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Knowledge Practices: A Critique Of Scientific Ideology

Kent Donald Hogarth

KNOWLEDGE PRACTICES:
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by

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ABSTRACT

The scientific ideology is identified as that perspective which considers knowledge to consists in propositional truths or representations of reality--knowledge-that--and which grants ultimate epistemic authority to science. A critical alternative view (the "praxical perspective") is presented in which know-how, modeled after simple skills, is epistemologically primary. The view of know-how developed in the context of simple skills is used as a model to re-conceptualize higher-order abilities--such as the achievements of modern science and technology--as forms of skilled practice rather than applied theoretical knowledge. In order to accomplish this, non-representational views of perception and language are presented. Perception is characterised as the acquired skill of learning how to recognize a situation as meaningfully structured for potential action. This view, in which learning how to do something is prior to the recognition of meaningful structures, is extended to cover the process of scientific discovery. A Wittgenstein-inspired view of language as practice is presented in order to undercut the tendency to model knowledge on propositional statements. This view characterises theoretical and factual statements as manifestations of enacted know-how rather than cognitive objects corresponding to features of the world. These elements are combined into a view of science as practice which makes sense of the progress and rationality of science without succumbing to many of the problems endemic to the perspective of the scientific ideology. Finally, it is argued that by situating knowledge in know-how rather than knowledge-that, the praxical perspective undercuts the notion that science embodies a special epistemic method. Science is characterised as one form of skilled practice among other possibilities, rather than the one correct route to true knowledge.

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1.

INTRODUCTION

> What are the roots that clutch, what branches grow
> Out of this stony rubbish? Son of man,
> You cannot say, or guess, for you know only
> A heap of broken images, where the sun beats,
> And the dead tree gives no shelter, the cricket no relief,
> And the dry stone no sound of water.
>
> --T. S. Eliot, The Waste Land

Science is undoubtedly the most distinguishing feature of the modern West and one of the greatest forces of change in the world today. What began as a philosophical movement in the European Renaissance has grown in scope, in importance, and in status until today the scientific way of knowing has achieved near total global dominance. Traditional cultures throughout the world are disappearing, overtaken by the forces of modern scientific technology.

And why should science not achieve such dominance? Science lays claim to ultimate truth. Stephen Hawking, one of the most highly-regarded scientists alive today, declares in his popular book A Brief History of Time that the goal of science "is nothing less than a complete description of the universe we live in."[1] To achieve this, he says, would enable us to "know the mind of God."[2] Modern philosophers commonly share this rapture with the scientific way of knowing. Paul Churchland argues in Scientific Realism and the Plasticity of Mind that we can--and for the benefit of humanity should--replace our ordinary terminology and conceptual framework with that of the physical sciences, on

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[1] Stephen Hawking, A Brief History of Time (New York: Bantam Books, 1988), 13.
[2] Ibid., 175.

the ground that once this were achieved we would be "perceiving the world directly in its terms."[3]

Science's claim to truth is supported by its results. At the birth of science Francis Bacon called for a new way of knowing, free from the illusions of tradition, prejudice, and abstraction, to be applied "for the benefit and use of life."[4] Many of the benefits Bacon prophesied for science have come to pass. Natural forces have been harnessed for human use; formerly devastating diseases and epidemics have been controlled or eliminated; working and living conditions have improved immeasurably for those in the scientifically and technologically developed parts of the world.

Some see the spread of science as not only a good, but a necessary development. In an article entitled "2020 Vision" in The Sciences, Jesse H. Ausubel projects a global population of eight billion by the year 2020, and argues that the best, perhaps the only hope that they may have for a decent standard of living will come from science.[5] He argues passionately that the cultural climate that fosters science and technology must be exported to the rest of the world for the benefit of humanity.

But what vision of reality does science deliver the world's teeming billions? It is an image which has changed little in essence from Descartes' mechanism to present-day quantum field theory: the image of a dis-godded, de-spirited, coldly abstract mechanical world. Knowledge of the ultimate realities is knowledge of the mathematical laws of space and time, and knowledge of lesser matters is expected to follow in this image as far as it can. The image of earth as a living mother is replaced by earth as a material eco-system; God as a living presence is reduced to a distant

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[3] Paul Churchland, Scientific Realism and The Plasticity of Mind (Cambridge: Cambridge University Press, 1979), 7.

[4] Francis Bacon, The New Organon and Related Writings, ed. Fulton H. Anderson (New York: Bobbs Merrill, 1960), 15.

[5] Jesse H. Ausubel, "2020 Vision," The Sciences, vol. 33 no. 6 (November/December 1993): 15-19.

abstraction; familiar spirits, deities and mystical powers that were once intimately involved in human affairs and the environment are banished, replaced by abstract laws and impersonal forces.

This scientific image of the world is supposed to deliver humanity from superstition, ignorance, and illusion, but it is also in its own way chilling to contemplate. In a youthfully exuberant essay, Bertrand Russell eloquently expressed the vertiginous sensation that results from seriously embracing this image. After recounting a bleak Faustian tale of the creation and destruction of the world at the whim of a bored god, he writes:

> Such, in outline, but even more purposeless, more void of meaning, is the world which Science presents for our belief. Amid such a world, if anywhere, our ideals henceforward must find a home. That man is the product of causes which had no prevision of the end they were achieving; that his origin, his growth, his hopes and fears, his loves and his beliefs, are but the outcome of accidental collocations of atoms; that no fire, no heroism, no intensity of thought and feeling, can preserve an individual life beyond the grave; that all the labours of the ages, all the devotion, all the inspirations, all the noonday brightness of human genius, are destined to extinction in the vast death of the solar system, and that the whole temple of Man's achievement must inevitably be buried beneath the debris of a universe in ruins--all these things, if not quite beyond dispute, are yet so nearly certain, that no philosophy which rejects them can hope to stand. Only within the scaffolding of these truths, only on the firm foundation of unyielding despair, can the soul's habitation henceforth be safely built . . . [6]

Other cultures have found different foundations for the soul's habitation. The scientific world-view reduces mysticism to emotional illusion and spirituality to psychological error and manipulation; but these were once the very essence of knowledge and the centerpieces of

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[6] Bertrand Russell, "A Free Man's Worship," Independent Review, 1903; reprinted in Mysticism and Logic (London: Unwin Books, 1963), 40-47.

culture. Even in the scientific culture of the modern West they survive as living forces, despite being banished from the realm of knowledge by the scientific ideology, and despite decades of official repression and subordination to scientific principles in totalitarian communist countries.

In place of spiritual comforts science promises material wealth and plenty. But there is growing evidence that we are reaching the limits of this promise.

The dark side of modern scientific technology became most apparent in the middle decades of this century with the introduction of atomic bombs. Developed to bring a quick end to a potentially long and bloody war, their subsequent proliferation brought unprecedented powers of destruction. Within a few decades there were enough nuclear weapons to threaten the continuation of life on earth as we have known it. Science gave humans the power to cause cataclysms on the scale of the great ice ages and the events that ended the reign of the dinosaurs. The threat has apparently receded with political developments in the last few years, but most of the weapons--and their destructive potential--remain.

Nuclear weapons offer power and danger over which we appear to have some control. Other developments wrought by science are more insidious. Nuclear energy promised cheap electricity to power a growing industrial world; but the dangers of nuclear waste came in its wake. Three Mile Island sounded the warning and Chernobyl proved that the price of nuclear energy includes the potential for widespread radioactive contamination.

Other forms of pollution have appeared with less forewarning. Chlorofluorocarbons (CFCs) were developed as inexpensive, effective, non-toxic solvents and refrigerants. Only by accident was it discovered that when they drifted into the upper atmosphere they acted as a catalyst for breaking down the ozone that protects all life on earth from harmful ultraviolet radiation. Other industrial chemicals--furans, dioxins, heavy metal compounds, PCBs--have been found to persist in the environment, spread throughout the world, and accumulate in the food chain to the detriment of all living things. The incidence of cancer continues to grow, and has largely resisted attempts to find a cure. Greenhouse gases such as carbon dioxide, a by-product of the modern technological way of life, threaten to affect the makeup of the atmosphere and the global climate, with consequent disruption to the conditions for life.

Even the most well-meaning scientific advances have proved to be of mixed benefit. The green revolution, begun with the promise of providing plentiful food for the world's growing population through scientific agriculture, brought with it a dependence upon dangerous pesticides and expensive fertilizers, disrupted delicately balanced ecosystems, and destroyed traditional ways that had sustained peoples for centuries. More recently, genetic engineering promises agricultural benefits, but also carries the threat of introducing into the environment organisms for which nature has no control system.

Medical advances conquered many diseases earlier in this century, but these victories may only be a brief respite. Some of humanity's ancient scourges have developed resistance to the miracle drugs of only a few decades ago, and no more potent drugs are on the horizon. Despite the heroic efforts of scientific medicine, AIDs and most forms of cancer remain incurable and continue to spread.

Life has never been free from the dangers of human stupidity, but the threats faced by humanity today are unprecedented in their scope. Ancient peoples also destroyed their habitats; but their destructive powers rarely encompassed more than a single valley or river basin.[7] Our dangers are no longer limited to one area or one people. There is no place left to move and start anew: these threats

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[7] See J. Donald Hughs, Ecology in Ancient Civilizations (Albuquerque: University of New Mexico Press, 1975), for a record of environmental destruction wrought by ancient peoples.

are global. Only modern science has given us this much power.

Supporters of science claim that these ill effects are outweighed by the benefits of science and can be controlled by careful management guided, of course, by further scientific knowledge. John Platt made such a case in a 1969 article in Science entitled "What We Must Do."[8] He argued that all the urgent crises facing the world could be brought under the heading of a crisis of transformation, the chief agent of which is scientific technology. The only way to solve these problems, he argued, is through a large-scale mobilization of scientists dedicated to developing a "science of survival." A quarter of a century later, despite accelerating advances in science, the problems are even more urgent; and still the cry is heard that we need more science to solve our problems.

The articles by Platt and Ausubel are only two particularly articulate examples of a widespread sentiment. But there is a note of desperation in these modern calls for more science to solve our problems. Where Francis Bacon looked forward to science with hope, we are now running to science in fear; and many of the dangers we are running from have been brought about by science itself.

Not everyone is confident of the ability of science to provide solutions for the problems introduced by scientific technology. Vaclav Havel, playwright and former president of Czechoslovakia, expressed his unease with the scientific approach in a speech at the World Economic Forum in Davos, Switzerland, as follows:

> Traditional science, with its usual coolness, can describe the different ways we might destroy ourselves, but it cannot offer us truly effective and practicable instructions on how to avert them. There is too much to know; the information is muddled or poorly organized; these processes can

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[8] John Platt, "What We Must Do," Science, vol. 166 no. 3909 (Nov. 28 1969): 1115-21.

> no longer be fully grasped and understood, let alone contained or halted. Modern man, proud of having used impersonal reason to release a giant genie from its bottle, is now impersonally distressed to find he can't drive it back into the bottle again.
>
> We cannot do it because we cannot step beyond our own shadow. We are trying to deal with what we have unleashed by employing the same means we used to unleash it in the first place. We are looking for new scientific recipes, new ideologies, new control systems, new institutions, new instruments to eliminate the dreadful consequences of our previous recipes, ideologies, control systems, institutions and instruments. We treat the fatal consequences of technology as though they were a technical defect that could be remedied by technology alone. We are looking for an objective way out of the crisis of objectivism.
>
> Everything would seem to suggest that this is not the way to go. We cannot devise, within the traditional modern attitude to reality, a system that will eliminate all the disastrous consequences of previous systems. We cannot discover a law or theory whose technical application will eliminate all the disastrous consequences of the application of earlier laws and technologies.
>
> What is needed is something different, something larger . . .[9]

This thesis is an attempt to work towards something different and larger than the scientific way of knowing.

Criticisms of science are hardly new. Since the beginning of modern science, many have felt some disquiet with the scientific world-view and science's claim to special epistemic status. Galileo was convicted by the Inquisition for contradicting the Church's interpretation of the Bible,[10] and many felt that the mechanical philosophy of Descartes and his followers undercut religion by making God

[9] Vaclav Havel, "Forget the Machines, Cut the Clichés, and Get Humanity Back into Politics," The Globe and Mail, 16 March 1992, Metro ed., sec. A, p. 11.

[10] A similar rear-guard battle against evolutionary theory is still occasionally waged by some fundamentalist Christian groups that want to preserve a literalist interpretation of the bible story of creation.

too remote. The Romantics of the nineteenth century decried science for its spiritual and aesthetic vacuity, urging a turn to form and feeling over content and scientific fact. Earlier in this century some existentialists[11] pointed out the deeply alienating nature of the scientific world-view that made all nature merely material and left no place in the world for the knowing subject. During the past few decades ecologists have been pointing out the dangers of runaway techno-science and some, under the banner of "deep ecology,"[12] have argued that if we are to survive we must develop a new spiritual vision and turn away from the scientific view that gives humans the right to control and manipulate nature. Recently some feminists have criticised the social sciences for their common androcentric bias and the natural sciences for the patriarchal attitudes implicit in their orientation towards manipulation and control of nature.[13]

But while such criticisms have waxed and waned over the centuries, they have always been a minority voice. Criticisms of science typically fail to have much force because they do not offer an adequate means of undercutting the prima facie epistemic authority of science. I aim to rectify this by taking a deeply epistemological approach.

The first step, undertaken in the next chapter, will be to elucidate the epistemic orientation of the scientific way of knowing. This is done via an analysis of the "scientific

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[11] Including Martir Heidegger, Hanna Arendt, and members of the Frankfurt school of social criticism--but some existentialists (such as Jean-Paul Sartre) embraced this alienation and made it the basis of their philosophy.

[12] See Deep Ecology: Living as if Nature Mattered, by Devall and Sessions (Salt Lake City: Gibbs Smith, 1985) for an overview and annotated bibliography of this material.

[13] Central among these are Evelyn Fox Keller, Sandra Harding, and Carolyn Merchant. Alison Wylie et al., "Feminist Critiques of Science: The Epistemological and Methodological Literature," Women's Studies International Forum, vol. 12 no. 3 (1989): 379-88, provides a useful bibliography of feminist critiques of science.

ideology," by which term I denote the cluster of attitudes, values, and beliefs that characterize our culture's common faith in science's epistemic authority. The deep core of the scientific ideology is revealed as a tendency to devalue know-how and conceive of knowledge as essentially knowledge-that. This is not a merely philosophical doctrine or theory, but a pervasive feature of modern Western thought which informs the structure of scientific practice, sets the agenda for many of the characteristic issues of modern philosophy, and underwrites our dominant cultural faith in science. Science was developed to generate explicit knowledge-that in the form of explicit true statements and theories, and its authority rests not only on its success in this task, but also on our culture's reverence for such explicit knowledge-that.

The scientific ideology is a perspective on knowing which gives us our general conception of the character of knowledge. Among other things, it tells us that what is needed to truly know or understand something--whether some aspect of nature, or knowledge itself--is an explicit account or theory of the object. Because most philosophers since the early modern period have agreed on the general outlines of this view of knowledge, epistemologies are usually explicitly presented as theories of how knowledge so construed comes about and is verified. In order to get beyond this perspective, something more than a theory of knowledge is needed: a new perspective must be forged which re-orients our conception of what knowledge is. Consequently, I will not present my account as another theory of knowledge, and will not proceed primarily via a critical analysis of the details of philosophical arguments for extant theories of knowledge. Rather, after delineating the core of the scientific ideology I will develop a critical alternative which is intended as a guide not only to a new understanding of what knowledge is, but also as a perspective which may influence epistemic practice so that we come to know differently.

This task is begun in the third chapter and carried forward in the remainder of the work. The alternative to the scientific ideology's granting of epistemic priority to knowledge-that is to view knowledge as essentially a matter of know-how. This perspective is introduced and given some flesh by analysing the nature of skills, where know-how is most clearly manifest. The epistemic and epistemological primacy of know-how is given plausibility by arguing that skills cannot be eliminated or reduced to knowledge-that without either incoherence or loss of some essential features of our experience of what it is to know. The function of chapter three, however, is more than merely showing the ineliminability of skill. Skill is introduced as a model for understanding knowledge construed as know-how. I extend the concept of skill with which we are familiar in such cases as driving and cycling to the achieved abilities of our culture by introducing the notion of skilled practices. Within the perspective I develop skilled practices (such as complex technological and scientific abilities), rather than the theories we more commonly recognize, are the primary epistemic achievements of our culture. This perspective does not eliminate knowledge-that or reduce it to skills, but resituates knowledge-that within know-how. How it does this is the concern of the next two chapters.

In the fourth chapter I introduce a view of perception as the presentation of structures meaningful for action as an alternative to the scientific ideology's view of perception as static representation. This is developed into a view of scientific observation that takes account of the experimental practices in which observations emerge, an area largely neglected in traditional philosophy of science. Where the scientific ideology tends to view observation as the static recording of a base level of empirical facts, I portray it as an active process where the meaning-structures revealed are situated within the practices through which they emerge.

