination that we have seen above, spring basically from a liberal feminist viewpoint. Here, the relative lack of achievement of women is ascribed to the discrimination that they face, and the solution to the problem is defined in terms of removing obstacles to achievement. Thus liberal feminists may seek laws that prohibit discrimination against women in academia and the workplace, for example, with regard to admission, hiring, and promotion. They may also seek to end other more subtle forms of discrimination. Thus they may argue that both men and women should receive equal encouragement and assistance from teachers and superiors, that they should have equal access to laboratories and equipment, and that women should have access to child care so that they are able to devote equal amounts of time to their work.[5]

This position, then, does not question the sciences in any way beyond that of issues of discrimination and access. It does not examine the assumptions of the scientific method, and in fact subscribes to these assumptions – of the rationality of the scientific method, its universal applicability (and the applicability of its findings), its objectivity with regard to its object of study, its value-neutrality. Nor, beyond the abovementioned issues of discrimination and access, does it examine scientific institutions and the roles that they play in society. These are the issues that are of interest to us, and which we will now examine.

In the first chapter, we examined the origins of positivist science and a positivist world-view. We saw that Steven Shapin mentioned four changes in views of the natural world, and knowledge of the natural world, that he associated with the beginnings of modern science. These include the mechanisation of nature, and the mechanisation of knowledge about nature. As we have seen, Shapin speaks extensively of how machines, particularly clocks, came to represent nature and its workings. Commenting upon Shapin's categorisation, Lederman and Bartsch point out that feminist analyses would add two further points. Firstly, they would point to the

[4] Rosser 2001: 127.

[5] The liberal feminist argument as presented here is not specific to the sciences. A liberal feminist look at other professions, say the legal profession, might raise similar sets of issues: access, equity, discrimination, and so on. For example, it might highlight the small number of women judges at the higher levels of the judiciary.

desacralisation of (female) nature: "Her secrets were open for investigation and Her body available for exploitation." Secondly, the structure of the science which emerged was itself masculine: it was developed largely by men, it was "self-identified as masculine by the use of phrases such as 'The Masculine Birth of Time'", and its characteristics are those that are socially considered masculine.[6]

Thus it is argued that from its outset, science has been a masculinist enterprise. Science as a project has been concerned with the aggressive examination of a female natural world. Secondly, it has involved not only the exclusion of women from science, but the valorisation of a typically masculine way of thinking as the ideal scientific method. We will examine these ideas below.

Nature as Female: The Significance of Analogies

Carolyn Merchant's work, *The Death of Nature* (1980) speaks at length of the notion of a female earth and its significance in the scientific revolution. The dominant image was of a female earth, docile and passive, ready to open herself up for examination. Merchant also referred to the highly sexualised language used in the new science.[7] The underlying image is of a passive, inert nature being acted upon by aggressive male knowers. This association of nature, femininity, and passivity is echoed in contemporary science. For example, Evelyn Fox Keller quotes various accounts of the activity of ovum and sperm in human reproduction. Conventional accounts show an "active [and] forceful" sperm penetrating an egg cell that merely "drifts" or is "swept" down the fallopian tube: the egg is the passive recipient of the activity of the sperm. Revised accounts, on the other hand, show the egg cell and the sperm as "mutually active", with the egg participating in the process of fertilisation along with the sperm.[8]

In *The Science Question in Feminism*, Sandra Harding asks about the utility of metaphors in science. Harding argues that we should understand sexualised metaphors and analogies as having "fruitful pragmatic, methodological, and metaphysical consequences for the sciences". She points out that other metaphors (for example the mechanistic metaphor) are seen as having a direct bearing upon the practice of science,

[6] Lederman and Bartsch 2001: 65
[7] Merchant 1980: 164-172
[8] Keller 1995: 34

in terms of directing the application of theory and method. How, then, can it be argued that sexual metaphors are irrelevant to the practice of science?[9]

There is another way of looking at the role of analogies and methods in science. In the previous chapter we touched on the concepts of the context of discovery and the context of justification. The context of discovery is the context wherein one comes across a problem, and the context of justification is that wherein one explains and solves it.[10] The presence of a separate context of justification allows for various things that might contaminate scientific research – values, biases, prejudices – to be weeded out of science. For in the process of justification, prejudices will come up against empirical evidence: therefore any beliefs one may have that have no basis in fact will be eliminated.

The example of fertilisation seen above suggests that the dividing line between these two contexts is rather more porous than might have been imagined. Our preconceptions might survive the journey from discovery to justification; in fact, they might serve as evidence for justification itself. Also we saw, in our examination of the work of Thomas Kuhn, that if in a particular case nature does not fit our paradigm, the implication is not that the paradigm is faulty, but that the scientist has erred. Let us imagine a situation in which a commonly held belief is not borne out during the course of an experiment. Suppose, for example, in a test of physical strength, women outperformed men. Our first instinct would be to look for errors in our test – because, of course, everyone knows that men are physically stronger than women.[11]

A Masculine Method

The third point that Lederman and Bartsch raise, of the masculine characteristics of the scientific method, is what we are going to examine now. In particular, we are going to look at the association of objective and rational thought with masculinity.

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[9] Harding 1986: 113

[10] The context of discovery, then, would be where one formulates one's hypothesis, and in the context of discovery one undertakes research and evaluates one's findings.

[11] An interesting example of this sort of reasoning, in the field of physical anthropology, can be found in Tuana 1995.

Scientific thought is presented to us as ungendered. Thus, if we ask ourselves what it means to be rational, the answer is: "to be rational is to be guided by legitimate reasoning."[12] This seems to be an innocuous enough definition – indeed, an innocuous concept. Yet "[t]he connotations of 'rationality' are of objectivity, abstraction, detachment,"[13] contrasted with feminine traits like emotion, irrationality, or other ways of knowing like intuition. Genevieve Lloyd argues that when such distinctions are made, when dualistic traits are assigned to the two genders, invariably the male characteristic is valued above the female.[14] Thus the simple insistence that women are also rational (i.e., as rational as men) seems to reinforce the notion that 'male' characteristics are more valuable than those considered female. Similarly, a heightened appreciation for 'feminine' traits does not go far enough towards critiquing or undermining the normative structures that produce those traits. Rationality, according to Lloyd, has been conceptualised as "transcendence of the feminine"; yet the feminine remains an important complement to rationality, making up for its shortcomings. Thus the moral values of the feminine are stressed, as against the cold, calculating nature of reason. Yet Lloyd does not appear to be too enthused by this fact, declaring that "making good the lacks in male consciousness, providing it with a necessary complementation by the 'feminine,' is a large part of what the suppression, and the correlative constitution, of 'womankind' has been all about."[15]

Dualistic schemas which assign specific traits to specific genders may be critiqued for their propensities towards essentialisation. However, an important question is raised by Phyllis Rooney: which types of knowledge, which insights, do we preclude, when we consider reason to be the single legitimate form of analysis?[16]

In *Gender and Science*, Evelyn Fox Keller points out that socially and culturally, science is associated with masculinity.[17] Thus girls may be dissuaded from studying

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[12] Cohen 2000: 415-419. Rationality is here linked to reason: "A general faculty, common to all or nearly all humans....This faculty has seemed to be of two sorts, a faculty of intuition by which one 'sees' truths or abstract things ('essences' or universals, etc.), and a faculty of reasoning, i.e. passing from premises to a conclusion (discursive reason). The verb 'reason' is confined to this latter sense, which is now anyway the commonest for the noun too, though the two senses are related (to pass from premises to conclusion is to intuit a connexion between them)." (Lacey 1996: 287-289)

[13] Lloyd 1998a: 165

[14] Lloyd 1998b: 387

[15] Lloyd 1998b: 388

[16] Rooney 1994: 2

[17] Keller 1995: 75-95. It is the association of science with masculinity, Keller argues, that has lead to the larger proportions of men in science, and not vice versa.

science subjects because they lack the necessary rigour. Keller quotes Simmel as saying that though in the abstract, objective ways of knowing belong to humanity in general, "in their actual historical configuration they are masculine throughout". How are we to understand this association of masculinity with scientific thought?

In scientific thought, there is a split between the knower and the known, between the mind and nature: a distance established between the subject and the object. Further, there is a prescription as to what kind of interaction between the two, what kind of thought, can lead to knowledge. The prescribed knowledge is that which does not threaten the distance between the subject and the object. Knowledge is derived "through reason rather than feeling, through 'observation' rather than 'immediate' sensory experience. Thus, along with a distinction between subject and object, we have another distinction between two forms of knowledge: objective and subjective.[18] In the former, the distance between the object and subject is maintained; in the latter, it dissolves. The sciences espouse objectivity, thereby maintaining the autonomy of the subject.