The fifth chapter develops a Wittgenstein-inspired view of language as a medium of practice rather than means of representation or conveyor of truths. Wittgenstein's account of meaning as use is interpreted in a strong sense and developed into deeply process or practice-centred views of reference and truth. The implications of this view of language for reconceptualizing what it is to know are illustrated by considering the practices of developing scientific knowledge. By situating linguistic meaning in the dynamics of know-how and practice I undercut the traditional view of language as a static bearer of meanings, and by extension the scientific ideology's use of the static conception of language as a model for knowledge. Scientific theories are thereby shown to be expressions of developing practices or know-how, rather than approximations to some static ideal of truth.

The perspective introduced schematically in chapters three through five is further developed in chapter six in the context of an account of natural science. Where the scientific ideology views natural science as a cognitively rational process for developing true theories (transcendent knowledge-that) on a foundation of observations (construed as experiential knowledge-that), I portray natural science as the pragmatically rational development of instrumental practices. I argue that scientific progress can be more perspicuously viewed as the development of skilled practices than as the acquisition of theories that approach to truth, and the structure of actual scientific practice appears more like the pragmatic rationality of developing know-how than like traditional epistemology's theories of cognitive rationality. I also argue that founding scientific knowledge in practical know-how counters both relativism and the metaphysical excesses of scientific realism.

The seventh chapter returns the discussion to the issues broached in the introduction above by drawing out the deeper consequences of the position developed. I argue that the epistemological perspective embodied in the scientific ideology limits knowledge to forms that mimic the instrumental practices of natural science. From this perspective it appears that the natural sciences have discovered that reality is essentially material, and that scientific theories portray the structural details of this material arena; consequently, we must guide our actions according to their dictates. By contrast, I argue that the scientific theories which we use to manipulate and intervene in reality are themselves components of the distinctive system of instrumental practices that we have developed. They are not separable from those practices, as the deliverances of a transparent epistemic method, but are elements of the instrumental know-how that constitutes scientific practice. I argue that other forms of practice, encompassing a larger vision of what there is and how we may live, are possible.

Finally, in the eighth chapter I turn the perspective on knowledge developed in this thesis on itself. I show that the vision is reflexively consistent and, despite the emphasis on practice, is not anti-philosophical or anti-intellectual. Rather, it re-introduces a moral purpose and seriousness which is lacking in the technical concerns of much recent philosophy.

2.

THE SCIENTIFIC IDEOLOGY IN FOCUS

> The world is everything that is the case.
> --Wittgenstein

> Nihil tam absurde dici potest, quod non dicatur ab aliquo philosophorum.
> --Cicero

In a 1987 article in Nature, two scientists--T. Theocharis and M. Psimopoulos--present an impassioned defence of science in the face of a sharp decline in Britain's science funding in the 1980s.[1] Their stated aim in the article is to "identify and endeavour to combat what we consider to be the most fundamental, and yet the least recognized, cause of the present predicament of science, not only in Britain but throughout the world." They argue that the root cause of the funding crisis is a decline in the status of scientific knowledge due to the propagation of some ideas originating in academic philosophy. They refer to these ideas as the "epistemological antitheses--the (un)philosophical positions which are contrary to the traditional and successful theses of natural philosophy."[2]

In a quick historical sketch, they identify--complete with a rogues' gallery captioned "Betrayers of the truth"--Sir Karl Popper, Imre Lakatos, Thomas Kuhn, and Paul Feyerabend as the chief originators and exponents of these dangerous "(un)philosophical" ideas. The solution they advocate is for both philosophers and scientists to "stop running down their own professions and start pleading the cause of science and philosophy correctly." They think this could best be accomplished "first by thoroughly refuting the

[1] T. Theocharis and M. Psimopoulos, "Where Science Has Gone Wrong," Nature vol. 329 (15 October 1987): 595-8.
[2] Ibid., 595.

erroneous and harmful antitheses; secondly by putting forth adequate definitions of such fundamental concepts as objectivity, truth, rationality and the scientific method; and thirdly by putting the latter judiciously into fruitful practice." They feel that this is an urgent task, because "what is really at stake is nothing less than the future progress of our civilization."[3]

This article is remarkable for a number of reasons: the authors' sense of panic about the declining status of science, their targeting of academic philosophers as the chief enemies of science and progress, and the fervid faith in science that informs the tone of the article.

Theocharis and Psimopoulos's panic about the decline of science and their targeting of academic philosophers seems almost paranoid. Any decline in science funding since the 1970s is more likely due to the economic situations faced by government funding bodies than the result of a declining status of science. While science criticism seems to be on the increase recently, this cannot be interpreted as an overall decline in science's status. Books, television programs, and magazines promote and popularize science as never before. Science is increasingly considered an important part of every child's education, and well-funded university science faculties are considered essential for national economic development and survival throughout the world. Modern governments and industries still spend billions of dollars on applied and pure scientific research. In many areas of public policy, whether it is a question of the safety of a new drug, the health effects of a new chemical, the environmental effects of a new factory or dam, or the social effects of a government program, legislators increasingly turn to scientists for expert advice. Science is an expanding force in modern life, and our reliance on it continues to grow. The recent increase in science criticism

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[3] Ibid., 597-8.

is probably largely due to the fact that only in the last few decades have the environmentally deleterious effects of our rampant use of scientific technology become critical, and the effect is not a decrease in the status of science but a call for more careful and environmentally accountable science.

As well, the academic philosophers cited by Theocharis and Psimopoulos are not in the forefront of science criticism. While their works have sometimes been used to support anti-scientific views, Popper, Lakatos, and Kuhn are not enemies of science. What they (and Feyerabend, who's attitude towards science is more ambiguous)[4] argue against is not science per se but the historically and conceptually inadequate views of science promulgated by their logical empiricist predecessors, who attempted to develop theories consistent with a strong interpretation of the notions of truth, objectivity, rationality, and scientific method. Theocharis and Psimopoulos perceive recent philosophy's revision of these notions as a threat to science because the strong interpretation is central to their self-interpretation as scientists.

Theocharis and Psimopoulos's paranoia can be understood once it is recognized that they are extreme and vociferous advocates of what I refer to in this work as the scientific ideology. By the term "scientific ideology" I intend to denote a set of attitudes and beliefs which provides its adherents with an understanding of the nature and value of scientific knowledge. These attitudes and beliefs do not form a well-defined set, but a group related by family resemblance; individuals may subscribe to more or fewer of these attitudes and beliefs, in stronger or weaker forms.

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[4] "I am not against science. . . . What I object to is narrow-minded philosophical interference and a narrow-minded extension of the latest scientific fashions to all areas of human endeavour--in short what I object to is a rationalistic interpretation and defence of science." Paul Feyerabend, Against Method, 3rd ed. (New York: Verso, 1993), 122 n. 17.

The scientific ideology is not something articulated in a dogma or creed, nor is it expressed in any universally accepted philosophical or sociological theory. Raymond Geuss calls an ideology in this sense a "form of consciousness": it inheres in the characteristic epistemic stance and behaviour of scientists, in attitudes and beliefs about science common among philosophers and scientists, and in the wider society's policies and actions respecting science.[5]

The outer manifestations of the scientific ideology are familiar, and many of them are expressed in the article referred to above. One aspect may be called scientism. In its strong form this is the faith that science is the one true path of knowledge and the guiding light of human progress, that science is inherently good and beneficial to human thriving, and that we must turn to science for all our answers and lend it our support or sink into the darkness of ignorance and superstition.

A corollary of scientism is the belief in the epistemic content of science, or the scientific world-view. This has become increasingly materialistic over time. The dawn of science was coincident with the decline of magic and the banishment of local spirits and demons, to be replaced by a distant, transcendent God.[6] By the nineteenth century even this God was becoming redundant, and Nietzsche pronounced that God was dead.[7] Vitalism--the idea of a special life force--survived a little longer, but died out early in this century, with Henri Bergson its last significant proponent.[8]

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[5] Raymond Geuss, The Idea of a Critical Theory: Habermas and the Frankfurt School (Cambridge: Cambridge University Press, 1981), 12.

[6] See Carolyn Merchant, The Death of Nature (San Francisco: Harper and Row, 1980); and Brian Easlea, Witch Hunting, Magic, and the New Philosophy (Brighton: Harvester Press, 1980).

[7] Nietzsche, Thus Spake Zarathustra, trans. R. J. Hollingdale (1961; reprint, New York: Penguin Books, 1977) first part, prologue section 2, p. 41; also The Gay Science, trans. Walter Kaufmann (New York: Random House, 1974); book 5, section 343, p. 279.

[8] James Lovelock's "Gaia Hypothesis" (Gaia: A New Look at Life on Earth (Oxford: Oxford University Press, 1979)), which treats the earth

Today the presupposition that any viable theory in science or philosophy must be compatible with materialism is so universally accepted it usually goes without saying.

But scientism and the scientific world-view may be seen as consequences of a deeper aspect of the scientific ideology. This deeper aspect underlies the clichéd expressions of science's virtues: truth, rationality, objectivity, and scientific method. These are the epistemic virtues appropriate to science's particular way of knowing, which may be characterized as abstract or theoretical. The scientific ideology embodies an orientation towards knowing which sees knowledge to consist essentially in explicit knowledge-that rather than know-how. From this perspective the aim of epistemic practice is to produce objectively true theories of the underlying structure of reality, and science achieves this by virtue of its rational method. These theories may then serve as the basis of calculative rational action. By this means it is conceived that mere skills and know-how are transcended by objective knowledge-that.

This orientation towards knowledge-that can be traced back at least to Plato, who praised contemplative knowing over craft skills, but it only became dominant in our culture with the scientific revolution. The shift to Copernican astronomy that displaced the earth from the centre of the universe and projected the knower to an imaginary Archimedean standpoint[9] outside of time and space can be seen as a metaphor for the shift to the scientific way of knowing. Science claims unique access to transcendent Platonic truths: knowledge outside of time and place that can be applied by anyone. Craft skills and know-how, by

as a living organism, is not vitalism but materialistic systems-theory applied to the global ecology. That it seems unassimilably radical to many is an indication of the strength of another--less central--element of the scientific ideology, its tendency to reductionism.

[9] I borrow the phrase "Archimedean standpoint" from Hannah Arendt, The Human Condition (Chicago: University of Chicago Press, 1958; New York: Anchor Books, 1959), 13.

contrast, are only local, depending upon personal involvement and traditional expertise. Such know-how may be universal, in the sense that it may be possible for anyone to acquire and apply, but it is not objective in the same sense as scientific knowledge. Scientific knowledge is an object to be acquired; and the statements that express the knowledge are signs which take the truths in reality as their object. Know-how may be universal, but it is immanent knowledge; scientific knowledge is objective, transcendent, factual knowledge: knowledge-that.

The scientific mathematization of nature is closely allied with this conception of knowledge. Galileo conceived the acquisition of knowledge of reality almost literally as reading the secret book of nature. He wrote that the book of the universe "cannot be read until we have learnt the language and understood the characters in which it is written. It is written in mathematical language, and its characters are triangles, circles, and other geometrical figures, without which it is impossible to understand a single word."[10] For Galileo geometry is more than a metaphor or model of knowledge; it is the very basis of reality itself. This Pythagorean conception of reality recurs throughout the history of science. From the mechanical philosophy of the seventeenth century to modern cosmology, theorists have attempted to explain reality on the basis of geometry alone.[11] The lure is clear: by eliminating objects, forces, and "powers," one is left with only bare geometrical structures which can be completely defined by their mathematical expression. There is no ineffable remainder,

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[10] Galileo, Il Saggiatore, quoted in Frederick Copleston, A History of Philosophy, 9 vols. (Garden City, New York: Image books, 1963), vol. 3, pt. 2: 98.

[11] See John C. Graves, The Conceptual Foundations of Contemporary Relativity Theory (Cambridge, Massachusetts: The MIT Press, 1971) for a sympathetic account of attempts to reduce physics to geometry.

nothing left over which is not amenable to explicit statement and computation.

Pure Pythagoreanism has always been an unfulfilled dream, so as a compromise science rests with materialism. The conception of what matter is has varied so much through the history of science that only a negative definition of materialism is possible: it is the view that whatever stuff the universe ultimately consists of, it does not exhibit such mental properties as consciousness, agency, or free will. The effect of adopting this view is to make all of reality amenable to objective knowledge-that. In contrast to some aspects of medieval alchemy and many "magical" and mystical traditions, it is not necessary to have direct communion with or gain the cooperation of non-human agents and powers.[12] All that can be done can be done through ordinary manipulations which anyone can perform. All that can be known can be written down and explained in terms comprehensible to anyone of ordinary experience. All legitimate experience and all know-how can be reduced to knowledge-that.

This orientation of the scientific ideology goes together with an ancient tendency to rationalism in Western philosophy; a tendency which has become particularly strong since the scientific revolution. Western philosophers have often dreamt of a universal rational method, statable in rules and formulae which anyone might follow, for the acquisition and verification of knowledge. Francis Bacon proclaimed such a method in The New Organon: "The art which I introduce with this view (which I call "Interpretation of Nature") is a kind of logic . . ."[13] Bacon, however, distinguished his logic from traditional formal sylogistic logic, assimilating it more to a practical art. Hobbes sounded the rationalistic note of the scientific ideology

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[12] See Brian Easlea, Witch Hunting, Magic, and the New Philosophy, esp. ch. 3, pt. 1, pp. 89-110.

[13] Bacon, New Organon, 19.

more clearly when he proclaimed that "When a man *Reasoneth*, hee does nothing else but conceive a summe totall, from *Addition* of parcels; or conceive a Remainder, from *Subtraction* of one summe from another . . . For REASON, in this sense, is nothing but *Reckoning* . . ."[14]

In the Rules for the Direction of the Mind, Descartes explicitly develops the scientific ideology's conceptions of knowledge as knowledge-that and reasoning as ratiocination. He begins by distinguishing the sciences from the arts: "Whenever people notice some similarity between two things, they are in the habit of ascribing to the one what they find true of the other, even when the two are not in that respect similar. Thus they wrongly compare the sciences, which consist wholly in knowledge acquired by the mind, with the arts, which require some bodily aptitude and practice."[15] Descartes defined knowledge as "certain and evident cognition,"[16] and sought an epistemic method modeled on but more general than the ratiocinative procedures of geometry and mathematics: "there must be a general science which explains all the points that can be raised concerning order and measure irrespective of the subject-matter, and that this science should be termed *mathesis universalis* . . . for it covers everything that entitles these other sciences to be called branches of mathematics."[17]

Leibniz took the conceptions of knowledge as the possession of propositional elements and reasoning as ratiocination to its greatest extreme when he proposed a universal symbolic language which assigns to all objects their "true characteristic numbers," and on the basis of which all problems could be solved and all controversies

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[14] Thomas Hobbes, Leviathan (London, 1651; reprint, New York: Penguin Books, 1981), chap. v., 111.

[15] René Descartes, "Rules for the Direction of the Mind," in The Philosophical Writings of Descartes, 2 vols., trans. John Cottingham, Robert Stoothoff, and Dugald Murdoch (Cambridge: Cambridge University Press, 1985), 1:9.

[16] Ibid., 10.

[17] Ibid., 19.

ended: "if someone would doubt my results, I would say to him: 'Let us calculate, Sir,' and thus by taking pen and ink, we should settle the question."[18]

The scientific ideology's epistemic orientation underlies the Enlightenment dream to make Reason the paramount guide in human life: to find a method that will eliminate the greys of shifting appearances, a means to forestall tragedy and lift the burden of relying on individual skill and judgement. Such a method would yield knowledge beyond practical know-how so that in any situation it would only be necessary to go to that well of certain knowledge and say *this* is true; now we calculate and all our possibilities and choices and their outcomes will be clear. The scientific ideology says that the physical sciences possess such a method in their sphere, and in all areas we must emulate their methods and take account of their pronouncements on the ultimate nature of reality to achieve epistemic respectability.

The scientific ideology is clearly manifested in science's aim to produce true theories, in traditional scientistic histories of science which portray it as the progressive discovery of great truths, and in philosophy of science's traditional theory-centric perspective. But it is also manifested in the technocratic character of modern politics; in the tendency in medicine and psychology to treat the person as a machine whose malfunctions can be fixed; and in the attitude that the environment must be managed by improved technological control. It permeates modern philosophy: philosophers are not so much paragons of wisdom, moral guides, and commentators on the human condition as intellectual workers who purvey theories and reason cleverly about the merits and faults of the minutiae of intellectual systems. This is as true in ethics as epistemology. Both strive to develop normative theories:

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[18] Leibniz, Selections, ed. Philip Wiener (New York: Charles Scribner's Sons, 1951), pp. 12-25; 15.

rational calculae to make wisdom and skill obsolete. As a consequence there is no contradiction in a modern philosopher being both a brilliant ethicist and a complete scoundrel.

The term "ideology" as used here obviously carries a pejorative connotation.[19] It signifies that the form of consciousness so designated is in some sense optional, and further that there is something wrong with it. The concept of an ideology provides a framework for understanding the passion Theocharis and Psimopoulos display in their article. By apparently throwing doubt on such key elements of the scientific ideology as notions of truth, objectivity, rationality, and scientific method, the philosophers they cite as "betrayers of the truth" throw into question the meaning and value of the work to which these scientists have dedicated their lives, as well as their self-interpretation as objective and rational seekers after the Truth. It is a psychological commonplace that questioning someone's se interpretation cuts the more deeply as it touches upon uncomfortable truths.

Raymond Geuss identifies three distinct ways in which a form of consciousness may be called an ideology in this pejorative sense, corresponding to three kinds of ideology critique: genetic, functional, and epistemic.[20] I will discuss each of these in turn in relation to the scientific ideology.

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[19] In addition to the pejorative sense, Geuss describes descriptive and positive senses of the term "ideology." In the descriptive sense, every social group has an ideology which consists of their characteristic beliefs and modes of acting, but no valuative judgement is attached to its elucidation. The positive sense refers to a position or doctrine adopted for the purposes of social reform. Neither of these senses of the term apply in the present discussion.

[20] Geuss, Idea of a Critical Theory, chap. 1.

1) Geuss writes that a form of consciousness is ideological in the genetic sense "by virtue of some facts about its origin, genesis, or history, about how it arises or comes to be acquired or held by agents, or in virtue of the motives agents have for adopting or acting on it."[21]

The motives contemporary agents have for adopting, holding, and acting on the scientific ideology are generally irreproachable. By living in the modern West we learn from early childhood to equate science with knowledge and progress, and virtually everyone who argues in support of the scientific ideology does so from the purest motives. Science does, after all, deliver many benefits. But precisely because the scientific ideology is so ubiquitous and apparently productive, it appears to be somehow natural. Science appears to be no more than an extension of common sense; it is presumed that any diligent effort to achieve knowledge will have the character of science.

Consideration of the origins of science can serve to suggest that the epistemic orientation of the scientific ideology is not natural, but a contingent historical development. Some writers, such as Giorgio de Santillana, place the origins of science in ancient Greece,[22] but this may be taken as evidence of how hindsight can be distorted by the scientific ideology: by equating science with universal human knowledge, any achievements presently accepted as scientific are seen as early examples of science. While some of science's intellectual influences may be traced back to antiquity, what we now know as science--a distinct, self-adjudicating discipline for generating authoritative knowledge--only emerged with the European Renaissance and became established during the Enlightenment.

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[21] Ibid., 19.

[22] Giorgio de Santillana, The Origins of Scientific Thought: from Anaximander to Proclus (Chicago: University of Chicago Press, 1961).

Between 1400 and 1600 Europe underwent one of the greatest intellectual upheavals in history. Global exploration, rapidly expanding commerce, new technologies such as the telescope, and the rediscovery of ancient writings introduced Europeans to strange new cultures and ideas. The resultant religious and intellectual ferment upset conventional ideas about religion, God, and the place of humankind in the universe. These changes brought on a general sense of intellectual disorientation and insecurity, resulting in widespread skepticism on the one hand and a quest for new foundations for knowledge on the other.

Two great influences shaped epistemological thought in the late Medieval period: the Judeo-Christian tradition and the newly recovered writings of ancient Greece. From the former came a preoccupation with the authority of the written word and the notion of divine laws. The tradition of preserving scriptures as the revealed word of God lent an aura of authority to explicit verbal formulae, as did the notion that laws governing the conduct of human affairs were imparted by God through the medium of prophets such as Moses. But the authority of God's verbal commands goes much deeper than the ten commandments carved in stone. The opening lines of the gospel of St. John--"In the beginning was the Word, and the Word was with God, and the Word was God"--echo Genesis, where it is written that God created the heavens and earth through his commands: "Let there be . . ." There is an incipient notion here of a cognitive order--the *logos* or word of God--transcending fallible human nature and underlying the shifting appearances of reality.

This incipient notion gained further form under the influence of Plato's writings. Plato draws a sharp distinction between contemplative knowledge and the skilled know-how of craftspeople, with a strong bias towards the former. Throughout Plato's dialogues Socrates demands that his interlocutors provide clear and explicit definitions of the terms and concepts they are using. That this is largely a rhetorical device to stir thought and throw question on complacent convictions is clear from the fact that the disputants rarely settle on a definition. However, Plato presents the ideal of certain knowledge, derived from insight into the Forms of things themselves, and stateable in definitions which anyone could apply. Plato's model for such certain knowledge is geometry, which appears to provide truths which can be seen to be true upon contemplation of their proofs. Over the entrance of his academy was written, "no one ignorant of geometry may enter."

Under the influence of these ancient strains in Western thought, the Renaissance urge for a new foundation of knowledge emerged into the form we now recognize as scientific. The core distinguishing feature of this way of knowing, as expressed earlier in this chapter with reference to Galileo, Bacon, Hobbes, Descartes, and Leibniz, is its orientation towards explicit knowledge-that. Certain knowledge was to be found in provable theories rather than in ancient tradition or know-how.

The defining orientation of the scientific ideology toward explicit knowledge-that is so familiar today that it is hardly recognized as something to which there can be an alternative. But there is considerable evidence that prior to the scientific revolution knowledge was largely considered to rest in tradition, acquired skill, and know-how that was passed from master to disciple, rather than in objective theories that could be applied in any situation by anyone. The great medieval cathedrals of Europe were not built according to scientifically engineered plans, but assembled under the eye of master builders who had a sense, acquired through experience and tradition, for how deep foundations and how thick walls had to be. The ships that explored the world during the same period were constructed similarly without benefit of naval engineers, but by the skilled hands and eyes of master ship-builders. In many parts of the world that have not yet been westernized the dominant forms of knowledge are still largely craft skills and know-how that are learned by tradition and apprenticeship. The distinctive difference between the modern West and so-called "primitive" cultures is not only in the relative extent of theoretical knowledge, but also in the ways of knowing.

A number of writers, among them Carolyn Merchant, Evelyn Keller, and Brian Easlea,[23] have advanced compelling historical arguments that science originated and came to hold dominance because the scientific way of knowing and scientific world-view sanctioned some questionable attitudes and served certain powerful interests. The rise of science was coincident with rapid commercial, industrial, and military power. The theoretical approach to knowledge served the technological interests inherent in these fields. Large buildings, ships, instruments of navigation and war could all be better and more reliably constructed on a sound theoretical basis. More than this, though, the mechanical philosophy sanctioned the exploitation and control of nature, which was morally problematic as long as the world was seen as an organic entity infused with spirit. The technical/instrumental orientation of science was explicitly expressed by Francis Bacon and the founders of the Royal Society: the aim of the new philosophy was to gain control over nature and bend it to serve human ends. Feminists such as Merchant and Keller have argued that such ends reflect strongly patriarchal attitudes, and that it is a historically contingent and deplorable fact that they--and the way of knowing appropriate to them--have become so dominant.

Easlea argues in addition that the mechanical philosophy was seen to uphold religious and social order against the perceived threats of natural magic and religious

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[23] Merchant, The Death of Nature; Evelyn Fox Keller, Reflections on Gender and Science (New Haven: Yale University Press, 1985); and Easlea, Witch Hunting, Magic, and the New Philosophy.

enthusiasm. The view of nature as something the workings of which can be described by explicit rules and laws and which may be instrumentally controlled and exploited contrasts strongly with earlier world-views in which everyday events are caused or influenced by gods and spiritual forces of which individuals can and must take account in all their actions. By banishing spiritual forces from the daily workings of nature, the scientific world-view made God too remote for individuals to interact with or comprehend by their individual efforts. The intermediary of the Church and its hierarchy of experts thus, Easlea argues, maintained a monopoly position of authority and influence in spiritual--and by extension social--matters.[24]

Historical considerations such as these can serve to illustrate the contingent origins of science and bring out the distinctive character of the scientific way of knowing, and thereby undercut the notion that science is just the natural development of universal human knowledge. However, there is a general problem with this critical approach, which may be termed the "genetic fallacy": the fact that something originated in questionable circumstances is no argument against its truth. Science may have emerged accidentally and served questionable interests at its inception, but none the less embody a correct vision of reality. The scientific ideology cannot be dismissed merely because of faulty pedigree; it must be critiqued on the basis of its present faults. This brings us to the next form of ideology critique.

2) A form of consciousness is ideological in the functional sense "in virtue of the fact that it supports or justifies reprehensible social institutions, unjust social practices, relations of exploitation, hegemony, or domination."[25]

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[24] Easlea, Witch Hunting, Magic, and the New Philosophy, 197.
[25] Geuss, Idea of a Critical Theory, 15.

The scientific ideology has often served such a functional role. Various unjust social practices and relations of exploitation have in the past been supported under the banner of science. In the last century phrenology--the determination of psychological and character traits by measurement of skull shape--was widely accepted as a scientific theory and was used to support racist and sexist practices and justify the mistreatment of criminals and the mentally ill. Earlier in this century IQ testing, and more recently sociobiology, have served a similar role. By providing an explanatory framework to account for social structures of every kind in deterministic evolutionary terms, sociobiology can be used to sanction sexism in the name of science.

However, criticisms of the scientific ideology on the basis of the functional role it plays in supporting unjust social practices are not very effective. It can be objected that the arguments supporting unjust social practices were (or are) based on false scientific ideas which science itself has uncovered (or will uncover) as false. The self-correcting nature of science, it is argued, prevents science from becoming an ideology in this sense.

A different line of functional critique may make the argument that the scientific ideology currently serves to support the global dominance of modern Western culture. But adherents of the scientific ideology argue that, deplorable as the destruction of traditional cultures may be, this trend represents progress because science is after all the path of truth. The prevalence of this kind of thinking may be illustrated by the fact that it is found not only in the rhetoric of multi-national companies seeking economic expansion and as a tacit presupposition of third-world "development" programs, but even in the thinking of some anthropologists: Robin Horton presumes that African witchcraft practices can only be interpreted as "primitive science," and by doing so relegates them to the status of error and inferiority.[26] He does not entertain the notion that different ends than material prediction and control may be at work, and that different phenomena than those uncovered by science may occur. But the distaste of ethnocentrism is no argument against claims of truth and epistemic superiority.

While functional critiques cannot seriously undermine the purported truth of the scientific world-view, they can serve to undermine some values inherent in the scientific ideology. The closely interrelated ideological notions that science produces pure knowledge, that such knowledge has value independent of utility, and that physics yields knowledge of ultimate reality, serve to support very expensive research which consumes money and resources that could be used to greater social benefit elsewhere. High energy physics is the obvious example here: modern particle accelerators cost billions of dollars to construct and operate, and it is doubtful that the findings of such research will have any direct application in the foreseeable future.

By demonstrating that the scientific form of consciousness has questionable origins and consequences, genetic and functional critiques may serve to throw doubt on the high value that the scientific ideology places on science. However, these forms of critique fail to have much force because of the prima facie epistemic authority of science. Science is in the business of developing knowledge and its results, manifested in technological developments, support its claim to special epistemic status. Regardless of anything distasteful about its origins or effects, science may, as its supporters claim, be delivering the objective truth about the world.

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[26] Robin Horton, "Tradition and Modernity Revisited," in Rationality and Relativism, eds. Martin Hollis and Steven Lukes (Cambridge, Massachusetts: The MIT Press, 1986), 201-60. This point will be discussed further in chapter seven.

3) This leaves the third form of ideology critique discussed by Geuss, the epistemic. But a complication ensues when this form of critique is applied to the scientific ideology. Geuss describes a form of consciousness as an ideology in the epistemic sense by virtue of mistaken notions about the epistemic status of some of its constituent beliefs: mistaking normative for descriptive beliefs, contingent or self-validating beliefs for necessary truths, or social for natural phenomena. Arguments can be made that these types of error have been committed in the name of science. "Scientific" arguments for the inferiority of certain races provide the obvious examples. However, this line of critique misses the target: the content of science is not identical with the scientific ideology. It can be argued from the perspective of the scientific ideology that science is self-correcting, uncovering its own errors of epistemic judgement.

What is at issue in a critique of the scientific ideology is not directly the epistemic status of the content of scientific knowledge, but beliefs and attitudes about knowledge itself. The scientific ideology is a proto-epistemology: it embodies a vision of what knowledge is that guides the epistemic practice of science and shapes the standards by which knowledge claims are judged. This is the conception that knowledge is ultimately knowledge-that; that knowledge-that is more fundamental than know-how; that explicit knowledge-that uncovers the underlying structures of reality and makes manifest what is only implicit or inarticulate in skills and know-how. Science is the practice which orients itself towards creating explicit knowledge-that; the scientific ideology is the epistemological orientation which sees knowledge as being essentially and fundamentally knowledge-that and science as the one true means of access to knowledge. A critique of the scientific ideology cannot be limited to uncovering mistakes of epistemic status from within the epistemic perspective of the scientific ideology, but must be a deep epistemological critique of the scientific ideology's epistemic perspective itself.

This is no easy task, for several reasons: the scientific ideology is so ubiquitous that there is no independent standpoint from which to judge claims about what knowledge is, and there is no agreed-upon epistemological explication of the scientific ideology. Most of modern epistemology has been carried out within the perspective of the scientific ideology. That perspective both sets the problems and issues which epistemology must deal with and provides the criteria for what counts as an adequate epistemological account. Because the scientific ideology construes knowledge primarily as knowledge-that and gives highest status to explicit theoretical knowledge, modern epistemology demands (with full reflexive consistency) an explicit theory of knowledge so construed.

As Edwin Arthur Burtt observed in 1924, and Rorty more recently, "the main current of speculative inquiry from Descartes onward has been permeated by the conviction that investigation into the nature and possibility of knowledge forms a necessary preliminary to the successful attack upon other ultimate issues."[27] The origins of this current of inquiry can be traced back to the epistemic insecurity of the Renaissance mentioned above, but it is no accident that epistemological concerns have continued to dominate long after the epistemic perspective forged as a philosophical movement in the Renaissance became established in the productive enterprise of modern science. The epistemic orientation of the scientific ideology presents profound epistemological problems.

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[27] Edwin A. Burtt, The Metaphysical Foundations of Modern Science (1924; revised ed., Atlantic Highlands, New Jersey: Humanities Press: 1980), 15; see also Richard Rorty, Philosophy and the Mirror of Nature (Princeton: Princeton University Press, 1979), especially the Introduction and Chapter III.

Most modern philosophers have adopted the scientific ideology to some extent. Bacon, Hobbes, Descartes, Locke, and Spinoza each attempted to develop epistemological and metaphysical systems that supported the emerging scientific world-view. Since science became established as an independent discipline about the time of Newton, most philosophers have taken science, and especially physics, as the epistemic paradigm around which they attempted to develop their theories and systems. Kant, Comte, Husserl, John Stewart Mill, Russell, and the logical positivists all explicitly declared their "scientific" bias and presented theories consistent with the epistemic orientation of the scientific ideology· knowledge was knowledge-that, cognitive possessions expressed by theories that could serve as a basis for ratiocinative action.

Even those philosophers so reviled by Theocharis and Psimopoulos as "betrayers of the truth" belong within the broad outlines of the epistemological tradition stretching from Descartes to the present day. Contrary to Theocharis and Psimopoulos' perceptions of them as enemies of science, Popper, Lakatos, Kuhn, and even Feyerabend have deep respect for science and generally take science as the paradigm of a successful epistemic practice around which they develop their theories. Feyerabend goes further than the others in denying that science has a special rational method or unique epistemic status, but for the most part these philosophers are only arguing against the unworkable notions of truth, objectivity, rationality, and scientific method promulgated by their logical positivist predecessors. Far from denying that science possesses such epistemic virtues, they each attempt to develop a more accurate theory of what scientific knowledge consists in and how it is attained.

Theocharis and Psimopoulos would be more comfortable with the new scientistic orthodoxy which has recently emerged in philosophy of science: the banner of the scientific ideology has lately been carried by scientific realism. As Jarrett Leplin says, "scientific realism is a majority position whose advocates are so divided as to appear a minority."[28] But among this fractious crowd, the common aim may still be described as the attempt to develop a theory of knowledge that underwrites science's claims of special access to explicit theoretical knowledge of the inner constitution of reality.

In fact, much of modern philosophy can be seen as a history of failed attempts to develop an epistemology adequate for the scientific ideology. It is not due to the scorn of philosophers that the "fundamental concepts" of the scientific ideology--objectivity, truth, rationality and the scientific method--are lacking adequate definitions, but because the epistemological project in which these concepts are central is deeply problematic.

In Philosophy and the Mirror of Nature, Richard Rorty analyses the history of philosophical problems occasioned by taking the role of philosophy as providing a foundation for knowledge where knowledge is conceived as representations of reality in the mind. By describing the core of the scientific ideology as an orientation towards knowledge-that, I intend to uncover something closely related to but slightly more general than Rorty's mirror metaphor. Knowledge-that may be--and as Rorty points out, most often has been--conceptualized as a mirroring or correspondence of some mental possession with external reality. But it need not be so conceived. As Wittgenstein realized in reaction to his earlier philosophy, propositions appear to have a different kind of relation to reality than the relation of images or diagrams to their subject-matter. Knowledge-that could be described as an epistemologically primitive state such as the cognitive possession of propositional truths, thus being distinct from know-how and yet falling outside the scope of Rorty's mirror metaphor. Rorty does not quite

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[28] Jarrett Leplin, ed., Scientific Realism (Berkeley: University of California Press, 1984), 1.

escape the orientation of the scientific ideology as I conceive it. He gives up the correspondence theory of truth implicit in the image of knowledge as a mirroring of nature, but retains the view that knowledge is a kind of propositional possession. The result, as Hacking puts it, is "yet another language-based philosophy, which regards all our life as a matter of conversation."[29] As a consequence, he does not have a truly critical purchase on the scientific ideology as I define it.