> In this process, the characterisation of both the scientific mind and its modes of access to knowledge as masculine is indeed significant. Masculine here connotes, as it so often does, autonomy, separation, and distance. It connotes a radical rejection of any commingling of subject and object, which are, it now appears, quite consistently identified as male and female.

Keller's emphasis on the maintenance of the autonomy of the subject is of particular interest here. In the traditional positivist account, the purpose of objectivity is to allow us to speak of the object as it really is, to keep our representations of it free of contamination by our subjective hopes, fears, desires, beliefs. However, Keller suggests that the purpose of objectivity is to prevent the violation of the *subject*, of the knower: "to ensure emotional and physical inviolability for the subject".

How do we explain the persistence of the association of science and masculinity? Keller argues that an answer to this question that is based in biology is inadequate: the answer must be sought in the "world of affect".

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[18] Keller 1995: 79

> The task of explaining the associations between masculine and scientific thus becomes...the task of understanding the emotional substructure that links our experience of gender with our cognitive experience.[19]

Keller's search for an answer takes her to psychoanalysis and psychology, looking at the development of the sense of self of the male and the female child. The ability to look at the world objectively is not innate:

> Rather, the ability to perceive reality "objectively" is acquired as an inextricable part of the long and painful process by which the child's sense of self is formed. In the deepest sense, it is a function of the child's capacity for distinguishing self from not-self, 'me' from 'not-me.'[20]

The process of the development of the child involves moving through a phase (in early infancy) where internal and external reality are indistinguishable, to a phase wherein distinctions are made between subject and object, self and other. This transition involves the recognition of the mother as an object separate from the self. The transition is a period of conflict: the separation from the mother, and the recognition of one's separate self, generates anxiety, and leads to a desire to return to the earlier state; simultaneously there is pleasure in autonomy, a pleasure threatened by the idea of a return to the earlier state.[21]

The mother is the emotional object in opposition to which the self is defined. Both boys and girls must establish a self-identity in opposition to the mother, but boys must additionally establish a separate gender identity.

> Further impetus is added to this process by the external cultural pressure on the young boy to establish a stereotypic masculinity, now culturally as well as privately connoting independence and autonomy. The traditional cultural definitions of masculine as what can never appear feminine and of autonomy as what can never be relaxed conspire to reinforce the child's earliest associations of female with the pleasures and dangers of merging, and male with both the comfort and the loneliness of separateness. The boy's internal anxiety about both self and gender is here echoed by the

[19] Keller 1995: 80
[20] Keller 1995: 80
[21] See Keller 1995: 81

> cultural anxiety; together they can lead to postures of exaggerated and rigidified autonomy and masculinity that can – indeed that may be designed to – defend against the anxiety and the longing that generates it.[22]

Thus a science whose method entails objectivity, separation, and distance, may appeal to those who share these masculine characteristics. Also, as Keller says, this characterisation may persist because of the emotional satisfaction derived from it by those who share these masculine characteristics.

Keller's analysis is fairly ahistorical and asociological: it has a rather uniform, static picture of the psychological development of children, more so than would be found upon empirical examination. Yet it gives us an interesting way of looking at scientific methodology: looking not only at the intellectual, but also at the emotional satisfaction that the discipline, through its methodology, brings to its practitioners.[23] It helps us to look at method and gender as mediated not by sex but by gender – and includes in the process of gendering, cultural as well as psychological factors.

* * *

We now move onto the main feminist epistemologies that we will be examining: feminist empiricism, feminist standpoint theory, and feminist postmodernism.

Feminist Empiricism: Merging Science and Feminism

We have seen how liberal feminists raise issues of the exclusion of women from the sciences, arguing that such exclusion counts as discrimination and therefore ought to be challenged. However, this does not exhaust the liberal feminist analysis of the sciences. Liberal feminism can also be associated with the critique of science that Sandra Harding terms *feminist empiricism.*

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[22] Keller 1995: 88-89. Also, according to Keller, a boy's gender identity may be more fragile than a girl's; similarly, a girl's self-identity may be "more vulnerable...to some degree hampered by her ongoing identification with her mother".

[23] We could ask similar questions of sociology itself, in seeking to answer how it is that certain people are attracted to one or the other sociological methodology, and how certain methodologies persist, or fail to persist, over time.

In the previous chapter, we pointed to a distinction between good and bad science. According to Harding, feminist empiricists see biases and values in science as a mark of bad science, and argue that a stricter adherence to the scientific method can rid bad science of those elements that make it so – elements like biases, values, irrationality, and so on.

Within this school of feminist thought, the entry of women into the sciences is seen as providing an opportunity for a reduction of androcentric bias within science. Nancy Tuana argues that, despite their differences, one common factor amongst feminist epistemologies is the tenet that diversity within the scientific community promotes greater objectivity. Tuana quotes Helen Longino, who says that the background assumptions of a community tend to remain invisible to members unless alternative beliefs are present to throw them into bold relief.[24] Thus in the absence of women who will point out incidences of androcentric bias, male-dominated science will remain biased, will remain bad science. Only when androcentric biases become visible can something be done to eradicate them.

Harding argues that feminist empiricism is appealing because it "appears to leave unchallenged the existing methodological norms of science....it identifies only bad science as the problem, not science-as-usual".[25] Nonetheless it involves a subversion of empiricism. The identity of the knower is supposed to be irrelevant for empiricism; yet here one is arguing that the influx of a certain section of the population into the sciences as knowers will improve the quality of science. It thus suggests a political remedy to an epistemological problem – the problem of how to increase the objectivity of the sciences. "...the best form of science will be that which is the product of the most inclusive scientific community."[26]

Yet it does all this with its commitment to science intact. To quote Tuana again:

> This, of course, does not mean that 'anything goes.' Although scientific standards are not seen as unchanging or unresponsive to such critical interaction, they do provide standards for acceptability. The "woman, the gatherer" model in human evolution studies arises out of a feminist political agenda yet meets the standards set by the

[24] Tuana 1995: 458
[25] Harding 1986: 25
[26] Tuana 1995: 459

> field in which it is proposed.. And this is important. Only if these alternative models receive a hearing within the scientific community will they ever secure serious attention.[27]

The norms of the scientific community are not questioned here. Similarly, Rosser states that liberal feminism does not question the integrity of the scientific method, nor does it question objectivity and value-neutrality: it holds that objective detachment is possible and desirable, and that bias is a failure to be objective. Rosser further attributes to liberal feminism the belief that science is not done differently by men and women.[28] Harding also argues that the empiricist project leaves the context of discovery, where much of the bias that we find in the sciences is located, untouched. Thus the feminist empiricist project may be incapable of eradicating bias as thoroughly as hoped.

Feminist empiricism, however, may not be as uncritical as the above account makes it out to be, and objectivity may not be unquestioningly accepted. In a paper titled 'Science, Facts and Feminism',[29] Ruth Hubbard argues that just as people going through their lives make up facts in socially sanctioned ways (or risk being labelled schizophrenic), so do scientists. Scientists submit to professional sanctions, for instance submitting new facts for review by peers, by publicising them by writing or speaking of them. We therefore submit to the sanctions of the group. What are the characteristics of that group? It is the group that has a particular kind of education, and whose members have learned to talk and think in accepted ways. For the most part, the people who can afford this kind of education have been white, upper-middle to upper-class men. The science (and technology) produced by this group serves to maintain power relations that are advantageous for itself: for example, by "[trying] to 'prove' that differences in the political, social, and economic status of women and men, blacks and whites, or poor people and rich people, are inevitable because they are the results of people's inborn qualities and traits." In this process, the relationship between the scientist and his object is denied or ignored. Objectivity is attained by looking at nature "in small chunks and as isolated objects".[30]

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[27] Tuana 1995: 459. For the gatherer model in human evolution studies, look at Tuana 1995: 455.
[28] Rosser 2001: 129
[29] Hubbard 1988
[30] Hubbard 1988: 7 and Hubbard 1988: 11

Hubbard argues that "feminists must insist that subjectivity and context cannot be stripped away...." She goes on to say that while she doubts that "women as gendered beings have something new or different to contribute to science...women as political beings do." This is to "insist on the political content of science and on its political role."[31]

> The pretence that science is objective, apolitical and value-neutral is profoundly political because it obscures the political role that science and technology play in underwriting the existing distribution of power in society. Science and technology always operate in somebody's interest and serve someone or some group of people. To the extent that scientists are "neutral" that merely means that they support the existing distribution of interests and power. [32]

Thus Hubbard highlights questions of objectivity and value-neutrality but not to suggest that a reformed science would achieve these ideals. Unlike Tuana above, she does question the norms of the scientific community. The rest of her argument, however, seems to fit in with the picture of feminist empiricism provided above. Thus feminist empiricism is epistemologically not as straightforward as it appears.