An analysis of the conceptual problems occasioned by the scientific ideology would range over most of modern philosophy and fill many volumes. In any case, a critique of the scientific ideology cannot proceed in the form of an argument against a philosophical theory or theories without danger of committing a straw-man fallacy. The success of science, it would be argued by adherents of the scientific ideology such as Theocharis and Psimopoulos, shows that a true account of the epistemology implicit in science must be possible, and any shortcomings with particular theories only shows that more work needs to be done. There can be no knock-down argument against a whole philosophical project. What must be done is to develop an alternative perspective to the one that animates that project, to demonstrate its merits and show how it illuminates the issues.

This, however, presents a very deep problem. The scientific ideology is so thoroughly embedded in our culture that the nature of this project may be misunderstood. Science has deep roots in a Platonic and Pythagorean orientation in philosophy; the success of science has only reinforced this pre-existing tendency to privilege the abstract and precise rational theory as the very essence of what it is to know and understand. Thus the scientific ideology does not merely influence the content of philosophical theories of knowledge--biasing them in favour

[29] Ian Hacking, Representing and Intervening (Cambridge: Cambridge University Press, 1983), 63.

of science--it also underlies the preconception in most contemporary philosophy that philosophical understanding is achieved by providing a precise, rational reconstruction which makes explicit the principles and standards presumed to govern practice. The scientific ideology has replaced the ancient idea of philosophy as the quest for wisdom with the quest for theories which may supplant wisdom.

There is, then, a reflexive difficulty to be faced. Contemporary philosophy of science is most often understood as the project of providing theoretical understanding of scientific knowledge, which is presumed to rest essentially in the possession of theories. The reflexive consistency implicit in this project informs philosophy of science's notions of what an adequate philosophical account is and what kinds of things it must do. Roughly, an adequate philosophical account must be a theory or rational reconstruction which accounts for the objects in its domain, and the better philosophical account is one that accounts for the phenomena better than its rivals and has fewer internal inconsistencies. That is, the philosopher's job is to provide a theory (an object for intellectual contemplation) more worthy of belief than any rivals. Different theories of knowledge within this sphere all agree on the general character of the object to be explained: knowledge is the kind of thing--explicit knowledge-that--paradigmatically delivered by science.

Note that the scientific ideology is not itself a theory in this sense: it is the framework or perspective within which theories are framed. It is not an epistemic object (theory or set of propositions), but a way of approaching the world which presents the phenomena and objects to be explained, as well as the notion that a theory of these objects is what is required to understand them. It is to this that I intend to provide an alternative, and not to any particular theory or theories within this domain of discourse. This is the reason why I call the view developed here a perspective rather than a theory: I am trying to get beyond the largely unarticulated assumption that what we want is a theory of knowledge, where a theory is understood as an object for rational intellectual contemplation which expresses knowledge of or explains its subject domain. A new perspective is something larger than another theory of knowledge; it is an orientation that opens up the possibility of engaging the world in a different way and revealing the objects in a given domain in quite different terms.

This is the deep difficulty I mentioned earlier. The task would be much easier if I were only providing a theory of some domain within the ambit of a shared perspective where there is general agreement on what needs to be explained and what counts as a good theory. The reader would have a general understanding of what kind of thing is being discussed and what counts as an adequate account. But what is at issue is the very nature of knowledge and understanding, not merely in science but in philosophy as well. What I am attempting to do is develop a different way of understanding these things, not provide a different theory of something the general nature of which is already understood in outline. By doing so I am deliberately working in different forms of epistemic and philosophical practice than those to which we are accustomed by the scientific ideology. But until this perspective is established, the reader's only guide to understanding it will likely be the existing philosophical tradition, which generally treats all philosophical accounts as theories and judges them specifically and exclusively on their merits as theories. The difficulty may be illuminated by Kuhn's idea of "paradigm shifts" which result in the world being seen differently. During a paradigm shift terms change their meaning and reference, and actions their point. As a consequence there may be no "purely rational" way of negotiating a paradigm shift: conversion is achieved more by rhetorical persuasion than logical reasoning.

In order to forestall some possible misunderstandings, a few remarks on my style of presentation may be useful. Because what I am developing is not a theory in the same conceptual space as most contemporary philosophy of science, I do not make extensive use of expository interpretations of the views of others, or argue that their views have conceptual errors, inconsistencies, or other rational failings which my view corrects. In fact, by the standards of contemporary philosophical fashion, I have relatively little to say about the views of others. I use the views of others only where they seem to illuminate the perspective I am developing. Where I point out differences it is not to argue that the other views are false and mine true, but rather to guide the reader to the perspective I am attempting to develop. For the most part I have tried to ground my views in familiar examples and common experiences rather than in the context of contemporary philosophical debate. The aim is to foreground the fact that the consequences of the position I develop are not confined to concerns internal to the debates of contemporary academic philosophy but are immediately relevant to how we all live our lives, and the position ought to be judged in terms of these practical implications.

Also, I sometimes express the same point in various ways and use different terms at different times. This is a deliberate rhetorical strategy, contrary to the aims of developing a systematic theory but consistent with the views of language and epistemic practice developed here. Because my aim is to draw the reader to a perspective rather than lay out a systematic theory, I make many different attempts to achieve the same effect so that if one fails or leads the reader astray it may be corrected by others.

Finally, many details in what follows remain to be developed. This too is deliberate because the central point

I intend to make does not lie in the details--as it would if this were a systematic theory--but in the practical consequences of adopting the perspective I am developing. I draw these consequences out in the final chapters. By developing a different perspective on knowing, the idea of a scientific method changes its sense: it becomes not a universal cognitive technique or epistemic method for achieving all valid knowledge, but a particular style of acting in and knowing the world. This opens the door to the possibility of different ways of acting in and knowing the world, and thereby results in the dissolution of the scientific ideology. The consequence is, I hope, the larger vision that Vaclav Havel called for in the passage quoted in the previous chapter. In order to get to that point, the alternative perspective on knowing must now be introduced and developed. This is the project of the next and succeeding chapters.

3.

AN ALTERNATIVE PERSPECTIVE

Im Anfang war die *Tat*!
In the beginning was the *act*!
--Goethe, Faust

The scientific ideology presumes that knowledge consists in the cognitive possession of facts, truths, or representations of the world. There is a dichotomy implicit in this perspective: knowledge is conceived of as something standing opposite the world known. This results in one of the chief problems of modern epistemology: how to bridge the gap between the knower and the known. A common conceit of the scientific ideology is the faith that science uniquely achieves this, so that scientific theories alone approach to true accounts or accurate depictions of reality. From this perspective knowing how to do something is subordinate to knowledge-that: know-how is either, as Plato thought, an inferior form of knowledge which is transcended by theoretical understanding, or else it is ultimately reducible to theoretical understanding.

The alternative I propose reverses this hierarchy and reinstates the form of knowledge Plato derided--the know-how exemplified in skilled actions--to epistemological primacy. I must stress again that this is not so much a theory of knowledge in the tradition of modern epistemology as a shift of perspective which re-orients our conception of what knowledge consists in. I do not offer an account of how we bridge the gap between the knower and the known, but abandon the picture of the knower standing opposite the world known. I do not argue that the other view is a false or incoherent one to which the alternative I offer is the true corrective; rather, I will develop the alternative and urge that we ought to view knowledge from this perspective and act consistently with this view because of its practical consequences.

The empiricist version of the scientific ideology conceives the process of acquiring knowledge in terms something like this: perception and scientific observation deliver representations of the surface features of "external" reality; then through rational processes of induction, metaphorical modelling, or sheer invention, we create theories of the deeper structures underlying the surface appearances and regularities. These theories are subsequently confirmed by the rational methodological processes that embody the "scientific method," in which they are tested against further perceptual observations. Our abilities to act successfully in the world are understood to rest upon rational computation from representations, facts, and theories so derived; explicitly in the case of scientific technology, and tacitly in the case of ordinary coping.

I propose to reverse the order of precedence embodied in the scientific ideology's conception of knowledge acquisition: to conceive the gain of knowledge, both temporally and conceptually, primarily as a matter of learning how to do something rather than the acquisition of some facts or representations. The factual information and representations that comprise knowledge-that have a place within this perspective: they are not the foundation and basis of know-how, but a consequence of and an aid to the successful practices that comprise know-how. In acquiring the knowledge of how to do something, certain constant features and structures in the environment we negotiate emerge as important for carrying forward our actions. We learn how to recognize these, and subsequently develop ways of expressing or representing them to provide guides to future action. Complex abilities do not emerge as the consequence of applied theoretical knowledge, and scientific knowledge is not the building of facts upon facts acquired and confirmed by means of scientific method. Rather, both are the expression and result of know-how building upon know-how.

From this perspective, modern chemical technology is not the consequence of having antecedently learned (for instance) that there are ninety-one naturally occurring elements distinguished by the number of protons in the nuclei of their atoms, and that their chemical properties of combination and reaction depend upon the structures of the electron shells surrounding the nuclei. Rather, we have learned how to manipulate the elements we find in the world in various ways, and our contemporary chemical theory is a consequence or reflection of the kind of things we have discovered it is necessary to take account of in order to accomplish the ends we have discovered are possible. This perspective may be given some plausibility by noting that many "false" chemical theories were seriously entertained before the present one was settled upon; but the abilities of scientists to manipulate chemical substances progressed steadily as radically different theories were taken up and discarded in turn. Even the alchemists made progress in metallurgy, improving the techniques for smelting ores and purifying metals, despite the fact that their theories were utterly fanciful by our lights.

From this alternative perspective knowledge does not consist ultimately in a body of timeless objective truths, but in knowing how to get on in the world. Theories and representations are not reflections of reality or Platonic truths, but are an integral part of how we get on; they do not transcend our situation, but are themselves situated within the context of our know-how. This perspective abandons the idea of a way the world ultimately is and the dream of a method that will deliver an accurate representation of that world. In knowing the world we do not, either through science or any other means, attain an Archimedean standpoint from which to view the world as if from without. Knowledge is immanent rather than objective: as knowers we are immersed within the world of which we are a part, and learn ways of getting on in that world. The gain of knowledge does not consist in adding to a fund of objective truths, but in furthering our know-how and extending our practices.

Because a label for the view developed here will be convenient and none extant seems quite appropriate, I will call it the *praxical perspective*. The term "praxical" emphasises the centrality of practice or know-how in this view; "perspective" emphasises that my aim is not so much to present another theory within a familiar territory as to achieve a shift in emphasis or a change of point of view that re-orients our conception of what knowledge is.

It will be obvious that this perspective is not wholly without precedent. It is foreshadowed in the pragmatism (or pragmaticism) of Peirce, James, Dewey, and Rorty. Elements of it can also be found in the phenomenology of Martin Heidegger and Maurice Merleau-Ponty, and in the later writings of Wittgenstein and the works of Gilbert Ryle. The views of science developed by Michael Polanyi, Norwood Russell Hanson, Thomas Kuhn, and Ian Hacking also tend towards this perspective to some extent. Their influence can be traced in pragmatic trends in many recent philosophers who cleave closer than they do to the scientific ideology, such as Bas Van Fraassen and the later views of Hilary Putnam. It is also evident in the works of a number of sociologists and historians who have recently developed detailed studies of science viewed as a system of practices, often in explicit opposition to traditional philosophical views of science. Drawing on continental philosophers, Joseph Rouse has developed a similar perspective as a propaedeutic to a Foucaultian political critique of science.

I have drawn on elements of all these sources, perhaps in some cases to a greater extent than I am aware or acknowledge. But I do not champion the view of any particular prior writer, nor do I claim that my view is a direct extension of prior work. I draw inspiration from many prior sources, but my aim is not to defend my reading of them as the "correct" interpretation or engage them in detailed critical debate. One reason for this is because my aim is constructive, and often it is not productive to engage in debate with those from whom I draw inspiration. A few comments on the grosser differences between my own views and some of these antecedent positions may serve to delineate the praxical perspective more clearly and explain why I have not engaged them in more detailed critical debate.

Pragmatism is related to the praxical perspective in its focus on practical ends and abilities. Unlike the praxical perspective, however, pragmatism has generally been developed as a thesis about meaning or truth.[1] While the praxical perspective as I develop it demands accounts of meaning and truth (which will be developed in chapter five), truth is not epistemically central. To see it as such is, I suggest, to retain the cognocentric perspective of the scientific ideology. Richard Rorty and the recent views of Hilary Putnam are representative of such a theory-centric pragmatism. They understand knowledge to rest ultimately in the possession of true propositions of the sort delivered by science, while giving pragmatic rather than foundational or correspondence accounts of truth. Similarly, William James characterised knowledge as the possession of true ideas, but described the truth of ideas as a matter of their practical utility rather than their correspondence with reality.[2] In addition most pragmatists have been great admirers of

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[1] "Pragmatism is first and always a doctrine of meaning, and often of truth as well . . ." V. J. M[cGill], s.v. "Pragmatism," Dictionary of Philosophy, ed. Dagobert D. Runes (Totowa, New Jersey: Littlefield, Adams & Co., 1962), 246.

[2] William James, Pragmatism and The Meaning of Truth, (Cambridge, Massachusetts: Harvard University Press, 1975).

science; as a result they have not been concerned to develop a critical perspective on the scientific ideology, which is central to the praxical perspective. In contrast to these forms of pragmatism, the praxical perspective makes know-how rather than propositions or ideas epistemically central and situates theoretical and factual statements within this context as enacted know-how. On this view science can be seen as one form of practice, not the one correct way to understand reality.

Recently some sociologists and historians of science, and a few philosophers of science, have moved away from the traditional preoccupation with theoretical reasoning and have begun to view science as a field of practices. This shift in thematic focus often results in accounts of science which are consistent with and support my views (and I draw on this material extensively in chapter six). Nevertheless, the proponents of these accounts do not go as far as I would recommend in developing a thoroughly praxical view of what it is to know. In fact, a thematic focus on science as practice is consistent with a variety of epistemological views.

Some who have turned to a focus on science as practice have been strongly influenced by the hermeneutic tradition in continental philosophy. Hermeneutics has its roots in textual interpretation, and as a consequence tends to retain a linguistic and cognitive focus when developed as a view of scientific practice. This is most obvious in the works of Bruno Latour and Steve Woolgar,[3] who conceptualize nature after the model of a text to be interpreted and the laboratory as a site for producing and authorizing inscriptions. In a sense their views are similar to the much more traditional theory-centred views of W. V. O. Quine and Mary Hesse (who was also influenced by the hermeneutic

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[3] Bruno Latour and Steve Woolgar, Laboratory Life: The Social Construction of Scientific Facts, Sage Library of Social Research vol. 80 (Beverly Hills: Sage Publications, 1979).

tradition): they all model scientific practice on sentential or linguistic ratiocination, and identify knowledge with the propositional products produced. Where they differ is in the degree of emphasis they place on the role of social negotiation in the process of establishing authoritative knowledge claims. Thoroughgoing social constructivists such as Latour, Woolgar, Barry Barnes, David Bloor, Harry Collins, and Trevor Pinch, emphasise the role of epistemically unconstrained social choices, while Quine and Hesse focus on rational epistemic factors. Even more relativistically moderate sociologists of science such as Karin Knorr-Cetina (and Andrew Pickering in some of his more recent works) develop decisionistic models of scientific practice according to which the epistemic product is understood to be the consequence of a number of cognitive choices made by the scientific community. In this regard they cleave to the focus of the scientific ideology on knowledge-that and on sentential models of reasoning.

Not all thinkers who take the turn to viewing science as practice are so wedded to this cognitive bias. Ian Hacking, and particularly Joseph Rouse,[4] have also urged that we take this turn, but they both place much more emphasis on material practices and researchers' laboratory manipulations than on cognitive reasoning and theoretical interpretation as the locus of knowledge. Rouse's views intersect my own in our conception of the scientific laboratory as a place where instrumental know-how or technological abilities are developed and disseminated to the rest of the world via the production of standardized products, techniques, and instruments, rather than through the discovery and dissemination of cognitively apprehended truths or representations of reality. However, while Rouse's view of scientific practice is similar to my own, he develops it from a different background and with a different

[4] Joseph Rouse, Knowledge and Power: Toward a Political Philosophy of Science (Ithica: Cornell University Press, 1987), ch. 3.

aim. The epistemological view implicit in his work is closely related to my own, but his different background and aim result in some subtle but significant differences.

In order to develop his view of science as practice, Rouse finds it necessary to distinguish very carefully the "theoretical hermeneutics" of analytical philosophers such as Hesse and Quine from the "practical hermeneutics" he finds in his interpretations of Heidegger and Kuhn. In the process, he acknowledges that he takes his readings of Heidegger and Kuhn in directions they themselves did not go. Rouse recognizes that in Being and Time Heidegger retains a vision of scientific knowing that fits squarely within the tradition which I have identified as the scientific ideology: Heidegger takes scientific knowing to be a form of detached observing which "lets things show themselves as they are," while developing the basis for a view of ordinary coping as "practical hermeneutics."[5] Rouse extends his account of practical hermeneutics into the sphere of science, as Heidegger did not.[6] As well, Rouse identifies two possible readings of Kuhn: a theory-centred one typical of Kuhn's critics, and a second more practice-centred reading which his critics systematically missed. Rouse develops his own views from the practice-centred reading, but acknowledges that it is clear from his later defensive responses that this is a reading which Kuhn himself did not fully recognise.[7]

I am sympathetic to many elements in the tradition of continental philosophy on which Rouse draws, but I make few direct references to it because I find that the style in which it is expressed attenuates its heuristic utility. Not only is the prose obscure, but the tendency to high theoretical abstraction works against the practical

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[5] Ibid., 73-80.