Feminist Standpoint Theory

Unlike feminist empiricism, which seeks to reform natural science, feminist standpoint theory (hereafter standpoint theory) seeks a new science itself. What does this mean?

In an essay titled 'Women's Perspective as a Radical Critique of Sociology',[33] Dorothy Smith uses an interesting analogy to describe the place of women in men's sociology, comparing it to the place of men in an afternoon soap opera. The world of the soap opera "is not a women's world in the sense of excluding men. But it is a women's world in the sense that it is the relevances of the women's place that govern."[34] Thus in established sociology it is the relevances of the men's place that govern. The question then is, what might sociology look like if it began from the place of women within it? This is not a simple question of 'adding women': "that merely extends the authority of the existing sociological procedures and makes of women's sociology an addendum."[35]

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[31] Hubbard 1988: 14
[32] Hubbard 1988: 14
[33] Smith 2004: 21-33.
[34] Smith 2004: 21
[35] Smith 2004: 21

It entails a reworking of the discipline: starting from the question of experience – of developing a sociology that can explain the experience of women – to reformulating the relationship between the subject and the object of knowledge, to rethinking the concept of objectivity.

Within standpoint theory, however, 'perspective' does not mean the perspective of the individual knower. "Rather, the sociologist's investigation of our directly experienced world as a problem is a mode of discovering or rediscovering the society from within."[36]

Later proponents of standpoint theory have more explicitly associated standpoint theory with a political project. Thus Nancy Hartsock, in an article titled 'The Feminist Standpoint: Developing the Ground for a Specifically Feminist Historical Materialism',[37] states, "I use the term, 'feminist' rather than 'female' here to indicate both the achieved character of a standpoint and that a standpoint by definition carries a liberatory potential."

Hartsock's notion of the feminist standpoint begins from the Marxist insight that "socially mediated interaction with nature in the process of production shapes both human beings and theories of knowledge."[38] Through this, she "[hopes] to show how just as Marx's understanding of the world from the standpoint of the proletariat enabled him to go beneath bourgeois ideology, so a feminist standpoint can allow us to understand patriarchal institutions and ideologies as perverse inversions of more humane social relations."[39] This is because

> the concept of a standpoint structures epistemology in a particular way....it posits a duality of levels of reality, of which the deeper level or essence both includes and explains the 'surface' or appearance, and indicates the logic by which the appearance inverts and distorts the deeper reality. In addition, the concept of a standpoint depends on the assumption that epistemology grows in a complex and contradictory way from material life.[40]

[36] Smith 2004: 29
[37] Hartsock 2004a: 35-53.
[38] Hartsock 2004a: 35
[39] Hartsock 2004a: 36
[40] Hartsock 2004a: 37

This last point – of the relationship between the standpoint and material life – needs explication. Dorothy Smith has argued that the worlds of men and women are different, a difference based in their divergent experiences, and that women's experiences cannot be explained using the theories and concepts developed to describe a male world. A sociology for women, then, must be grounded in women's experiences. However, women's experiences themselves need to be critically examined. This is because "the everyday world is not fully understandable within its own scope. It is organised by social relations not fully apparent in it nor contained in it."[41] The everyday world of women (and also men) is structured by forces that are external to it. For example, decisions made in and by parliament, government, corporations, may have very significant consequences for the lives of women, but are not directly visible in their lives. Secondly, the categories through which women think about and organise their lives may also come to them from outside: they need not have been generated by women themselves. "Simply to be a woman, then, is not sufficient to guarantee a clear understanding of the world as it appears from the standpoint of women."[42] Thus, a point of view based upon women's experience alone may be an insufficient ground for a liberatory feminist practice.

Thus a standpoint does not simply exist; it must, as Hartsock says, be achieved. For Hartsock, the achievement of a standpoint is the epistemological consequence of the sexual division of labour. Women's activity fulfils the conditions to be a standpoint: "women's material life activity has important epistemological and ontological consequences for both the understanding and the construction of social relations." It operates as an inversion of what Hartsock calls 'abstract masculinity', showing it to be partial and perverse, yet as it has "[structured] the material relations in which all parties are forced to participate"[43], it is not capable of being dismissed as simply false. Thus the standpoint must be the achievement of an analytic and political struggle that reveals the structures undergirding women's activity and experiences. And, ultimately, because it reveals the perversity and inhumanity of human relations, it forms the basis for moving beyond these relations.[44]

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[41] Dorothy Smith, quoted in Gorelick 1991: 464
[42] Jaggar 2004: 61
[43] Hartsock 2004a: 37
[44] Hartsock 2004a: 46-48

What, in sum, is standpoint theory? It is a perspective of feminist analysis and practice that begins from the experience of women but quickly moves beyond it. What standpoint theory seeks to understand is, why the experiences of women are as they are: what are the structures that produce and shape them? What forms does the oppression of women take in society? And, most importantly, how are these structures to be resisted? How are they to be transformed?

Sandra Harding – Standpoint Theory in the Sciences

Smith, Hartsock, and Jaggar, whose work on feminist standpoint we have briefly looked at above, theorise the standpoint from perspectives of sociology and political studies. Harding takes the idea of a standpoint and applies it to the natural sciences as a distinctive feminist epistemology.

In *The Science Question in Feminism*, Harding states that it is "useful to think of standpoint epistemologies, like the appeals to feminist empiricism, as 'successor science' projects: in significant ways, they aim to reconstruct the original goals of modern science."[45] The idea being, that feminist standpoint and empiricist theories provide us with a way of doing science that if followed, will actually give us the kind of knowledge of reality that modern science is supposed to give us but for a variety of reasons does not. Thus feminist empiricism is an improvement upon conventional empiricism. Standpoint theory, by beginning from the lives of women, provides us with better natural and social science.

Why women's lives? Harding argues that in a society stratified along the lines of gender, the activities and consequently experiences of men and women will be different. "Using women's lives as grounds to criticise the dominant knowledge claims, which have been based primarily in the lives of men in the dominant races, classes, and cultures, can decrease the partialities and distortions in the picture of nature and social life provided by the natural and social sciences."[46]

Beginning from women's lives, we can generate a "fresh and critical analysis"[47] of the social and natural worlds. As an oppressed group, women have fewer stakes in

[45] Harding 1986: 142
[46] Harding 2001: 146
[47] Harding 2001: 149

maintaining the status quo, and are more likely to recognise the structural factors contributing to their exploitation and oppression than are their oppressors.[48]

Yet achieving an understanding of these structural factors is not an automatic process, but the outcome of a struggle.

> ...we can come to understand hidden aspects of social relations between the genders and the institutions that support these relations only through struggles to change them...hence, feminist politics is not just a tolerable companion of feminist research but a necessary condition for generating less partial and perverse descriptions and explanations. In a stratified society the objectivity of the results of research is increased by political activism by and on behalf of oppressed, exploited and dominated groups.[49]

Thus we come to a significant dimension of Harding's argument: her critique and reformulation of the concept of objectivity. But before we examine this, one point must be made. The purpose of a feminist critique of science, or of a reworking of science through standpoint theory/epistemology, is not to establish a feminist science which would in some way parallel the prevailing masculinist science. Standpoint theorists do not attempt to "substitute one set of gender loyalties for another – 'woman-centred' for 'man-centred' hypotheses." What they seek is "to arrive at hypotheses that are free of gender loyalties."[50] We need, therefore, to establish that feminist standpoint claims are not justified on grounds of subjectivism or relativism. By critiquing objectivity, do we lose all grounds but subjectivism and relativism to justify our claims?

For Harding, this depends upon what we mean by 'objectivity'. If what we mean by objectivity is "'objectivism' – the assumption that objectivity must always be satisfied by value-neutrality," then upon critiquing/rejecting it we are forced to fall back upon

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[48] Additionally, "women's perspective comes from mediating ideological dualisms: nature versus culture." (Harding 2001: 150) Elsewhere Harding argues that "The androcentric ideology of contemporary science posits as necessary, and/or as facts, a set of dualisms: culture vs. nature; rational mind vs. prerational body, and irrational emotions and values; objectivity vs. subjectivity; public vs. private – and then links men and masculinity to the former and women and femininity to the latter in each dichotomy....Could there be an alternative mode of knowledge-seeking not structured by this set of dualisms?" (Harding 1986b: 136)

[49] Harding 2001: 149-150

[50] Harding 1986: 138

relativism ("the assumption that no value-directed enquiries can be objective and therefore all are equally justifiable").[51]

> From the perspective of this conventional notion of objectivity...it has appeared that if one gives up this concept, the only alternative is not just a cultural relativism (the sociological assertion that what is thought to be a reasonable claim in one society or subculture is not through to be so in another) but, worse, a judgemental or epistemological relativism that denies the possibility of any reasonable standards for adjudicating between competing claims...From the perspective of objectivism, judgemental relativism appears to be the only alternative.[52]

Therefore, we need to move beyond the concept of objectivism, which Harding considers a "weak" form of objectivity.[53] We need to move to a "strong objectivity".

> A feminist standpoint epistemology requires strengthened standards of objectivity. The standpoint epistemologies call for recognition of a historical or sociological or cultural relativism – but not for a judgemental or epistemological relativism. They call for the acknowledgement that all human beliefs – including our best scientific beliefs – are socially situated, but that they also require a critical evaluation to determine which social situations tend to generate the most objective knowledge claims. They require, as judgemental relativism does not, a scientific account of the relationships between historically located belief and maximally objective belief. So they demand...*strong objectivity*....[54]

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[51] Harding 1986: 137. According to Harding, objectivism is the notion of a value-free, impartial, dispassionate objectivity guiding research, without which we cannot distinguish between justified belief and opinion, or between knowledge and mere claims to knowledge. (Harding 2001: 154)

[52] Harding 2001: 154

[53] What, according to Harding, makes objectivism weak? Firstly, "it too narrowly operationalises the notion of maximizing objectivity." It is supposed to aid the removal of all social values from research, yet it is only successful in eliminating those values that differ amongst the members of the scientific community. Thus if the community comprises only of men, who then produce androcentric research and knowledge, this bias will not be eliminated because it will most likely not be identified. Secondly, objectivism also seeks the elimination of all social values from the process and results of research. However all social values do not have negative consequences for research. "Democracy-advancing values have systematically generated less partial and distorted beliefs than others." (Harding 2004c: 136-137)

[54] Harding 2001: 155. Italics in original.

What does strong objectivity entail?[55] It requires what Harding calls 'strong reflexivity': that "the subject of knowledge be placed on the same critical, causal plane as the objects of knowledge." Culturally-held beliefs and values function at all stages of the scientific process, be it the formulation of hypotheses, research design, data collection, analysis, etcetera. Therefore the subject of knowledge ("the individual and the historically located social community whose unexamined beliefs its members are likely to hold 'unknowingly', so to speak") must be seen as part of the object of knowledge.[56] If we are to take a critical look at the producers of knowledge, then we must recognise that "a maximally critical study of scientists and their communities can be done only from the perspective of those whose lives have been marginalised by such communities. Thus, strong objectivity requires that scientists and their communities be integrated into democracy-advancing projects for scientific and epistemological reasons as well as moral and political ones."

What are the advantages of strong objectivity for feminist knowledge production? It enables us to examine and critique both the contexts of discovery and justification of the natural sciences, thus uncovering the biases that are part of the very foundation of scientific research and knowledge. It allows us to include certain values within science – for example, democracy-enhancing values – that are good both epistemologically and politically. But more importantly, we can use standpoint theory and epistemology to reformulate and remake science, starting from completely different premises – premises that are as per our feminist politics, more liberatory.

The interesting part of standpoint theory is its insistence on feminist politics. Of course, one argument is that for a transformation of science, we need a transformation of society. The argument is well taken – all social institutions are interconnected, and

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[55] Harding 2004c: 136-138. The stronger standards of objectivity provided are linked to the nature of the subject of knowledge in standpoint theory. In contrast to the subject in empiricism, the subjects in standpoint epistemology are "embodied and visible, because the lives from which thought has started are always present and visible in the results of that thought." Second, subjects as well as objects of knowledge in standpoint epistemology are socially located and embodied and therefore are not fundamentally different from one another. Harding points out that the same kind of forces that shape objects also shape (but do not determine) subjects. Third, communities and not primarily individuals produce knowledge: this is because personal belief only becomes knowledge when it is socially legitimated. Fourth, "subjects/agents of knowledge for feminist standpoint theory are multiple, heterogeneous, and contradictory or incoherent, not unitary, homogeneous, and coherent as they are for empiricist epistemology." (Harding 2004c: 132-134)

[56] This does away with the distinction between the contexts of discovery and justification, as both contribute to the knowledge that is produced, and therefore are equally amenable to and in need of examination and analysis.

therefore changes within one cannot but be somewhat superficial without changes in the whole.

Yet in standpoint theory, politics are essential for epistemological purposes themselves. We need to ground our research in women's experience and women's lives, that is true: but not in women's lives per se, rather in a certain understanding of women's lives.[57] For women may not understand or explain their lives in the same ways that standpoint feminists (or any feminists, for that matter) do. Hence the stress on the achieved character of the standpoint. Achieving a standpoint is a process wherein one learns to see certain structural factors as responsible for everyday experiences, and also learns to recognise the oppressive element in them. Thus politics, particularly in the form of 'consciousness-raising', is very significant. The purpose of starting from the lives of women is that, as a marginalised community, women should be able to correct the distortions of male dominated scientific discourse, distortions they have no interests in maintaining. However they can hardly do this if they themselves have a distorted view of nature/society.

Harding has described standpoint theory as a "feminist critical theory about relations between the production of knowledge and the practices of power."[58] This brings us to one of the major critiques of standpoint theory – the questioning of the category of 'women'. Standpoint theory is based upon the notion that the marginalised and the powerless within a community have a greater interest in producing undistorted knowledge than those who do have power. Hence, women as a marginalised and powerless group are ideally located to develop a standpoint.

But will women as a group produce one standpoint? Do women even constitute a group? Patricia Hill Collins states that "common location within hierarchical power

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[57] The difference between experience and an awareness of the causes of that experience may be expressed thus: "The daily experience of oppressed groups provides them with an immediate awareness of their own suffering but they do not perceive immediately the underlying causes of this suffering nor even necessarily perceive it as oppression. Their understanding is obscured both by the prevailing ideology and by the very structure of their lives." (Jaggar 2004: 60) Karl Popper would say here that standpoint feminists are claiming that the truth of women's lives would be manifest, were it not for the role of the dominant masculinist ideology in obscuring that truth. That aside, another point strikes us as important here. One aspect of strong objectivity mentioned by Harding is reflexivity: the placement of both the subject and object of knowledge on the same critical plane. In the case of the analysis of women's lives, the subjects of knowledge are standpoint feminists themselves.

[58] Harding 2004b: 1

relations creates groups."[59] Groups then exist within the category of 'women' itself – there are differences of power within this group, not only relative to the category 'men'. And these relations may often be of oppression and exploitation.

The problem arises when one examines the idea of 'women' as a singular, homogenous group.[60] It glosses over the many differences in women's lives and experiences – differences in the very things that were to serve as the basis for a standpoint, such as different racial and class backgrounds. If we acknowledge these differences, how do we develop a single standpoint? And how do we see the political transformation that the standpoint is supposed to help us achieve?

For Hekman, the idea of multiple locations and situated knowledges necessarily leads to the conclusion that no perspective/standpoint is epistemologically privileged. Thus, where we once claimed to have access to a feminist standpoint, we now have access to many perspectives, none of which can be said to be superior to any other.

There are many responses to this point. Harding argues that all locations are not equally good for understanding social reality,[61] and that all accounts of reality cannot be said to be as good as all others. Hartsock justifies privileging certain accounts of reality over others thus: "the criteria for privileging some knowledges over others are ethical and political rather than purely 'epistemological'....The most important issue for me is the question of how we can use theoretical tools and insights to create theories of justice and social change that address the concerns of the present."[62] Nonetheless the points that Hekman has raised come from a shift in the nature of theorising, one which has implications for feminist theory as well.