[6] At least not in Being and Time; Heidegger's later writings suggest this direction, but they are extremely difficult to interpret.

[7] Rouse, Knowledge and Power, 27.

consequences of the praxical perspective. The idiom of this tradition leads Rouse to a position that falls short of my aims in some important areas. The key term "interpretation," whether understood in terms of practical or theoretical hermeneutics, indicates the process by which an object or situation comes to have a meaning for a subject. This suggests that there is a pre-existing object, circumstance, or reality, that does not have a meaning for the subject, or does not have a clear meaning, which it subsequently comes to have through the process of interpretation. Implicit in this notion is a division between the uninterpreted thing and the knower, which parallels the epistemic gap between the world and the knowing subject which I described earlier as a feature of the scientific ideology. The division is not as sharp as Descartes's distinction between a material world and a knowing mind, but it does not quite escape the Cartesian separation. The implicit presupposition of a mind/matter split is hinted at in Rouse's work when he speaks of linguistic meaning as determined by the "self-adjudicating behavior of the community," and quotes approvingly Horwich's account of linguistic ability as "*knowing how to use the expressions of the language, associating the right meanings with those expressions . . .*"[8] These formulations suggest a view in which language consists of the physical behaviours of material bodies to which we attach meanings in a cognitive mental act. This separation between meaning and world is reinforced when Rouse speaks of an interplay in science between theory and practice,[9] and of our understanding of the world as the "emerging result of many small, locally intelligible practices."[10]

This implicit division--which makes knowing or understanding the cognitive act of a subject standing

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[8] Ibid., 150.
[9] Ibid., 229 and passim.
[10] Ibid., 243.

opposite the world--is not a limitation for Rouse, because his goal is to develop a view which re-interprets the meaning of science in our lives. His central aim is to unseat the scientific ideology's interpretation of the relation between knowledge and power in order to develop a basis for a political critique of science. While my own view has similar political ramifications, my aim in this work is more epistemologically radical. My goal is to challenge the epistemic limitations inherent in the scientific ideology. By breaking the boundaries of what the scientific ideology counts as knowledge, I aim to point the way to a larger conception of what we can know, what there is, and how we may live in the world.

In order to achieve this, it is necessary to develop a conception of action which does not separate meaning and behaviour; a conception according to which actions are themselves meaningful and the division between world and knower is more radically erased than in Rouse's account.

Epistemologies developed within the perspective of the scientific ideology have relied predominantly on two different but related models for understanding knowledge. Early in the modern period knowledge was conceived after the model of pictures in the mind of the knower. More recent propositional theories model knowledge on the linguistic statement. In these latter theories propositions function like true sentences and the processes of reasoning by which knowledge is confirmed and applied are modeled after sentential computation. Both models place the knower and knowledge opposite the world known. The praxical perspective requires an entirely different model for understanding knowledge. I will use skill as a model for a unitary know-how which does not analyse into a mental and physical part.

Within the perspective of the scientific ideology, as it persists in the presuppositions even of pragmatic, sociological, and hermeneutic treatments of sciences that focus on practice, know-how has generally been treated as consequent upon or reducible to knowledge-that. In the remainder of this chapter I will develop a preliminary account of know-how in the context of skills such as swimming, riding a bicycle, and playing games like chess, and I will argue that the know-how manifest in such skills is not reducible to knowledge-that in the form of rules and factual information about the situation. A sketch of the relation of rules and information to such skills will indicate that a key part of learning a skill is learning how to recognize general features of a situation as meaningful for action. In the next chapter I further develop the insight that learning a skill involves learning how to perceive a situation as meaningfully structured for action into a non-representational account of perception in which know-how is prior to the perception of factual information about a situation. In the following chapter I develop a view of language as a form of skilled practice in which factual statements are enacted know-how rather than representations of an independently existing reality. I will combine these three elements of the praxical perspective--irreducible skill, non-representational perception, and language as enacted know-how--into an account of scientific practice in which theories are not the detachable epistemic product of a cognitive method, but elements of scientific practice meaningful only within the context of developing scientific know-how. In this way the concept of know-how developed first using the examples of simple skills will be extended to more complex practices which we usually do not think of as skills, but as applied knowledge-that.

An analysis of the way we use the term "skill" reveals a number of simple but salient points.

Skills are distinct from mechanical processes. We ascribe skills to human (or animal) agents, but not to machines, even if the machine (such as a welding robot or chess-playing computer) achieves the same or better results than a human agent. As well, we distinguish skills from habits. While habits are involuntary and mechanical processes are automatic, skilled actions are active processes implying conscious intelligence, agency, and volition.

A skill is not identical with the behaviour in which it is manifested. One still possesses a skill in the intervals when it is not being exercised, as one may know a fact without using or stating it. The possession of a skill is an epistemic state, as is the possession of a piece of knowledge; but as I will argue, this is irreducibly a state of know-how rather than knowledge-that. It is not a cognitive object that is possessed (such as a set of rules or facts), but an ability to do something.

Skills are not innate. We do not say that someone is skilled at digestion or breathing (except in cases where a special breathing technique is meant, such as in singing or playing a musical instrument), but they may be skilled at carpentry or skiing. One may have an aptitude for developing a skill of a certain type, but undeveloped aptitude is not skill. Skills are epistemic achievements, something learned.

Unlike facts, skills cannot be learned in a single event, but are achieved through repeated practice and diligent effort. In exercising or developing a skill, the agent aims at and strives for the end to be achieved by the skilled action. The degree to which the end is approached provides feedback for adjusting the actions that constitute the skill, thus guiding the accomplishment in the particular case and improving competence in the skill. The development of a skill thus requires the capacity to set goals and judge relative degrees of achievement.

Some skills are highly complex achievements encompassing many other lower-order skills. We may say of someone, for instance, that he or she is a very skilled house-builder. This encompass skills in financing, purchasing, measuring, cutting, nailing, and painting; and these in turn encompass skills in language and mathematical computation, which in turn rest upon perceptual and motor skills. But the skill of house-building is not the simple sum of these constituent skills. It is conceivable that one could possess each of the constituent skills, and yet not be able to co-ordinate or mobilize them in the skillful construction of a house. The skill of house-building encompasses an aim and structure that is not contained in the sum of its constituent skills. That is, skills may be arranged in a holistic hierarchy.

A skill, once acquired, is not limited to the circumstance in which it was learned, but provides a general ability which can be extended to other contexts. For instance, once one has learned how to throw a ball with some accuracy from a standing position using an overhand action, one can also throw a ball with some accuracy sidearm, or underhand, or while riding a bicycle, or while off-balance after jumping for a catch. In learning the skill one has learned, through repetition, a combination of physical motions; but the skill is more than that particular repeated combination of physical motions. Skills are general, extendible abilities which have an inherent point or aim, not specific behaviours or mechanical motions.

The term "skill" usually refers to something possessed by an individual. However, the concept can be metaphorically extended to incorporate the joint or co-operative achievements of a people. Social practices such as manners, morals, and language, can be seen as skills developed by cultures striving for harmonious prosperity. Individuals within the culture must of course attain skill in the practices of the society, but the practices can themselves be seen as skills of the society. Not all social practices, however, can legitimately be described as skills; some practices are just conventional ways of doing things. Examples of this would be the particular details of the rites of marriage, naming, and burial. Only those practices that aim at some end which admits of better or worse achievement may be profitably viewed as skills. It is these skilled practices (which I will sometimes call simply "practices")--in particular our modern scientific and technological abilities--rather than conventional practices, with which I will be concerned.[11]

Note that my use of the term "practices" is slightly different than its use in many sociological studies of science. Where sociologists who view science as practice (such as Barnes, Bloor, Latour, Woolgar, Knorr-Cetina, and Pickering) tend to emphasise the element of social convention and socially negotiated choice in scientific practice, I treat scientific practices primarily as epistemic achievements. Scientific practices in my sense are the acquired abilities of the scientific community, not merely the way the community has decided, through historically contingent events or socially mediated choices, how to act. Our usages are common in that they problematize the distinction between the epistemic and non-epistemic elements, but I am not concerned to promote relativism or undermine the achievements of science by emphasising the role of non-epistemic elements of practice at the expense of epistemic matters; rather, I intend to expand what counts as epistemic.

The distinction between the epistemic and non-epistemic is problematized because there is no independent standpoint from which to differentiate practices, characterise their

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[11] Much recent research in psychology--including studies of multiple personality disorder, split-brain research, and investigations into the compartmentalization of cognitive functions as revealed by patients with localized brain damage--suggests that individuals do not contain a single seat of consciousness or "self" that surveys and controls the whole, but that a person consists of a collection of interacting but more or less autonomous structures. Given this, the extension of the concept of skill from an individual to a group may be less metaphorical than at first appears.

point, identify which practices are interesting or important to pursue, or distinguish a priori between conventional and necessary ways of acting. We discover the point and meaning of practices as we learn what it is possible to do. Even the standards of what counts as success are in a way internal to a practice, because there may be no independent way to characterise what is being achieved by the practice. This does not result in cultural relativism, however, because we cannot succeed at whatever we wish by virtue of socially contingent cognitive choices. The world constrains what it is possible to do; we choose what we want to do and, to some extent, how we go about it.

This problematizing of the distinction between the epistemic and non-epistemic is as it should be, because it is a feature of our epistemic position that we often do not know what purported fact is a feature of the world and what is a reflection of our choices. The racist and sexist notions which were once defended as scientific facts provide an obvious example. I don't believe there is any general method for deciding what is real and what is a reflection of conventional practices: the only way of finding that out is through further development of our practices.

In order to consistently develop the praxical perspective, skilled know-how must be treated as an epistemic foundation and epistemological primitive. That is, know-how must not be conceived to rest on something more basic. The scientific ideology, on the other hand, has generally treated know-how as reducible to knowledge-that.

One way that the scientific ideology has reduced know-how to knowledge-that is by what Gilbert Ryle has called the "intellectualist doctrine." The intellectualist, according to Ryle, holds:

> (1) that Intelligence is a special faculty, the exercises of which are those specific internal acts which are called acts of thinking, namely, the operations of considering propositions; (2)

> that practical activities merit their titles 'intelligent', 'clever', and the rest only because they are accompanied by some such internal acts of considering propositions (and particularly 'regulative' propositions). That is to say, doing things is never itself an exercise of intelligence, but is, at best, a process introduced and somehow steered by some ulterior act of theorising.[12]

The intellectualist doctrine as Ryle defines it has the merit of preserving the intuition that there is a distinction between actions performed by persons and similar behaviours performed by a machine. For instance, we say that a person skilled at chess has an intelligent understanding of the game, but a chess computer understands nothing, merely computing outputs on the basis of inputs by some automatic process. The person exercises judgement and volition, while the computer merely behaves in a mechanistically determined way. However, locating intelligent agency (know-how) in the consideration of rules (knowledge-that) is very problematic.

An obvious difficulty is that, for many skills, there is no conscious concomitant consideration of propositions or rules. Such rules may never even have been explicitly formulated. It is doubtful that anyone has formulated rules for the skill of walking, and almost certain that no-one has ever learned to walk or ride a bicycle by considering rules. The intellectualist response to this problem is to insist that the rules are nonetheless present, but they are being followed "internally," as if a silent reasoning process occurs in the mind of the agent.[13] But postulating a silent

[12] Gilbert Ryle, "Knowing How and Knowing That," Proceedings of the Aristotelian Society N.S. 46 (1945-46): 1-16; reprinted in Gilbert Ryle, Collected Papers, 2 vols. (London: Hutchinson, 1971), 2: 212-25; see also The Concept of Mind (1949; reprint, Harmondsworth, Middlesex: Peregrine Books, 1963), chapter 2, 26-60.

[13] For instance, Michael Polanyi writes: "I shall take as my clue for this investigation [of skills] the well-known fact *that the aim of a skillful performance is achieved by the observance of a set of rules which are not known as such to the person following them.*" Personal Knowledge (Chicago: University of Chicago Press,

internal process of considering rules, as if there were a homunculus in the person's mind who is aware of things the person is not but who thinks and considers rules similar to the way a person reasons, does not solve the intellectualist's problems. In fact, it leads to an infinite regress.

The regress results because following a rule is itself a matter of skilled practice: know-how, not knowledge-that. Ryle shows a number of ways in which the regress can arise: if skills are performed by the consideration of rules, there must either be a great number of rules to cover all possible situations, or a smaller number of very powerful general rules. In the one case, it will require skill to choose the correct rule; and in the other, it will require skill to decide how to apply the rule to the specific case. If there are rules for the choice of rules, these too must require rules for their application, and so forth.

Ryle notes that this point was made in reference to rules of deductive reasoning by Lewis Carroll in "What the Tortoise said to Achilles."[14] The Tortoise is shown a deductively valid argument; he understands the premises and the conclusion, but fails to see that the conclusion follows from the premises. Achilles thereupon states the rule of inference. The Tortoise assents to it and adds the rule to the premises of the argument, but still fails to see that the conclusion follows; so Achilles gives a further rule, and so forth. The point is that considering a rule, and even assenting to it, do not compel one to perform the inference: one must know how to follow the rule. This know-how cannot be imparted by further propositionally expressed rules without the same problem arising. Understanding a rule is

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1962), 49; italics in original. Polanyi does not, in fact, postulate an internal rule-follower, despite the appearances of this sentence.

[14] Lewis Carroll, "What the Tortoise said to Achilles," Mind, N.S., 4 (1895): 278-80.

not knowing a fact, but knowing how to do what the rule enjoins.

Similar regress arguments underlie Wittgenstein's account of rule-following in the Philosophical Investigations. He points out that rules can be interpreted differently, so that any course of action could follow from a rule on some interpretation.[15] To halt the regress of rules for interpreting rules, it must be accepted that "there is a way of grasping a rule which is *not* an *interpretation*, but which is exhibited in what we call 'obeying the rule' and 'going against it' in actual cases."[16]

Of course propositionally expressed rules do, at least sometimes, play a role in intelligent action. Some skills are taught by imparting rules, and some kinds of know-how can be guided by the observance of rules. The relation of rules to skills has been most perspicuously examined by Hubert and Stuart Dreyfus. Reviewing their account will further elucidate the nature of know-how and the relation of know-how to knowledge-that.[17]

Dreyfus and Dreyfus recognize five distinct stages in the acquisition of skills through instruction.

The first level is that of the *novice* or rank beginner. The novice has learned to recognize "context-free" elements relevant to the skill and rules for determining actions

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[15] Ludwig Wittgenstein, Philosophical Investigations, trans. G. E. M. Anscombe, 3rd ed. (1967; reprint, Oxford: Basil Blackwell, 1984), sec. 86, p. 40; sec. 163, p. 65.

[16] Ibid., sec. 201, p. 81.

[17] Dreyfus's discussion of skills can be found in Hubert L. and Stuart E. Dreyfus, Mind over Machine: The Power of Human Intuition and Expertise in the Era of the Computer (New York: Free Press, 1986), 16-51; "What is Moral Maturity? Towards a Phenomenology of Ethical Expertise," in Revisioning Philosophy, ed. James Ogilvy (Albany, N.Y.: State University of New York Press, 1992), 111-31; and "From Socrates to Expert Systems," in Interpretive Social Science: A Second Look, ed. Paul Rabinow and William M. Sullivan (Berkeley: University of California Press, 1987), 327-50.

based on those elements. "Context-free" elements are objective facts or features of a situation that do not depend upon the situation or events that are occurring. Dreyfus gives automobile speed and distance between cars as examples of such context-free features; the student learns rules such as "shift up to third at thirty miles per hour," and "maintain a three-second following distance." The novice has not learned how to judge by the situation when to make exceptions to such rules, and applies them largely by rote. Applying more than a few such rules requires such concentration that the student's "capacity to talk or listen to advice is severely limited."[18]

At the next level, the *advanced beginner* is able to recognize both context-free and "situational" elements. The latter are aspects of a situation that cannot be defined by objective elements and rules, but are recognized by similarity with previously experienced situations. Recognizing a particular dog by the sound of its bark, knowing when to shift by the sound of the engine, and distinguishing a drunk from an impatient driver are examples of situationally guided action. Experience is more important than rules in recognizing situational elements and knowing when to act on them.

The *competent* practitioner, knowing more rules and being able to recognize more context-free and situational elements than can be conveniently considered at one time, learns to use a hierarchical decision-making procedure. This involves adopting a particular plan of action, and being able to recognize which rules and elements of the situation are important for the plan. Only those factors most relevant to the chosen plan of action are considered. Competent performers still see the situation as a set of facts and reason upon them to choose their actions; but they are able to choose their own organizing plans and goals.

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[18] Dreyfus and Dreyfus, Mind Over Machine, 22.