Donna Haraway: Situated Knowledges

In a paper published in 1988, Donna Haraway argued that "feminists have both selectively and flexibly used and been trapped by two poles of a tempting dichotomy on the question of objectivity."[63] One the one hand lie social constructionist arguments,

[59] Collins 2004: 248
[60] See Hekman 2004
[61] Harding 2004d: 257
[62] Hartsock 2004b: 245
[63] Haraway 1988: 576

for which science (facts and artefacts included) is rhetoric, a power-generating discourse, having nothing to do with reality itself. On the other are the feminist approaches, whether empiricist, Marxist, psychoanalytic, or various combinations of the three, offering feminist versions of objectivity.[64] Here the concern was not so much with showing the "radical historical contingency and the modes of construction for everything" but was the insistence on "a better account of the world". The problem then is:

> how to have *simultaneously* an account of radical historical contingency for all knowledge claims and knowing subjects, a critical practice for recognising our own 'semiotic technologies' for making meanings, *and* a no-nonsense commitment to faithful accounts of a 'real' world, one that can be partially shared and that is friendly to earthwide projects of finite freedom, adequate material abundance, modest meaning in suffering, and limited happiness.[65]

Thus the aim is an account that commits itself to what appear to be a set of contradictory aims, at least contradictory in light of the two ends of the dichotomy posited above. Yet "–[a]ll components of the desire are paradoxical and dangerous, and their combination is both contradictory and necessary."

> Feminists don't need a doctrine of objectivity that promises transcendence, a story that loses track of its mediations just where someone might be held responsible for something, and unlimited instrumental power....We need the power of modern critical theories of how meanings and bodies get made, not in order to deny meanings and bodies, but in order to build meanings and bodies that have a chance for life.[66]

For Haraway, the question of objectivity is now to be understood through the metaphor of vision. Her insistence is on the "embodied nature of all vision." Objectivity then is "a doctrine of embodied objectivity that accommodates paradoxical and critical feminist science projects: Feminist objectivity means quite simply *situated knowledges*."[67]

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[64] Haraway 1988: 578-579
[65] Haraway 1988: 579. Italics in original.
[66] Haraway 1988: 579-580
[67] Haraway 1988: 581. Italics in original.

In contrast to objectivity as situated knowledges is the 'god trick': "seeing everything from nowhere", "a route to disembodiment", a "false vision promising transcendence of all limits and responsibilities".[68]

> The moral is simple: only partial perspective promises objective vision....Feminist objectivity is about limited location and situated knowledge, not about transcendence and splitting of subject and object. It allows us to become answerable for what we learn how to see.[69]

Situated knowledges also entail a revision of the idea of the object of knowledge: "Situated knowledges require that the object of knowledge be pictured as an actor and agent, not as a screen or a ground or a resource, never finally as slave to the master that closes off the dialectic in his unique agency and his authorship of 'objective' knowledge."[70]

What, then, does situated knowledge mean? It means to learn to see, to learn to see from somewhere, to acknowledge that one cannot see everything, to see without denying the agency of what one looks at, to be accountable for what one sees and the representations one makes. It is this, Haraway says, the idea of multiple partial situated perspectives, which gives us an objectivity that allows for rationality, accuracy, and responsibility.

Haraway's work marks a transition for us – from standpoint theory to postmodern feminist theory.

We have seen, above, the rejection of the idea of 'women' as constituting a single group. In 'A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century',[71] Haraway argues against the homogenising tendencies of feminist thought.

> With the hard-won recognition of their social and historical constitution, gender, race, and class cannot provide the basis for

[68] Haraway 1988: 581-583

[69] Haraway 1988: 583. Haraway raises another significant issue here: where do we see from? The standpoint feminist argument that we have seen above trusts the "vantage point of the subjugated; there is good reason to believe vision is better from below the brilliant space platforms of the powerful." Yet "there also lies a serious danger of romanticising and/or appropriating the vision of the less powerful while claiming to see from their positions."

[70] Haraway 1988: 592

[71] Haraway 1991

> belief in 'essential' unity. There is nothing about being 'female' that naturally binds women. There is not even such a state as 'being' female, itself a highly complex category constructed in contested sexual scientific discourses and other social practices.

Socialist and radical feminist trends, according to Haraway, have not been capable of capturing the differences amongst the women whom they were trying to theorise. Instead, they have falsely universalised from certain features (say, labour) and have arrived at essentialised images and models of women. In the process, they have created their own forms of domination, their own ways of being unable to make room for different voices within these categories.[72]

Haraway, on the other hand, focuses not on the establishment or maintenance of boundaries but on their permeability. According to Haraway, late twentieth-century (and now early 21st century) capitalism sees significant breakdowns and reconstruction of various boundaries: in particular, the breakdowns in distinctions between animals and humans, humans and machines, the physical and the non-physical. For purposes of theorising, then, she uses the figure of the cyborg. A cyborg is a hybrid: part machine and part (human) organism. For Haraway this figure is a metaphor, a manifestation of the fluidity of our culture, our identities, our social formations and locations.

Standpoint epistemologies, with their insistence upon the significance of the view from below, fixed the social location of women precisely there – below. Cyborg culture, on the other hand, recognises no such fixity of location. The boundaries which feminist theory drew upon, which allowed for the categorisation of space into distinct realms – public and private, home and workplace, personal and political – now become increasingly permeable.[73] Therefore it is no longer possible to speak of a 'view from below' (much less the privilege of the view from below). Along with the rejection of the fixity of location is the idea of the "permeability of boundaries in the personal body." Personal identity, like social location, has become fluid: "The cyborg is a kind of disassembled and reassembled, postmodern collective and personal self. This is the

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[72] Also, having identified certain basic axes of the domination of women, these trends can only account for others by "analogy, simple listing, or addition." See Haraway 1991: 160

[73] "So let me return to the earlier image of the informatics of domination and trace one vision of women's 'place' in the integrated circuit, touching only a few idealized social locations seen primarily from the point of view of advanced capitalist societies: Home, Market, Paid Work Place, State, School, Clinic-Hospital, and Church. Each of these idealised spaces is logically and practically implied in every other locus, perhaps analogous to a holographic photograph." (Haraway 1991: 170)

self feminists must code." Nor does this self attempt to locate itself at some transcendental point: "it has no truck with bisexuality, pre-oedipal symbiosis, unalienated labour, or other seductions to organic wholeness through a final appropriation of all the powers of the parts into a higher unity."[74]

We saw, above, Susan Hekman's argument that the acknowledgment of the existence of many epistemological perspectives necessarily leads to a position where one cannot privilege any one of them – in short, to epistemological relativism. However for Haraway, relativism is another god trick, "a way of being nowhere while claiming to be everywhere equally. The 'equality' of positioning is a denial of responsibility and critical enquiry. Relativism is the perfect mirror twin of totalisation in the ideologies of objectivity; both deny the stakes in localisation, embodiment, and partial perspective; both make it impossible to see well."[75]

Postmodern epistemology is, however, thought to lead not only to an epistemological relativism but to judgmental relativism as well: to a situation where we cannot privilege any opinion, any viewpoint, where all views are equally valid.[76] In this situation, our attempt to use our epistemology to ground our attempts for political transformation appears to be entirely undermined.

Yet for Haraway, the 'fracturing of identities' is the beginning of politics – of a new politics not based upon monolithic identities but upon the many possibilities thrown up by the multiplicity of identities, the contradictory positions made possible by postmodernism. "So my cyborg myth is about transgressed boundaries, potent fusions, and dangerous possibilities which progressive people might explore as one part of needed political work."[77]

Like the feminist empiricist and standpoint trends, postmodern feminist theory also seeks to give women tools to do better science. In an essay on critiques and

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[74] Haraway 1991: 163 and Haraway 1991: 150
[75] Haraway 1988: 584
[76] For an example of this position, see Nanda 2003.
Contributing to the idea that postmodern science is hyper-relativistic is the idea that it makes no distinctions between the truth of scientific and non-scientific discourse: that modern science is a social product like any other, constituted by social factors like any other social institution. Titles like 'Primatology is Politics by Other Means' would certainly appear to bear this out. (Haraway 1984; see also Haraway 1989)
[77] Haraway 1991: 154

reconstructions of immunology, Lisa Weasel[78] argues that conventional immunological models can be productively critiqued using Haraway's notions of fractured identities and "split and contradictory selves".[79] Immunology has presented models of immunological response based upon the notion that an organism (the 'self') perceives foreign objects (the 'other') as threats and thus mounts a response against them (Weasel refers to this as the self/non-self model). The explanatory value of this model is limited, however (for example, it fails to adequately explain why a pregnant woman does not mount an immune attack against her foetus), and other alternatives have been considered. Weasel considers a reformulated model of immunological response, developed mainly by Polly Matzinger: a 'danger' model wherein the organism mounts an immune response against not all foreign bodies it encounters, but to those which it perceives as dangerous. This perception is "context-dependent [and] biosemiotically mediated": thus there is no "universal 'other'" which cannot ever be tolerated by self.[80]

This reworking of the theory of the immune system incorporates the notion of the permeability and fluidity of boundaries that we have seen in Haraway's work, and therefore could be considered a postmodern feminist theory. Unlike the other feminist theories that we have seen however, it was not intended to be a feminist theory. Thus Weasel points out that Matzinger, who has been instrumental in developing this theory, has not stated any commitment to feminism in her work: she is not trying to do feminist science of any kind.[81] Yet her theory could be looked upon as a good example of feminist science by feminist empiricists, standpoint theorists and postmoderns. Of course, feminist empiricists and standpoint theorists have made an overt commitment to feminist goals (howsoever defined) an integral part of feminist scientific practice. According to Weasel, this might not be necessary:

> While some may believe that a feminist science must come from a consciously articulated feminist commitment or can only arise once we live in a feminist world, I tend to disagree. Although today's scientific laboratories and classrooms may not be filled with feminist scientists, it is up to those of us who dream of such a future to begin assembling the rough outlines of what such a vision could hold in

[78] Weasel 2001
[79] Haraway 1988: 586
[80] Weasel 2001: 39
[81] Weasel 2001: 41

> store. There is no better place to begin our search for a feminist science than with scientific theories themselves.[82]

This, perhaps, is the point of divergence between Weasel and Haraway. For Haraway, the fracturing of identities still provides for the possibility of necessary political action: and political action is necessary. A second point might also be made: searching within scientific theories will not help resolve the problems of exclusion from the sciences that liberal feminists have highlighted, nor will it necessarily help to counter androcentric biases that standpoint feminists critique.

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Hilary Rose: Responsible Rationality and Caring Labour

One of the problems that we have highlighted with the positivist conception of the sciences is how, using the familiar distinction between 'is' and 'ought', the question of ethics and values is considered external to scientific method and practice. In this section I will look at the work of Hilary Rose, and her attempt to transcend this distinction, and seek a scientific method and practice that is both feminist and ethical in nature.

Hilary Rose's feminist understanding of the natural sciences emerges from her work in the political economy of science. Her early publications deal with the question of science in a capitalist society.[83] In her later work, Hilary Rose points to her

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[82] Weasel 2001: 41

[83] *Science and Society* (1969), co-authored with Steven Rose, examines the "inter-relationships between science, technology and society". The focus is on how science is organised in Britain, "that is, how it is financed and controlled, how and why scientists embark upon particular pieces of research, how particular scientific decisions are made". (Rose and Rose 1969: xiv) The book traces the development of science in Britain, from the private activity of a few to a large and ever-expanding industry, "massively financed and heavily controlled". (Rose and Rose 1969: xvii) The book thus looks at the links between science, industry, and government, extending its analyses from Britain to the rest of the world. Elsewhere, Rose and Rose speak of the importance of examining science as a part of capitalism, speaking of issues such as the proletarianisation of the labour force, the role of science as a generator of ideology, and the internationalisation of science as a necessary result of it being a capitalist enterprise, similar to the setting up of the multinational corporation. (Rose and Rose 1976a: xv)
Rose and Rose argue that the idea of scientific progress as something automatic and inevitable is incorrect. "...science is not an unpredictable act of gods in white coats, nor is it the product of forces of an unspecified 'progress' which are outside our powers to control....It is the product of certain philosophies, ideologies, economic and political structures. It is thus to a considerable extent modifiable and plannable." (Rose and Rose 1969: 241)
How, and to what extent, can science be planned? There is a point up till which science is independent of planning. We cannot plan to build nuclear reactors without the theoretical knowledge and technological capability to build them. Beyond that point, the ability to plan the direction which science is to take rests upon the power to give or withhold the resources necessary for scientific research. Of

dissatisfaction with the theoretical insights generated by the radical science movement, arguing that they failed to adequately answer questions pertaining to women and the sciences.

The Marxist political economy espoused by the radical science movement entails a conceptualisation of the division of labour (between mental and manual labour) that is part of the process of production. According to Rose, it does not recognise the division of labour entailed in the process of reproduction, i.e. the sexual division of labour, and thus is unable to conceptualise the relationship of science to patriarchy. In *Love, Power and Knowledge: Towards a Feminist Transformation of the Sciences*, Rose recounts the attempt of second-wave feminism to show that women's lives and the forms they took were not part of 'natural' but were "socially and historically constructed".[84] The division of labour between the sexes, Rose writes, was recognised within the west but in a completely naturalised way.[85] In feminist theory, this division of labour was seen as not natural but social.

According to Rose, women's labour, whether paid or unpaid, often involves the element of personal service that she considers to be a mark of caring labour. The sexual division of labour allocates what Rose calls 'caring labour' primarily to women.[86] What is caring labour?

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course, the sheer availability of resources does not guarantee results. However, directing resources to certain areas makes it more likely that results will emerge; starving another area of funds, equipment and so on make it difficult for even interested researchers to do research. Also in certain environments certain questions may not even be asked – and therefore never answered. "It is in this sense that even the most basic of science that we do is a product of our society." (Rose and Rose 1969: 243)
For Rose and Rose, the problems of modern science have to do with its association with capitalism. In developing a programme for the radical science movement, they argue that the way forward is, firstly, to understand and explore the ideological components of capitalist science; secondly, to create a contra-science within the existing framework; and thirdly, to break down the barrier between the expert and the non-expert. (Rose and Rose 1976b: 24-25) The purpose is to create a science for the people, one that is non-elitist and in which previously marginalised communities (the working class, women, etcetera) can participate as equals. The end result will be the transformation of science.
Rose and Rose speak of science as a social activity: the questions that it addresses are determined socially, and the use to which it is put depends upon societal factors. "Science is never neutral, for its goals are never neutral. "Science [is done]...in a context that places value judgements upon its goals." (Rose and Rose 1969: 262) Also, the autonomy of science has been undermined by the need for science to seek external funding. Hence their question in *Science and Society*: who is to be master? Who, between the state, capital, scientists, and the people, is to be in charge of the scientific enterprise? These, then, were the issues and problems facing the radical science movement.

[84] Rose 1994: 28

[85] Thus domestic labour was the preserve of women, of course, and the paid labour outside the home was ideally to be somehow an extension of their roles as wives and mothers (for example, teaching). (Rose 1994: 29)

[86] Rose 1983: 73

> Perhaps to make the nature of this caring, intimate, emotionally demanding labour clear, we should use the ideologically loaded term 'love'. For without love, without close interpersonal relationships, human beings, and it would seem especially small human beings, cannot survive. This emotionally demanding labour requires that women give something of themselves to the child, to the man.[87]

This caring labour becomes visible, in the home, in the manner in which women take care of children, of invalids, of the elderly, of men. It is work: one must think about the tasks to be performed (for example, how best to perform them), one must perform those tasks, and one must give comfort to the cared-for in the process. It requires more than just a mechanical performance of tasks – as Rose has said, it requires that one give something of oneself to the cared-for. And at the end, it results in a feeling of satisfaction for both the carer and the cared-for.

Yet Rose points out that upon analysis, caring labour is not entirely unproblematic. For she asks, "Is it all a con? Is it part of the emotionalisation of housework?" She is suspicious of the "negative way emotion as integral to caring labour has become historically linked through the processes of mass consumption to a degrading emotionalisation of housework". Thus a woman's love for her family is expressed, according to television adverts, in "superwhite shirts for [her husband] and children".[88] Yet the pleasure of caring for someone is still real, and still yields understanding and satisfaction.

The second problem occurs when caring labour again becomes seen as part of, or an extension of, women's nature or essential being.[89] Instead it is a skill that is learned, not by instruction but through practice, through experience. Yet these skills are simultaneously naturalised and undervalued. Thus to quote Rose's examples, childrearing is seen as something that comes naturally to women, although experience clearly has an impact upon one's ability to take care of a child – 'the second child is easier than the first'. Similarly, the caring labour involved in nursing the sick may significantly impact a patient's health and wellbeing, yet the value of this labour is not reflected in nurses' salaries.