The fourth level or skill recognized by Dreyfus and Dreyfus is that of *proficiency*. Proficient agents no longer see a situation as a set of facts upon which to deliberate; they recognize immediately the sense of whole situations. They are so involved in the situation that goals, plans, and possible actions occur to them spontaneously, and whole situations are recognized as similar to ones previously experienced. However, proficient performers still deliberate on what to do; and in the course of deliberation they may break the situation down into individual facts and apply rules. While for the most part they are involved in an intuitive understanding of their situation, the spell may be broken while they revert to an earlier level of skill to decide what to do. "A proficient driver approaching a curve on a rainy day may sense that he is travelling too fast. He then consciously decides whether to apply the brakes, remove his foot from the accelerator, or merely to reduce pressure on the accelerator."[19]

Finally, *experts* transcend rules and conscious decision-making altogether. They have what Dreyfus and Dreyfus call a "deep situational understanding." Expert drivers and pilots become one with their craft; their skill is so much a part of them that they are no more aware of it than a person is normally aware of his or her body when walking and talking. "*When things are proceeding normally, experts don't solve problems and don't make decisions; they do what normally works.*"[20]

Dreyfus and Dreyfus report an interesting experiment they performed to demonstrate that experts perform no conscious ratiocinative decision-making in the exercise of their skill. They asked an international chess master to add in his head a sequence of numbers, at the rate of about one per second, while simultaneously playing speed-chess. They observed that his chess performance was not noticeably

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[19] Dreyfus and Dreyfus, "From Socrates to Expert Systems," 338.

[20] Dreyfus and Dreyfus, Mind Over Machine, 30-31; italics in original.

diminished even though his rational mind was fully occupied.[21] Experts do not reason out their actions; they act with a kind of Zen-like fluidity. Experts know how to act with a know-how that does not depend upon cognitive reasoning with facts and rules.

Dreyfus and Dreyfus' discussion reveals a number of facts about the role that consciously considered rules play in the performance of a skill. The obvious point is that the consideration of rules is not essential to skilled performance. This point was made earlier by noting that many skills are learned and performed without the intermediary of rules; the Dreyfus brothers' discussion adds that where such rules are employed they are transcended when expertise is achieved. Transcending the rules learned at an earlier stage is not merely a matter of "internalizing" formerly explicit rules. An expert's performance cannot be duplicated by following explicitly stated rules that the expert may have once learned or can currently state. This is an expected consequence of the regress arguments rehearsed earlier; Dreyfus and Dreyfus also argue this point from the empirical failure of attempts by artificial intelligence researchers to model expertise on the basis of rules elicited from experts.[22] Experts do not know enough rules to account for their expertise; in fact, their expertise does not rest on explicit rules. Rules serve a heuristic and mnemonic role: the teacher uses them to point out to the student what to do, and the student uses them as a reminder or guide on the way to achieving expertise.

It should also be noted that there is a hierarchy of rules on the way to expertise. At each level the student learns more advanced rules and transcends the rules of the lower level. Those rules are no longer considered except when something goes wrong. Once mastery of the rules

[21] Dreyfus and Dreyfus, "From Socrates to Expert Systems," 339.
[22] Dreyfus and Dreyfus, Mind Over Machine, 103-121.

appropriate to a particular level is achieved, the action is no longer performed by considering the rules, although those rules may describe the action. This is closely akin to Wittgenstein's point mentioned earlier that there is a way of following a rule which is not an interpretation.

A further point that this discussion brings out is that agents not only learn more complex rules on the way to expertise, they also learn to perceive more advanced or abstract features of the situation. With each advance, agents are able to recognize features of the situation not accessible at the previous level of skill. The beginner cannot distinguish the contextual features on which the novice's rules depend; the novice cannot differentiate the relative importance of features on which the competent agent's performance is based. The rules agents learn refer to features of the situation which they must also learn to perceive. Rules not only guide action, they also serve to point out or draw attention to what is important in the situation. Agents not only learn to act more skillfully; they also learn to perceive more.

This examination of the phenomenology of skills, and the regress arguments discussed earlier, are powerful refutations of the intellectualist doctrine that intelligent action results from the consideration of propositional rules. However, the intellectualist doctrine is not so easily put to rest. We are now familiar--as Ryle and Wittgenstein were not--with computers which apparently follow instructions, in the form of computer programs, as a matter of course. The manner in which a computer interprets a rule and applies it in a particular case is in a sense "built in," so the regress problems do not arise. Computers can now perform many tasks once thought to be the preserve of human intelligence and skill. It is an article of faith of many workers in the fields of cognitive science and artificial intelligence that human cognitive processes, including knowledge, expertise, and know-how, can be modeled computationally. This faith is underwritten by the success computers have had in mimicking human behaviour and performance in such areas as checkers, chess, and medical diagnostics.[23]

The cognitive science program is not identical with the intellectualist program as Ryle defines it, but it is a close kin. Both attempt to eliminate skill or know-how as an epistemic primitive: the intellectualist by reducing it to knowledge-that, the cognitive scientist by reducing it to mechanistic behaviour. Both are manifestations of the scientific ideology's epistemological perspective which treats knowledge as fundamentally knowledge-that. Intellectualists include knowing agents as representers of the world and entertainers of propositions in their accounts; but this leads to a regress of representers and representations. Cognitive scientists stop the regress by treating both the knower and knowledge as objects in the representations of the world. They adopt the Archimedean point outside the world; but in so doing they attempt to step outside their own shadow, and thereby--paradoxically--eliminate their own experience of knowing from their representations of what it is to know.

The cognitive science program is not incoherent in the way that the intellectualist doctrine is, but a number of internal arguments have been advanced against it by its most vocal critic, Hubert Dreyfus. He has pointed out that the successes achieved by artificial intelligence have fallen far short of the promises. Chess and checkers computers are very good, but they can still be beaten by humans. Similarly, expert systems such as medical diagnostic programs have become a useful aid, but cannot yet supplant real experts.

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[23] See Hubert L. Dreyfus, What Computers Can't Do: The Limits of Artificial Intelligence, revised ed. (New York: Harper and Row, 1979), Part 1, 91-151.

The only areas where expert systems have approached human skill are those where the situation can be presented to the computer in an unambiguous, pre-interpreted way. Game pieces and positions require only a handful of variables with a finite number of states; medical symptoms can be listed on a multiple-choice chart. It has proven remarkably difficult to develop computer systems that can recognize objects visually, even in very artificially restricted environments. Manufacturing robots guided by video cameras can pick out pieces from an assembly line, but only from a limited repertoire, and only if they are regularly oriented. Recognizing an object from any orientation, even against a blank background, is almost insuperably difficult.[24] Humans, on the other hand, act with ease in a visually very "busy" world.[25]

In addition, the processes underlying computer behaviour do not appear to be the same as the processes underlying human action. This is true whether one adopts a cognitive or materialist view. Early in the cognitive science program, it was thought (consistent with the intellectualist doctrine) that expertise is achieved by the observance of rules, so to construct an expert system it was only necessary to elicit the rules that the experts knew. But it is extremely difficult to elicit such rules. The performance of skilled experts far exceeds what can be achieved by any rules of which the experts are themselves aware. Attempts to represent the additional knowledge by further rules quickly results in such a cumbersome system of rules that no human expert could keep them all in mind, and even very powerful computers have difficulty matching the speed of human performance.

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[24] Dreyfus and Dreyfus, Mind Over Machine, 54-8.

[25] Note that this is closely related to the earlier point that skill-learners must learn to see what is important in a situation. This aspect of perception is precisely what appears insuperably difficult for computers. Perception will be discussed in the next chapter.

While these arguments suggest problems with the cognitive science program, they are not decisive against it. A deeper problem, approaching to circularity, emerges when it is recognized that computer simulations not only fail to represent the processes of human cognition, they do not accurately represent material brain processes either. They cannot, because neuro-physiology as yet has little or no understanding of what those brain processes are. The faith that human cognition must be representable by computer systems rests on the presupposition that humans are material systems, and all material processes can be represented in a computational system. This is, at the very least, a long promissory note of the scientific ideology.

From the perspective of the scientific ideology, the materialist presupposition of the cognitive science program is necessary and defensible: materialism is part of what it is to be scientific, and the success of science--together with the fact that science has discovered no non-material entities, properties, or processes--provides the justification for this manner of proceeding. Circularity emerges, however, if (as I will argue in chapter seven, and have already suggested in the previous chapter) materialism is seen as a consequence of the perspective of the scientific ideology. It is as if an artist, lacking any colours but shades of red, has decided that the proper way to view the world is through red glasses. He then justifies his palette on the grounds that with it he can paint everything he can see, and justifies wearing red glasses because with them he sees the world in a way which he can accurately portray. The red glasses in this metaphor correspond to scientific method, and the palette to the conceptual system of natural science. To break out of such a circle one needs both to introduce a richer palette and to show (which is more difficult because it is denied by the scientific ideology) that we are viewing the world through coloured glasses. Once one steps outside the circle of the scientific ideology, the materialist basis of the cognitive science program appears as an insupportable a priori metaphysical presupposition.

The a priori character of the cognitive science program is already suggested by the observation that it is true neither to the phenomenology nor the neuro-physiology of human cognition. It does not so much reduce know-how to something more basic (physically instantiable computational processes) as ignore skill, know-how, and the experience of knowing altogether. It attempts only to duplicate, through computational means, the behaviours which in humans are the result of skill and knowledge, but does not elucidate their nature. Conscious experience, which is the basis of human knowledge and the foundation upon which we act and create representations of the world, serves no role in the cognitive scientist's program. Where the intellectualists discussed by Ryle preserve a role for the conscious knowing agent (as a follower of rules and perceiver of the situation) in their attempts to reduce know-how to knowledge-that, cognitive scientists eliminate the agent and subject of consciousness from their accounts altogether, with the result that they speak only of behaviours and representations rather than skill, know-how, or conscious knowing.

The point to be drawn from the foregoing arguments is that if we are to speak of knowing as we experience it, know-how is ineliminable. The attempts to reduce know-how to knowledge-that result either in an infinite regress or in replacing the concepts of lived experience, knowledge, and agency with notions of blind representation, dumb computation, and mechanistic behaviour. In performing intelligent actions we do not necessarily follow propositionally expressed (or expressible) rules, and computers which do follow rules in mimicking human behaviours do not, in any ordinary senses of the terms, act, perceive, or even know anything, regardless of how much information they may store and utilize.

Neither the intellectualist nor the cognitive scientist's account is true to the experience of what it is to know. But such experience is central to our conception of knowledge. Knowledge is exhibited in intelligent, meaningful, conscious action which is not mere mechanical behaviour. Factual information and rules can only have a role in knowledge where they are available for conscious deliberation. Scientific knowledge does not consist in unconscious representations; theories are employed in conscious ratiocination and founded upon our conscious awareness. It would seem that we ought to take account of such awareness and agency in our accounts of knowledge, rather than reason a priori about computational reasoning, sensory reception, and cognitive representations.[26] Skilled know-how provides the conceptual category that puts the conscious agent back into our understanding of what it is to know.[27]

If it be admitted that know-how is necessary for an adequate understanding of human knowing, what role is it to play? One possibility, closely akin to the intellectualist approach, is to give it a minimal role: allow that skill is

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[26] This view is strongly argued by Maurice Merleau-Ponty throughout The Phenomenology of Perception, trans. Colin Smith (London: Routledge and Kegan Paul, 1962).

[27] My opponents will argue that the concept of conscious agency is my insupportable metaphysical presupposition, which the scientific program attempts to eliminate or show unnecessary. There may be no way to settle a clash of metaphysics at this level, but for now I can point out that we experience ourselves as conscious agents regardless of whether that concept can be shown unnecessary or eliminated from a scientific account of human cognition; and the concepts of know-how, agency, and conscious experience which I employ are familiar and comfortable to anyone who has not studied too much science and scientistic philosophy. My ultimate defense is the sense that the praxical perspective brings to our experience of the world, and the virtues inherent in adopting this perspective.

ineliminable, but limit its role to the general skills required for considering propositions and following and applying rules. A little reflection, however, will show that this will not do, because it does not properly account for the place of conscious agency and deliberation. Most intelligent actions are performed not by deliberating upon facts and rules, but directly upon the actions and situation in which they are performed. We cannot save the spirit of the intellectualist reduction of know-how to knowledge-that by stopping the regress at the skill of rule-following. As Ryle argued, intelligent actions must themselves be considered as examples of know-how, not the result of silent (skillful) rule-following.[28]

The primacy of know-how can be further illustrated by considering the relations between information, understanding, and knowledge. A book may contain a great deal of information, but it is not knowledge unless there is someone to understand it. And a person cannot be said to understand a proposition unless they know how to apply it in actual practice. This point is well illustrated by Richard Feynman's discussion of his experiences teaching physics in Brazil.[29] The physics education system in the Brazilian universities at the time emphasized knowledge of facts. The students learned the definitions, propositions, laws, and equations of advanced physics; many of the students were very good at answering questions and solving problems, as long as they were phrased in the terms in which they had been memorized. But the students often could not answer even relatively simple real-world problems involving the knowledge they had supposedly learned. They had memorized a great number of facts relevant to physics, but had learned no physics. In a deep sense they did not know any physics,

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[28] Ryle, "Knowing How and Knowing That," and The Concept of Mind, 26-60.
[29] Richard Feynman, Surely You're Joking, Mr. Feynman! Adventures of a Curious Character (New York: Bantam Books, 1986), 191-8.

because they did not know how to use the information they had memorized.

The know-how that is required for the understanding that raises information to knowledge is not a general sort of skill, but skill in the specific practice in question. The Brazilian physics students Feynman encountered were highly intelligent young people with many skills and perfect command of the language in which the information they memorized was expressed. They lacked no relevant facts or skills except skill in the practices of physics. That skill could not be imparted by giving them further information to memorize; it could only be learned through practice. This is how science is actually taught in more successful schools than the Brazilian ones Feynman encountered: the students are not merely given a body of information and rules, but given practice in applying that information in actual situations, both in theoretical problem-solving and in the laboratory. Good teaching practice recognizes that knowledge is not merely the possession of information, but that know-how or skill in the practice is necessary; and this know-how is not reducible to further rules or to more basic skills.

The point of the foregoing arguments has been to develop an understanding of skill which can be taken as a model for understanding what it is to know. The aim has not been to prove the primacy of skill, but to establish a perspective in which know-how is primary. The argument is not that scientific knowledge reduces to the simple intellectual and bodily skills of practicing scientists (in instrument reading, tool manipulation, linguistic vocalization, and calculation, for instance), or merely that such skills are ineliminable in achieving scientific knowledge. Skill is a model for understanding such advanced practices as biochemistry and high energy physics as the acquired skilled practices or abilities of the scientific community rather than as bodies of applied and theoretical knowledge. Skilled actions are conscious, but not cognitively conscious or the consequence of mental reasoning. Skilled practices are not behaviours (something physical) upon which we place an interpretation (something mental) to lend them meaning, and upon which we might place different interpretations. There is intelligence, consciousness, and meaning in action itself.

This perspective reorients our understanding of the essence of human intelligence from the model of a rational calculator standing opposite the world to the model of a skilled agent acting within the world. But this vision is not yet complete. The scientific ideology depends upon representational conceptions of perception and language, which leave it open to its adherents to argue that skill may serve a necessary role in acquiring, confirming, and employing knowledge, but knowledge is still essentially cognitive representation. After all, it is argued, knowledge begins in perceptual representations of the surface features of the world and ends in theoretical representations of the deep structures of reality. In order to get beyond this vision, it is necessary to develop non-representational views of perception and language. This will be the task of the next two chapters.

4.

PERCEPTION AND OBSERVATION

> Now I a fourfold vision see,
> And a fourfold vision is given to me;
> 'Tis fourfold in my supreme delight
> And threefold in soft Beulah's night
> And twofold Always. May God us keep
> From Single vision and Newton's sleep!
>
> --William Blake

While we may not consider rules in the performance of skilled practices, we certainly consider the situation. Intelligent action is based on both our know-how and what we believe or perceive to be the case. In the previous chapter the point was made that acquiring skill in a practice involved not only learning rules and how to act, but also learning to perceive the features of the situation relevant to the practice. In this chapter I will examine in more detail what is involved in learning to perceive. The general features revealed in an examination of ordinary visual perception will be extended to an account of what is involved in scientific observation.

Empiricism, which encompasses a major strain of the scientific ideology, has traditionally taken direct perceptual experience as the foundation upon which scientific knowledge (knowledge-that) is based. There is something very right about the empiricist doctrine: knowledge of the world is knowledge of what is the case, and our primary access to what is the case is what we experience.

Because empiricists generally build their theories around materialist presuppositions, they consider experience to rest on physiological sensation. Early in this century, logical empiricists attempted to develop an epistemology in which knowledge was construed to consist in propositional truths rationally founded upon a basis of sense-data. This may be seen as an attempt to bridge the epistemic gap between knower and the world which I described in chapter two as an inherent feature of the scientific ideology. Sensory experience was supposed to provide the link between the "external" world and theoretical representations of it. Logical empiricism required that a sharp distinction be drawn between observation and theory: only in this way could observation provide a pure foundation for theories.