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[87] Rose 1983: 83
[88] Rose 1994: 39
[89] As Rose puts it, "as the natural expression of femininity itself". (Rose 1994: 43)

What is the significance of caring labour for the sciences? This concept has two major consequences:

Firstly, the concept of the sexual division of labour allows us to link science and patriarchy. What is important, for Rose, is that the idea of women's labour not simply be added to the understanding of the process of production, as this would again result in a naturalisation of the labour of women. On the other hand, we must learn to recognise the dialectical relationship between the process of production and reproduction.

> The dialectical relationship between both systems of production – the production of things and the production of people – holds the explanation not only of why there are so few women in science, but also, and equally or even more importantly, of why the knowledge produced by science is so abstract and depersonalised.[90]

The fact of caring labour being performed by women is also reflected in the composition of the female workforce. When they enter the workforce, women perform activities that are extensions of caring labour. Thus,

> Most women in natural science and engineering are relegated to those tasks that most markedly parallel their primary task as wife-mother. If we examine the full labour force - not just the scientists but also the technicians, secretarial staff, and cleaning personnel - we see that the majority of women are still carrying out menial and personal service work.[91]

The second significant consequence of the concept of caring labour is the way in which it allows us to rethink the notion of rationality. For Rose, the caring labour performed by women "foster[s] a more relational understanding both socially and bodily." It requires the ability of the carer to read the emotions of the cared-for, often simply from body language. It requires "empathy and affection which honour the autonomy of the cared for." It is thus "complex practical and emotional labour."[92] This incorporation of emotion within the concept of labour has, according to Rose, accompanied a feminist reformulation of the concept of rationality. In this reformulation, "a rationality of

[90] Rose 1983: 84
[91] Rose 1983: 86
[92] Rose 1994: 49

responsibility for others becomes central."[93] Rationality is thus reformulated to contain within itself an ethic of caring. It therefore has an emotional content: emotions which are necessary for a non-violent understanding of the natural world as well as the social. It is this emotional and ethical content which allows for a responsible rationality.

Rose argues that the different feminist critiques of science have a common wish to challenge "the ethic of no ethic, the culture of no culture that lies at the universalising core of modern science...and to rebuild the sciences as respectful and responsible."[94] Rethinking the notion of rationality to include responsibility, the notion of knowledge and power to include love, can help to realise this desire to make science an ethical, responsible enterprise.

Hilary Rose presents us with a critique of some of the central tenets of positivist thought. Her earlier work, in collaboration with Steven Rose, challenges the inherently progressive nature of science, arguing that the progress of science depends to no small extent upon material factors. Her critique of, and reformulation of, the concept of rationality, challenges some of the dualisms that lie at the centre of positivist science: those of fact and value, of reason and emotion. In her reformulation, values play a part in shaping facts. Emotion, far from being a subjective element that has no place in science, becomes a necessary part of the process of reasoning.

The subtitle of Rose's book – *Towards a Feminist Transformation of the Sciences* – reflects a theme that we see running through her earlier work as well: that of understanding the sciences with a view to changing them.[95] Rose constantly reiterates the fact that science is a social activity: that it is affected by social structures and processes, and simultaneously affects them as well. Thus science can be changed and shaped by society (it is 'plannable') and ought to be changed, for according to her, masculinist science and technology are part of a culture of death.

> That science claimed its ideological purity, leaving by implication its partner technology to carry the responsibility for the dirty side of the

[93] Rose 1994: 49
[94] Rose 1994: 231
[95] Thus, as we saw above, *The Radicalisation of Science* speaks of the transformation of science through the creation of a contra-science.

> relationship, was part of science's skill at conveying a culture of no culture.[96]

If we recognise that science has both a culture and an ideology, we allow ourselves the possibility of reformulating both. An ethic of caring does not allow us to posit the distance between ourselves and our object of study that is necessary for the perpetuation of a culture of death.

Yet the idea of a responsible rationality derived from women's caring labour appears to be quite an unpalatable solution from a feminist point of view. As we have seen, any monolithic view of 'womanhood' is anathema for a postmodern feminist perspective.[97] 'Caring labour' may not be the same everywhere, may not yield the same pleasures (may not be expected to yield the same pleasures) for all those who perform it. The idea of the performance of caring labour by women, a labour in which one gives something of oneself to the other, where one must be selfless, is, despite Rose's caveats about learned nature of caring labour and the emotionalisation of housework, quite close to an essentialised view of womanhood. It is quite easy to move from it to the notion that women are naturally more caring, and therefore more suited to performing caring labour. When referring to women's work in the public sphere, Rose states that women are 'relegated' to tasks that mirror the caring labour performed in the home. However she does not use the term 'relegated' when referring to the division of labour within the household itself, although the mode of assigning caring labour to women within the household may well be described using the term 'relegation'. Women performing caring labour within their households may do so reluctantly, may find it lonely, alienating and unrewarding. Rose also glosses over the violent acts that women are capable of and do commit within and without the household – acts that may be committed against the very people who are recipients of their caring labour.

Secondly, the idea that science needs to be reformed by a responsible rationality that women can provide merely reinforces the stereotype that women's qualities act as a necessary complement to men's: in this case, by having women provide the caring, responsible, human element that masculine sciences lack.

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[96] Rose 1994: 2

[97] Interestingly, Rose does not make distinctions between the caring labour performed by women from different class positions. Would a woman who could afford domestic help to care for her infant, or for infirm dependants, have a different notion of caring labour from one who was performing this labour herself?

What are we to make of this? On the one hand, the problem that Rose identifies – of the atrocities perpetrated by a scientific rationality *not* informed by any ethical element, of the culture of death – are all too real. Yet the solution that she presents seems to in turn perpetrate some of the stereotypes that women have actually sought to challenge. However, perhaps the significant dimension of Rose's work is not the idea of caring labour itself. We may not accept this idea in its entirety. But the results that the idea of caring labour is supposed to achieve – an ethical science informed by a responsible rationality – have important implications. A responsible rationality would implicate issues of power – power in and of the sciences, and issues of a greater democratisation of the sciences. It would most importantly make ethical issues not political problems peripheral to scientific research and practice, but part of this research and practice.

* * *

The variety of feminist perspectives that we have seen in this chapter make it clear that there is no such thing as *the* feminist critique/reformulation of the sciences. There are many different opinions on the nature of the science, on the role of science in society, in the desirability of the sciences. Some of these are fundamental differences in outlook: thus for example empiricist and postmodern views on how to reformulate the sciences would be very different, based as they are upon different conceptualisations on the nature of science. What, then, are we to make of the idea of a feminist critique of science? What can we say is common to all of these positions?

The first, and perhaps one of the most significant, features which is common to all the feminist critiques which we have studied is the idea that science is not an activity carried out by detached, neutral observers – that the identity of the person who is selecting a field of study, making observations, interpreting data, and developing theories is a significant part of what is considered the content of science. All feminist critiques question the distinction between the contexts of discovery and justification, a point which we have made above. Thus a feminist critique begins from the position that science is a social product, and with the idea of understanding the place of women within it. The 'place of women' includes many things: if women are adequately represented in scientific institutions, how they are described in scientific theories, what their relationship is to scientific methodology. It is in these questions, as we saw above,

that very many divergences appear in feminist theories: the way the questions of women and science are formulated vary tremendously from one perspective to the next.

Yet here as well, certain commonalities can be found, the most significant is perhaps the commitment to changing the sciences. The desired changes range from correcting the biases of scientific theory and methodology, to entirely overhauling the epistemological, methodological and theoretical dimensions of the sciences. whatever the level at which these changes are pitched, they all involve aligning science with feminist values, the argument being that this will enable us to do better science.

'Doing better science' is also very important. Feminist scientists do not reject science as a way of knowing in its entirety. As we saw above, it has been argued that the postmodern feminist trends incorporate a hyper-relativism that does not permit one to judge between scientific and non-scientific accounts of natural phenomena. Yet as we have seen, all postmodern perspectives do not endorse a runaway judgemental relativism that would prevent one from judging between competing claims. However better science in the feminist parlance would not only be a science which gives us better accounts of the world, but which is also informed by feminist values.

The last point that I would like to raise refers to one of these values – one that is not only a feminist value. This is the desire to make the sciences more democratic, more egalitarian, more accessible. The idea of democracy may be in terms of making the products of science and/or technology more accessible to all, making scientific institutions open to all, or highlighting and eradicating the elitism of the academic world. Thus despite their many internal differences, the various strands of the feminist epistemological project do come together in many ways.

The feminist critiques go both further and not as far as the post-positivist critiques that we have examined in the previous chapter. They go further than them because they challenge the fundamentals of scientific methodology that scholars like Kuhn and Popper left untouched. Popper and Kuhn did not challenge the basic idea of science as a rational, progressive, objective discipline, did not challenge the value of science for society, and certainly did not challenge the value of rationality itself.
They do not go as far because they do endorse the 'anything goes' anarchism of Feyerabend. Perhaps this is how we could read idea of responsibility in Haraway's

formulation of situated knowledges: that we must locate ourselves somewhere and be able to account for that location, be able to hold ourselves responsible for choosing that location.

—CONCLUSION—

We have been following certain themes throughout this dissertation, trying to trace their development, modifications, rejections, reformulations, and so on. In this process, we have seen the varied ways in which these concepts have been described, reformulated, and rejected. In this conclusion, I would like to try to reconsider these themes, looking at them through the lens of the post-positivist and feminist critiques that we have examined.

What do we make of objectivity? Popper, Kuhn and Feyerabend have, either quite deliberately or by implication, forced us to rethink the notion of the objectivity of the sciences. We began with two ideas of objectivity – ontological and epistemic. Popper, as we saw, retained both concepts in his work; however his work, with its stress upon the fallible nature of all knowledge, does not allow us to retain these concepts unquestioningly. The work of Kuhn has done much to do away with the idea that there is a fixed, ontologically objective reality to which we have access: reality is instead constituted by the prevailing paradigm. Feyerabend, of course, does not believe that epistemic objectivity exists at all – the impression of epistemic objectivity is merely the failure of the writer to state his subjective perspectives and biases.

Feminist scholars too have had a varied engagement with objectivity. The empiricist trends in feminism can be seen as providing ways for science to become more objective, by eradicating bias. (Of course, Feyerabend might argue that they are merely replacing one set of biases with another.) Standpoint and postmodern scientific trends call for redefinitions of objectivity. Thus Sandra Harding calls for the dissolution of dualisms – between knower and known (subject and object), facts and values, and so on – for purposes of creating a better scientific theory and practice. Donna Haraway argues that objective vision is only possible from local, partial perspectives.

Yet at the same time, we have seen how objectivity is associated with masculinity, and is formulated as distance and detachment from our object. The question then is, why should feminist scholars be speaking of objectivity at all? Should the concept not be rejected in favour of one that does not carry the connotations of detachment that feminist scientists have critiqued? The feminist reconstructions of objectivity are quite removed from its conventional formulation. Why, when attempting to formulate a way of knowing that breaks down dualisms, that defines certain positions *in* the world as better located for deriving objective knowledge than positions outside the world, that produces knowledge not only *of* the object but also *for* the object (and oneself as part of the object), must we still denote this way of knowing by a term which has traditionally connoted the opposite of all these features?

Perhaps the answer to this question lies in the multiple meanings of the word 'objectivity' itself. As we have seen, this connotes not only a way of looking at the world, but also an idea of how the world is constituted. Feminist scholars, who do critique conventional notions of epistemic objectivity, still argue that the terms and concepts they use (for example, patriarchy, oppression, sexual divisions of labour, and so on) refer to something that actually exists in the real world. Indeed, the idea that one may have a feminist politics informed by feminist theory depends upon this claim. Thus the idea of ontological objectivity is still retained (though perhaps not unquestioningly). Therefore, when feminists describe their ways of knowing as objective, perhaps the connotation is that what they speak of is ontologically objective.

In our first chapter, we spoke of positivist science as being inherently progressive, as being defined as progressive. Progress implied self-correction: the idea that bad science would be weeded out through the scientific process itself. In our discussions of Kuhn and Popper, we saw science as either evolving or correcting itself towards better knowledge and better accounts of the world. In our discussion on feminist epistemologies, however, we did not speak of progress directly. We did not see, in feminist theory, any notion of the self-corrective nature of science – indeed, if science were self-correcting, it would not need feminist interventions at all.

Popper's notion of science as progressing through conjectures and refutations applies only partially in the case of feminist epistemologies. Feminist empiricists do describe 'better science' as that which is more empirically adequate when it come to facts about

women. Thus when the 'passive ovum and active sperm' of reproductive biology have been replaced by notions of active sperm *and* ova, progress has been made, and our theory is empirically more adequate.

Yet insofar as standpoint and postmodern feminist theory is concerned, progress would be defined not only in terms of better accounts but also better methodology and epistemology – methodology and epistemology reworked and informed by feminist epistemology, politics and values. Replacing a biased account of biology with a more gender-neutral account is insufficient. Thus progress here is not only about the content of science, but also about its epistemology and politics. The question then is, do the sciences progress naturally? Are they self-correcting in this respect? We saw one example that appeared to show that they can be – that is, the argument made by Lisa Weasel in reference to the immune system. The argument here was that elements of a feminist science might already be located within the existing body of scientific knowledge, and have to be unearthed. However it should be noted that Weasel's example was of a theory not self-consciously developed as feminist, but which could be interpreted as aligned to a postmodern feminist theory. It remains to be asked whether other theories in other fields can also be interpreted thus.

We saw above certain theories of rationality as a male preserve, contrasted to, and provided a necessary corrective by (female) emotion and intuition. These ideas do seem to be too essentialist to be entertained. Yet we also spoke of a reformulated responsible rationality.

Popper speaks of science as critical rationality, and of rationality as a certain association of means and ends. Thus the sciences are not the only rational activity one can engage in – rationality is possible in any situation. As we saw above, theories are rational insofar as they try to solve certain problems, insofar as they provide solutions to those problems. To be rational, we need to ask certain questions of our theories, to understand how well they solve our problems. Perhaps, for a responsible rationality, we would need to ask a series of questions of our theories, and ourselves: whose interests do our theories (and practices) serve? Whom do they hurt? How innocent are our notions of harm and benefit?

* * *

I would like to end with two observations.

First, all the theories and theorists we have seen above have been concerned with asking question of the sciences with the broad aim of asking what exactly scientific methodology is and how it comes to give us certain results; and by extension, how it may give us the kind of results we want. However, one may examine the sciences with another question in mind, which is: what do we want scientific knowledge to do? What do we want it for? We may want it simply to tell us the way things are: we may want it to describe nature to us, through concepts, theories, laws. We may want it to explain nature – we may want causal explanations. We may want to manipulate nature – and then science must give us both conceptual tools, and also, in collaboration with technology, give us the physical means to do so. Science is used for all these things. Scientific methodology, more broadly, is used for these things. We may ask the same question of social scientific methodology – what do we want it to do? Do we want it to describe the social world, to explain it, to help us manipulate it? Again, the social sciences can be used for all these things.

There is, however, one other desire that we could want the sciences – natural and social – to fulfil. We could want the sciences to help us to understand ourselves, and our place in the world. This is the idea behind the desire for a reflexive science, this is the opportunity that a science that succeeds in dissolving the subject-object dualism should give us. Yet I must admit that I cannot, at this stage, picture what such a science would look like. I do not have the conceptual tools to understand what social science would look like were these dualisms actually dissolved. I do not even have a name for something that could be both subject and object, this subject-as-object or object-as-subject. Somehow, putting together the two parts in this manner, almost as if we were just adding them up, seems clumsy and moreover, inadequate.

My second point is as follows. In the first chapter, we saw how J.P.S. Uberoi described positivism as an essentially dualistic system. In the second, we came across some of his ideas in the section on science and ethics. In the third chapter, we encountered Donna Haraway's ideas on situated knowledges as the ideal locations for knowledge, and the idea that we need to take responsibility for the positions we adopt.

Some common themes run through the work of both these authors. Both are concerned with the ethical implications of scientific knowledge, and both reject the dualistic

tendencies of the sciences. Yet their views are also very different. Uberoi rejects dualisms in the attempt to transcend them, while Haraway rejects dualisms but makes no attempt to transcend them. Haraway's knowledge is from partial perspectives: "not about transcendence and splitting of subject and object". (Haraway takes us to a second question that I cannot claim to answer, which is, is transcendence possible only through splitting the subject and the object?) In Uberoi's semiological method, on the other hand, the whole explains the part – thereby requiring an understanding of the whole. This would be for Haraway another god-trick – claiming to see everything, certainly not from nowhere, but claiming to see everything nonetheless. Thus though they have similar concerns, their theories take us in very different directions.

What if we recast this in terms of our first question: which direction would we like to take? On the one hand, we have limited, partial, responsible perspectives, and on the other, an analysis of systems in their entirety. Perhaps the challenge before us is to make possible a view of the whole that does account for its internal differences and diversity, that does not claim to see from nowhere, and that takes responsibility for the claims it makes.

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