N. R. Hanson dealt such accounts a serious blow in his 1958 work, Patterns of Discovery. The first step of his argument is to point out a gap between the sensory field and what is visually experienced. He uses a number of examples to show that identical sensory stimuli can be seen differently. Two microbiologists viewing a prepared slide see different things: one sees a cell containing a cluster of foreign matter which is an artefact of the staining process; the other sees a Golgi body. On viewing an amoeba, one sees a one-celled animal, the other a non-celled animal. Tycho Brahe saw the sun moving, Kepler saw the sun fixed and the earth moving. To say that they "see the same thing . . . just because their eyes are similarly affected is an elementary mistake. There is a difference between a physical state and a visual experience."[1]

Hanson further argues that it is a mistake to say that two observers see the same thing but interpret it differently. If there be such interpretation, it must be both silent and virtually instantaneous, because we are not aware of any such process, nor does there seem to be time for it to occur. Conscious experience occurs at the point of what is seen, which may be different for different observers, or for the same observer at different times, while the sensory stimulation remains the same. In order for interpretation to occur, the object must already be seen as

[1] Norwood R. Hanson, Pa ns of Discovery (1958; reprint, Cambridge: Cambridge University Press, 1985), 8.

something which can be interpreted; but we are not aware of two things, the uninterpreted sensation and the interpreted object. We see only the one thing, and we see it as something.

Hanson uses the line drawing of an open cube to illustrate his point: it may be seen as a box viewed from below or from above; we see it either as one or the other, and it snaps from one to the other without conscious awareness of any interpretive process. To resort to a concept of interpretation to account for the difference, Hanson argues, is to misuse the term "interpretation." "Instantaneous interpretation hails from the Limbo that produced unsensed sensibilia, unconscious inference, incorrigible statements, negative facts and *Objectiv*. These are ideas which philosophers force on the world to preserve some pet epistemological or metaphysical theory."[2]

Hanson's arguments suggest that the bare physiological processes involved in sensation are not sufficient to account for the seeing that is the foundation of knowledge: seeing is a conscious experience which is organized in some meaningful way. Something more than sensory stimuli is required to account for the meaning-structure in experience.

The organizing influence, Hanson argues, is the background knowledge the perceiver brings to the situation. A child and a physicist do not see the same thing when they look at an X-ray tube; but after attending university and learning some physics, the grown child sees an X-ray tube.[3] He has gained knowledge which organizes his experience in a new way. A famous example from Pierre Duhem brings out the role of background knowledge:

> Enter a laboratory; approach the table crowded with an assortment of apparatus, an electric cell, silk-covered copper wire, small cups of mercury, a mirror mounted on an iron bar; the experimenter is inserting into small openings the metal ends of

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[2] Ibid., 10.
[3] Ibid., 15-16.

> ebony-headed pins; the iron oscillates, and the mirror attached to it throws a luminous band upon a celluloid scale; the forward-backward motion of this spot enables the physicist to observe the minute oscillations of the iron bar. But ask him what he is doing. Will he answer, 'I am studying the oscillations of an iron bar which carries a mirror'? No, he will say that he is measuring the electrical resistance of the spools. If you are astonished, if you ask him what his words mean, what relation they have with the phenomena he has been observing and which you have noted at the same time as he, he will answer that your question requires a long explanation and that you should take a course in electricity.[4]

Hanson described the background knowledge which organizes experience as theory: "There is a sense, then, in which seeing is a 'theory-laden' undertaking. Observation of *x* is shaped by prior knowledge of *x*."[5]

The concept that observation is theory-laden presented serious difficulties for the logical empiricist program, because it undercut the basic distinction between the observational foundation and theoretical superstructure. The possibility that there is no theory-free observational foundation for scientific knowledge introduced the fear of relativism. Without such a foundation, the link to the world is cut: theories cannot be tested against reality, but only against other theory-mediated perceptions. With a sufficiently large change in background theory, every observation may change its meaning; we might be caught forever within a web of theoretical representations with no foundation in reality. Instead of science progressing towards truth about reality, it may be just one damned theory overtaking another for extra-epistemological reasons. This is how many interpreted Kuhn's account of scientific revolutions, and it has been taken up by some sociologists of science of a relativist bent who emphasise the influence of social structures on theory-selection.

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[4] Ibid., 16-17.
[5] Ibid., 19.

On the other side, there has been--and still is--a great deal of philosophical ink being spilled in an effort to show how a science based on theory-laden observations can still be progressive, rational, and convergent upon truth. One line of argument is to show that while there is no absolute distinction between theoretical and observational terms or acts, there is a pragmatic distinction: observations can be more or less theoretical, or founded upon more or less "entrenched" background theory. Another line is to argue for extra-empirical, rational grounds for theory-choice--simplicity, conciliance, explanatory power, etc.--that constrain theory-choice. To a considerable extent, these debates encompass the sphere of contemporary philosophy of science. Whenever there is this much noise and confusion and disagreement, one may suspect that something has gone fundamentally wrong.

A clue to the root of the problem is given when Hanson declares that "vision is essentially pictorial," while "knowledge is fundamentally linguistic."[6] This is an unambiguous declaration of adherence to a dual aspect of the scientific ideology: perception is conceived in representational terms, and knowledge in propositional terms. Following the later Wittgenstein, Hanson saw a gap between pictures and propositions. In order to bridge the gap, he sought a framework by which experience is structured in a form amenable to propositional expression. Hanson's concept of "seeing" provides this bridge between vision and knowledge. He recognized the organizing role of context and background knowledge that the observer brings to the perceptual situation, and expressed it as *theory*; that is, in terms of propositional or theoretical knowledge.

Hanson was right that perception is meaningfully structured by context and background knowledge, but he introduced enormous confusion by expressing the background

[6] Ibid., 25.

knowledge and the ensuing meaning-structure in propositional terms. In order to impinge upon our consciousness in a way that enters into knowledge, experience must be meaningfully structured in some way. (This is not to say that every *sensation* is meaningful: those that are not meaningfully structured merely exist in a background blur and buzz that retreats from attention.) The meaning-structure need not be very definite: some things appear as just big, hot, frightening, or noisy. But to say (as has Feyerabend, e.g.) that every observation is theory-loaded, is (to quote Hacking), "hardly worth debating because it is obviously false, unless one attaches a quite attenuated sense to the words, in which case the assertion is true but trivial."[7]

Animals, who are incapable of entertaining any kind of theory, or even of framing propositions, must surely have their visual experiences of the world organized in some meaningful way, or else their actions would not be coherently structured. A dog chases around and barks because its visual field is meaningfully structured as containing a rabbit, even though the dog cannot call it a rabbit or state any propositions about rabbits. To construe the epistemic background that organizes the dog's visual experience as a "theory" is to stretch the concept of theory beyond the breaking point in the interests of preserving an epistemological theory.

"Meaningfulness" is employed here differently than the usual sense of the term "meaning" within the perspective of the scientific ideology. The difference illuminates the nature of the perspective shift I am advocating. The scientific ideology generally construes "meaning" in propositional terms. To say that something is meaningful is taken to imply that there is some propositional meaning structure underlying the situation. The way things appear as meaningful for action is assumed to rest on an underlying

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[7] Hacking, Representing and Intervening, 174.

knowledge-that (usually construed propositionally) of the structure of things, from which the possibilities for action emerge via a process of cognitive ratiocination. The praxical perspective, on the other hand, takes the *meaningfulness for action* as primitive. The dog's experience is meaningfully structured as containing a rabbit, towards which it can act as potential prey or play-thing. Humans have a wider range of possible actions, which includes linguistic action: we can name things, refer to them, and talk about them, as well as chase them, point to them, grab them, and eat them. The cognitive structure of a situation depends upon the range of practices agents bring to it. Linguistic meaning is subordinate to meaningfulness for action.

This perspective is supported by scientific research into the psychology of perception.

It has been known for some time that a person born blind due to cataracts or some other surgically correctable pathology of the eyes does not suddenly begin to see when the situation is corrected later in life. The experience is not like the sudden switching on of a light in a dark room; a long, difficult, and often unsuccessful learning process is required before the person learns to see. The visual sensations are differentiated, but they do not immediately make sense. With extensive practice handling objects and feeling their way about while attending to the scene with their eyes some subjects learn to make sense of the visual field, but often they prefer to find their way about with their eyes shut.[8]

These examples show that it is necessary to *learn* to see even the most basic objects, and this learning involves

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[8] See M. Von Senden, Space and Sight: The Perception of Space and Shape in the Congenitally Blind Before and After Operation, trans. by Peter Heath (London: Methuen and Co. Ltd., 1960); this is a translation of Raum-und Gestaltauffassung bei Operierten Blindgeborenen (Leipzig: J. A. Barth, 1930).

something more than "background theory." Congenitally blind persons who are given vision later in life have a great deal of knowledge of the objects in their environment prior to their eye surgery, even though they have never seen them. They are able to interact quite well with normally sighted persons, but their background knowledge is not sufficient to structure their visual field in a meaningful way. They still have to learn to see.[9]

What is involved in learning to see is further revealed in a famous study on the development of vision performed by Hein and Held. They raised two groups of kittens in complete darkness except for a few hours a day, during which time they were harnessed in pairs in a special apparatus which permitted one kitten to move about actively while the other was passively carried in tandem in a basket. The chamber and apparatus were constructed symmetrically so that each kitten had a virtually identical visual stimulus, the only difference being that one was able to move while the other remained passive. After a few weeks the kittens were released into a normal environment, and it was found that members of the group that were allowed to move about actively in the chamber behaved normally, while members of the group that had only passive visual stimuli behaved as if blind: they walked into walls, stumbled on objects, and fell over precipices. There was nothing physiologically wrong with this second group; the only difference was that they had not been permitted to act within the environment they visually experienced. The conclusion drawn by the researchers was that visual stimulus alone is not sufficient

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[9] Recent studies show that the formation of brain structures necessary for perception requires visual stimulus at an early age: the growing organism must learn to see. See Carla J. Shatz, "The Developing Brain," Scientific American, September 1992, 61-67. That this learning involves the formation of physiological and not only cognitive structures is of no consequence here; the point is that "seeing" must be learned, and it is immaterial to my argument whether this learning is physiological or psychological.

for developing vision: the perceiver must learn to see in the context of acting in the situation.[10]

A further experiment underscores the way that learning to perceive in the context of action meaningfully structures the field of perception. Paul Bach y Rita developed a number of experimental visual aids for the blind consisting of a video camera connected to an array of skin-stimulating electrodes strapped to the abdomen. The experimental subjects were people who had lost their vision in childhood; they had once learned to see but lost the ability due to physical damage to their eyes or optic nerves. Upon first donning the apparatus the subjects experienced what one would expect: a changing but largely meaningless pattern of abdominal tinglings, among which they could eventually learn to discriminate shapes and objects with some concentration and effort. But when the video camera was mounted on eye-glass frames and the subjects were able to move about and interact with their environment while wearing the apparatus, a dramatic change in the quality of their experiences came about. They no longer experienced the sensations as patterned irritations on the skin, but as objects situated out in the space where they were encountered. They began to "see" objects "in the world," much as sighted persons see them. This quality of experience did not come about when the camera was mounted on a stationary tripod which did not permit it to become part of the agents' means of interacting with the environment.[11]

The spatial orientation of objects "out in the world," "ahead," is difficult to conceive in terms other than as how they are meaningfully situated for action. The space in front is where objects are encountered when acting in the

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[10] Reported in Richard Held, "Plasticity in Sensory-Motor Systems," Scientific American, November 1965, 84-94.

[11] Paul Bach y Rita, Brain Mechanisms in Sensory Substitution (New York: Academic Press, 1972), and elsewhere; these experiments are briefly described in Robert B. Livingstone, Sensory Processing, Perception, and Behaviour (New York: Raven Press, 1978), 35-7.

world: there they are grasped, bumped into, or avoided. That the perceived spatial situation of objects is something learned in action is further illustrated by the experiences reported in experiments with inverting spectacles. Initially, the world appears inverted. The subject is disoriented, reaching or turning the wrong way and stumbling into things. After a period, however, the subject's visual experience becomes re-organized: up, down, left, and right in the visual field emerge again endowed with the correct meanings for action.[12] Were the agent not to act in the world presented to experience, direction and spatiality would have no experiential meaning.

Non-computational theories of perception that make sense of the experiences described above have been developed--independently and in very different forms, but with some common influence from Gestalt theory--by Maurice Merleau-Ponty and James J. Gibson.[13] I will not discuss the details of their theories here because my aim is not to develop a theory of perception, but merely to point out the essential role of action in rendering perceptual experience meaningful. Gibson and Merleau-Ponty both argue strongly against passive "spectator" theories of perception, whether physiological/empiricist or intellectualist/rationalist, on the grounds that no process of reasoning or computation on sensory stimuli can result in meaningful experience. It is necessary to include in any account of perception as it is consciously experienced the active agent for whom the experience is meaningful. In their accounts, as in the empirical results described above, agents learn to perceive

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[12] See Hubert Dolezal, Living in a World Transformed: Perception and Performative Adaptation to Visual Distortion (New York: Academic Press, 1982).

[13] Maurice Merleau-Ponty, Phenomenology of Perception, and The Structure of Behaviour, trans. Alden L. Fisher (Boston: Beacon Press, 1963); James J. Gibson, The Senses Considered as Perceptual Systems (Boston: Houghton Mifflin, 1966), and The Ecological Approach to Visual Perception (Boston: Houghton Mifflin, 1979).

the kinds of entities, events, and structures in their environments which are meaningful for the kinds of actions they have learned to perform.

However, their accounts (especially Gibson's) largely limit experience to the perception of "medium-sized dry goods": objects that persons encounter in physical, bodily interaction with the world. As a consequence, these theorists focus attention on the contribution of bodily action to experience. This bodily focus is correct as far as it goes, but it only accommodates a rather limited range of experience. "Affordances," to use Gibson's term for the meaning of experiences for bodily action, encompass the range of experiential meaning we share with animals, and is probably surpassed in human experience early in childhood. Our range of interaction with the world encompasses practices well beyond the animal nature given by our physiological constitution; and our experience includes meaningful structures of a cognitive sort that go well beyond, and are not reducible to, the visual perception of material objects and spatio-temporal relations and events.

This point may be illustrated by considering how we experience someone's behaviour as a faux pas. Most of us would not need to consult rules of etiquette to conclude that the person seen drinking wine directly from the bottle at the cocktail party was behaving inappropriately. The inappropriate behaviour is immediately perceived as such by someone with the requisite social skills. In a foreign environment where the social practices are unfamiliar, one may commit untold faux pas with no consciousness whatever of the fact. In order to see a faux pas, one must have skill in the social practices of the culture. These practices may be articulated in rules, but usually they aren't. Where they are articulated, the rules do not dictate practice; they are abstracted from existing practices. Members of the culture typically learn the practices directly by example rather than by learning the rules which articulate the practices.

The perception of a faux pas is not a direct visual experience, but neither is it a theory-laden cognitive interpretation of a visual experience. It is an experience that is meaningfully structured and rendered recognizable by virtue of skill in the social practices--ways of acting and behaving--of the group.

The point to be drawn from the above discussion is that experience is not theory-laden, but practice-laden. The background knowledge that gives experience some meaningful structure is not static knowledge-that, but know-how. This perspective subtly realigns the concept of seeing. In Hanson's concept of "seeing," as in most modern theories, perception is construed as a contemplative act. Despite the constituting role of the subject, perception appears to be primarily for passive intellectual contemplation.

As I argued in the second chapter, such passive contemplation and intellectual reasoning upon what is presented for contemplation have been given the highest epistemological status in the tradition of the scientific ideology since Plato. But the further one presses such accounts, the more remote from the world the conscious subject of such contemplation becomes. Kepler, one of the first to develop a modern theory of perception, studied the optics of vision but simply abjured discussion or speculation of how conscious experience comes about.[14] In Descartes' account, the subject retreats from the world altogether into an alternate realm of the mental which is somehow mysteriously connected to the material world via the pineal gland. In such accounts the conscious subject appears to be like a pilot who watches representations of the

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[14] Stephen Straker, "The Eye Made 'Other': Dürer, Kepler, and the Mechanisation of Light and Vision," in Science, Technology, and Culture in Historical Perspective, ed. Louis A. Knafla, Martin S. Staum, and T. H. E. Travers, University of Calgary Studies in History No. 1 (Calgary: University of Calgary, 1976), 7-24.

surroundings on a radar screen and other instruments and flies the airplane by manipulating controls.

Even this "ghost in the machine" (to use Ryle's apt phrase) becomes superfluous when the materialist presupposition implicit in the scientific ideology is pressed consistently. One could imagine a computer system that is able to "recognize" objects in the environment on the basis of inputs from a video camera. Although this has proven very difficult in practice, it does not seem to be impossible in principle. Dreyfus argues that it may be impossible using linear algorithmic computers, but he does not rule out "holographic" recognition devices, which may be electronically instantiable.[15] But the "recognition" instantiated by such machines would involve something like printing out "teapot" or "tarantula" depending upon whether it was a teapot or a tarantula in the camera's optical field, or perhaps initiating some other process depending upon what is "recognized." Such a device could also calculate on the basis of what is "recognized"; it could reason in the ratiocinative sense. But it does not seem that such devices would be conscious. In fact, one cannot imagine that they would "see" in any normal sense of the term.

On the other hand, it is difficult to imagine *acting* intelligently in a situation where one is not consciously aware. A person sitting in passive contemplation takes little note of the passing scene, but on becoming actively involved a wealth of intricate detail becomes apparent. Attention becomes focussed on the points where choice is necessary or possible; things emerge into consciousness for deliberation in terms of the possibilities and necessities for acting. It is not necessary to be actually acting in a situation in order to be aware of it, although action tends to focus attention. But know-how or skill for potentially acting brings forth details otherwise unnoticed. The rock

[15] Some artificial intelligence researchers are currently investigating this possibility with so-called "connection machines."

climber sees details in the rock face that one unskilled in the art simply does not notice; the skilled gardener sees much more in the back yard than the flowers and bugs that I see. Conscious awareness seems more intimately involved with action or potential action--skill and know-how--than with contemplation or knowledge-that.

The intimate relation of consciousness and knowledge with action is apparent in the case of "blindsight." Blindsight occurs in rare cases involving damage to certain regions of the brain while the eyes and optical nerves remain intact. Persons with this condition declare that they are blind, but when forced to guess what is before them they can correctly discriminate a wide variety of visual stimuli, and they are able to respond to visual stimuli with reflex actions. They can often, for instance, catch a ball thrown at them or duck at the appropriate moment. Yet they are not aware of what they "see," and they grope about as if completely blind. They cannot voluntarily act with intelligent awareness of the situation, even though they can sometimes involuntarily react. They cannot form projects or plan their actions on the basis of what they "see." And because they are not consciously aware, they gain no knowledge from their vision.[16]

Contemplative theories of perception and knowledge tend to be construed in terms of representation. Descartes postulated "mind" as the contemplator of representations of the "external" world impressed upon structures in the brain; modern cognitive scientists theorize about systems that represent the situation in computational terms. But the view of perception sketched here, where experience is organized as meaningful-for-action in the context of know-how, may be more perspicuously conceived as presentational than representational. Rather than a passive consciousness

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[16] See Semir Zeki, "The Visual Image in Mind and Brain," Scientific American, September 1992, 69-76; blindsight is discussed on pages 73-4.

viewing a mental representation of the external scene, the world is presented in consciousness in the context of active agency. The awareness is not a reflection of external reality, but the emergence of meaning for action to one who has skills and know-how that give choices for acting in a concrete situation. Once the world is presented to consciousness, the agent may act in it with conscious deliberation in a variety of ways. One of them may be to re-present the scene: using words or pictures to re-invoke in others, or in oneself at a later time, the same or similar experiences. Representations are something we make, and representing is one of the characteristic activities of humans.[17] From the praxical perspective it is a mistake to characterise perception as representation; and it is also a mistake to so characterise knowledge, belief, and linguistic meaning. The view that language and theoretical representations are skilled practices or modes of acting in the world will be developed further in the next chapter; but before addressing those issues I will apply the concept developed above--that seeing is practice-laden--to the issue of scientific observation.

Construing the background that organizes experience as know-how rather than theory allays the fear of relativism in science to some extent, because know-how is not a matter of mere intellectual commitment in the way theories are. If all observation were theory-laden, a sufficiently deep change in theoretical commitments could result in a complete change in how things are seen: everything could appear differently by an act of intellectual choice. But practices cannot be as easily changed as beliefs, because they depend upon what we can do in the world. Once we have discovered and developed a practice that reliably achieves its end, it will continue to work no matter what beliefs we hold.

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[17] A point made by Hacking in Representing and Intervening, 130-39.

Although relativist fears may be somewhat allayed by this perspective, knowledge is not grounded in the way empiricists have hoped. They have sought a privileged level of observation to provide a foundation for knowledge-that; from the praxical perspective knowledge is grounded in skilled practices, or what the observer as an agent knows how to do. This provides a very different image of the role of experiment and observation in science than is customary in the positivist tradition. With its emphasis on knowledge-that and focus on theories, the dominant philosophical tradition of this century has largely ignored experiment, or treated it merely as a source of low-level observations and facts with which to construct or test theories.

In the praxical perspective, scientific research is primarily the development of practices or ways of acting in the world. As Hacking notes, "Often the experimental task, and the test of ingenuity or even greatness, is less to observe and report, than to get some bit of equipment to exhibit phenomena in a reliable way."[18] Within the context of the developing practices of experimental research, phenomena (objects, structures, relations, etc.) emerge into awareness and are subsequently articulated in theory. "Observation" in science, then, is not all bare instrument-reading or "direct perception" of what is apparent to anyone with eyes to see, but the perception of meaningful structures in the context of developing practices. Such perception requires skill in the relevant practices (this may include theoretical skills); and it may include the perception of highly "theoretical" structures.

These points are illustrated by some facts about scientific observation noted by Ian Hacking. Arguing against the thesis that all observation is theory-laden, Hacking points out that noteworthy observations are often made prior to any relevant theory, or in the absence of any adequate

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[18] Ibid., 167.

theory, or by an observer who lacks the requisite theoretical knowledge. Grimaldi and Hooke observed that there is some illumination in the shadow of an opaque body; careful examination revealed regularly spaced bands at the shadow's edges. Newton observed the dispersion of light, and Hooke and Newton observed coloured bands in thin transparent sheets. All these observations were made without the benefit of any theory of the phenomena.[19]

What is observed in these examples, however, often would not have come to attention were it not for the fact that the researchers were interested in a certain range of phenomena and worked closely with the materials and conditions where these phenomena were apparent. Optical researchers collected lenses and prisms, constructed pin-hole blinds, and experimented with casting shadows, reflecting surfaces, and refracting materials. In the context of these developing practices, the phenomena emerged as significant. While most of these phenomena had no doubt previously been seen, they only emerged as a focus of attention (and as something meaningful for action) within the constellation of the developing practices of optics. And they were noticed there prior to any adequate optical theory.

The phenomena observed in the above examples could have been (and probably were, at least occasionally) seen by anyone with normal perceptual capacities, but were not noticed as something significant until the practices of optical science emerged and people expended effort to develop skills in those practices. That scientifically meaningful observation requires skill in a practice (and not necessarily theoretical understanding) is underscored by two further examples from Hacking. "In England," Hacking writes, "it is still not too uncommon to find in a lab a youngish technician, with no formal education past 16 or 17, who is

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[19] Ibid., 156.

not only extraordinarily skilful with the apparatus, but also quickest at noting an oddity on for example the photographic plates he has prepared from the electron microscope."[20] These technicians, presumably, have little theoretical understanding of the phenomena with which they are working; but they possess the skill, gained from long and intimate experience, to perceive whether the apparatus is working correctly, and to distinguish between familiar, faulty, and interesting phenomena.

Hacking also uses the example of the astronomer Caroline Herschel who, he says, probably discovered more comets than anyone else in history. She achieved this by scanning the sky every cloudless night with an apparatus that allowed her to cover the entire sky without missing any part, and following up any interesting "naked-eye" observations with the aid of a telescope. But what particularly enabled her to discover so many comets (eight in one year) was that she could "recognize a comet at once . . . just by looking."[21] She of course had deep theoretical understanding of astronomy, but unlike other astronomers she did not have to compare photographic plates and calculate trajectories over a period of days to conclude that some spot of light in the sky was a comet. Her intimate familiarity with the night sky and observational skill gained from experience enabled her to recognize comets without any conscious application of astronomical theory.

Optical phenomena and comets are the sort of things that anyone might be able to see once they were pointed out. But just as the earlier example of perceiving a faux pas illustrated that everyday perception is not limited to material objects and relations but includes structures which are only meaningful for quite abstract social practices, so scientific observation includes the perception of phenomena

[20] Ibid., 179.
[21] Ibid., 180.

meaningful only in the context of highly developed scientific practices. This is contrary to the traditional empiricist conception of observation. Neo-empiricists such as van Fraassen wish to limit "observation" to things anyone could see with the naked eye, thereby providing a firm epistemic foundation upon which scientific knowledge may be theoretically constructed.[22] But scientists do not honour this distinction: they speak of observing the interior of the sun, or observing sub-atomic particles and their interactions.[23] Not only can such things not be seen without the aid of huge amounts of complex equipment, they are not the sort of things that ever could be seen except in the context of the equipment and practices within which they are manifested. They are highly theoretical phenomena, in that they only have meaning in the context of advanced theoretical understanding. Hacking calls the observation of such phenomena "massively theory-loaded observations."[24]

I wish to argue that we ought to conceive these cases too as practice-laden rather than theory-laden. The entities, events, and law-like structures observed in scientific research are the things experienced (by scientists with the relevant skills) as meaningful for the instrumental practices of materialist science. "Theoretical entities" are not rationally constructed from a base of pre-theoretical observations and invented theoretical commitments, but are rather the entities directly encountered through scientific practice. Similarly, law-like and causal relations are not, contrary to David Hume and his positivistic followers, constructed by cognitive inference from discrete cases represented in the mind of the knower, but are perceived as whole relations meaningful for the practices developed by researchers.

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[22] Van Fraassen, The Scientific Image (Oxford: Clarendon Press, 1980), passim.
[23] Hacking, Representing and Intervening, 182.
[24] Ibid., 183.

By arguing that scientific observation is practice-laden rather than theory-laden, I do not intend to deny a role for theory. My aim is not to contrast theory with practice, but to reconceive how theory is situated within practice. Theory does not stand opposite practice, as something that gives it meaning, but is part of scientific practice; a way of enacting scientific know-how. From this perspective scientific observation of theoretical entities is not different in principle from ordinary perception; the only significant difference is in the kind and extent of underlying practices that structures the experience. In order to develop this further, it will be necessary to examine language from the praxical perspective and show how theory is situated within practice. This will be the aim of the next chapter.

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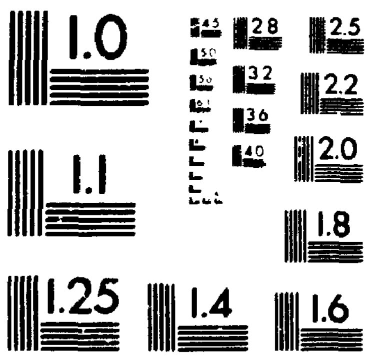

5.

LINGUISTIC AND THEORETICAL ISSUES

> Words are also actions, and actions are a kind of words.
> Emerson, "The Poet"

> Words, Caravaggio. They have a power.
> Michael Ondaatje, The English Patient

There is a particular view of language intimately related to the scientific ideology. The scientific ideology sees facts (rather than skills) as epistemically central; and facts are commonly expressed in sentences. Knowledge, understanding, and reasoning are then modeled upon language conceived primarily as a bearer of facts. Reasoning and thinking are thought of as a kind of internal conversation; belief and knowledge as sets of sentences held to be true. The highest form of knowledge is thought to consist in the propositions expressed by well-confirmed scientific theories, and the epistemic warrant for these theories is modeled upon the sentential arguments advanced to support them.

By conceiving language as primarily a bearer of facts, the scientific ideology's great dichotomy between the knower and the world known is recreated in theories of language. Language is conceived as an existent system of signs standing for objects and relations in the world, which language-users employ to express their thoughts and to represent facts about the world. Thus language is constituted as an object for theoretical investigation: a thing which can be better understood by illucidating its formal structure and relations to the objects signified. This perspective puts a particular cast on the concepts of meaning, reference, and truth: meanings tend to be seen as objects attaching to words (residing in minds, propositional space, or some other realm of metaphysical invention); reference as a relation between signs and objects signified, and truth as correspondence between statements and states of affairs, or, if establishing such a correspondence is despaired of, as some form of maximal logical coherence among statements.

From the perspective of the scientific ideology, the ability to use language appears to depend upon knowledge of the structure of the sign-system. The speaker or writer is seen as a manipulator of signs who encodes private thoughts and desires in words and sends them forth to be decoded by others. This perspective results in a particular view of what is required of a theory of language. As one philosopher has recently written,

> The principal task of a theory of language is to state the knowledge that speakers have in virtue of which they are able to understand their language. Following [Donald] Davidson . . . we might put the matter more precisely as follows: for any language L, an adequate linguistic theory of L will provide us with a statement T such that a person understands L just in case he *knows that T*.[1]

The bias of the scientific ideology is clear in the above quote. It is presumed that linguistic know-how, which is essentially a skilled practice, can only be understood in terms of the language-user's knowledge-that. In at least some places Davidson is careful to point out the difference between a theory which is a model of a language-user's linguistic competence and the actual mechanisms which underlie successful language use in practice:

> Claims about what would constitute a satisfactory theory are not . . . claims about the propositional knowledge of an interpreter, nor are they claims about the details of the inner workings of some part of the brain. They are

[1] Robert J. Mathews, "Learnability of Semantic Theory," in Truth and Interpretation: Perspectives on the Philosophy of Donald Davidson, ed. E. LePore (Oxford: Basil Blackwell, 1986), 53; my emphasis.

> rather claims about what must be said to give a satisfactory description of the competence of the interpreter. We cannot describe what an interpreter can do except by appeal to a recursive theory of a certain sort. It does not add anything to this thesis to say that if the theory does correctly describe the competence of an interpreter, some mechanism in the interpreter must correspond to the theory.[2]

The distinction between the theory and the mechanism of language-competence is important because the presumption that a language-user's understanding of a language L rests upon knowledge of a theory T leads to regresses of the sort pointed out by Ryle and Wittgenstein which I rehearsed in an earlier chapter. The theory T must presumably be expressed in some language L', which would require a theory T' for understanding, and so forth. Unfortunately, Davidson doesn't always make the distinction clear, and often phrases things in a way that suggests that speakers do instantiate some such theory.

Even if the regress is avoided by distinguishing between the theory and the mechanism of language-competence, the approach of Davidson and other language-theorists of his ilk retains a kind of regress, reflected in the assertion that it is *only* by developing a recursive theory T of language L that we can describe what a language-user can do. From this perspective, an account of how a language L works must be expressed in the form of a set of rules in a metalanguage L' (which may be the same language). These rules would, for instance, specify the referents and truth-conditions of terms in L, and give a compositional account of truth for sentences. But as long as our theory only steps back to a metalanguage, we remain within the circle of language. Such theories may explain how *a* language works, assuming we have a language in which to express and understand the theory; but they do not explain how *language* works. The general ability to use and understand signs is

[2] Donald Davidson, "A Nice Derangement of Epitaphs," in Truth and Interpretation, ed. E. LePore, 439.

presupposed, and must be presupposed as long as it is presumed that languages are self-sufficient sign-systems standing opposite the world.

In "A Nice Derangement of Epitaphs" Davidson comes to the conclusion that this conception must be given up. He bases his arguments on an examination of malapropisms and other examples that suggest hat actual language use is too variable and heterogeneous to be encompassed in a theory. He concludes that "there is no such thing as a language, not if a language is anything like what many philosophers and linguists have supposed . . . We must give up the idea of a clearly defined shared structure which language-users acquire and then apply to cases."[3]

I do not intend in this chapter either to contribute to the project of developing a theory of language in the sense defined by Mathews, or to argue that such a theory is an impossible or unreasonable goal. I believe that the variability of language makes such a project extremely difficult if not impossible to complete, but the extent to which it may be possible is an empirical question. Nor do I intend to imply that the project is worthless. There is some practical justification for it: for instance, it may be necessary to take this approach to develop computer systems for parsing or translating natural languages. What I intend is rather a shift of perspective, from the theoretical perspective of the scientific ideology which views language as an object to be understood by theoretical explication, to a praxical perspective which views language as a system of practices embedded within our wider practices for living in the world. The aim is not to explicate the structure of language, but to give an account of how language works.

This perspective, which is derived largely from my reading of Wittgenstein's Philosophical Investigations, may be introduced by the fairly obvious observation that nothing

[3] Ibid., 446.

is a sign (in the linguistic sense, as opposed to natural signs such as spoor) except that it is used as a sign. The system of signs which makes up a language are signs only because they are used as signs; the meaning of words is their use in practice. The point of adopting this perspective is to bring out some features that are largely invisible when language is treated as a system of signs, but become apparent when language is viewed as practice. What follows is not so much a theory of language as a set of reminders about some familiar things that language-users are doing and taking account of in actual employment of language.

From the praxical perspective linguistic ability does not rest on knowing a set of facts about language, but in having skill in a set of common practices for interpersonal action in the world. The child learning a first language learns how to respond appropriately to words and sentences, and also learns how to use language to elicit desired responses in others. This approach takes account of the continuity of language with more primitive means of interpersonal communication such as the infant's cry and the parent's guiding hand, and also takes account of how language is embedded in learned practices for dealing with the world. The child learns to draw her mother's attention not only by crying but also by saying "mama"; she learns to stop when she hears "no" as well as when a firm hand interrupts her action; she learns to differentiate cows from horses and to use the correct words to mark the distinction.

It is easiest to see language as a set of learned practices in the case of single-word commands, like those of the primitive language-games Wittgenstein describes at the beginning of Philosophical Investigations. He describes a language consisting of words for block, pillar, slab, and beam; when the builder (A) wants a block, he calls out "block," and the assistant (B) brings the appropriate object. All that is necessary for such a language to work is that A and B have learned the practices associated with these words: A has learned that when he wants a block, he must call out "block"; B has learned that when he hears "block," he is to bring a block; and so forth for all the words of the language.[4]

Of course real languages are much more complex than this. Not all of language can be conceived as a set of commands. Neither, as Wittgenstein argues, can it be conceived as a set of names for objects and statements of fact. However, all of language may be conceived as a system of practices for responding and eliciting responses, if one recognizes the range and complexity of ways of acting of which we are capable. Wittgenstein uses the term language-game to "bring into prominence the fact that the *speaking* of language is part of an activity, or a form of life."[5] The uses of language, therefore, can be as various as the range of human activities.

Wittgenstein gives a number of examples of different kinds of activities which can be performed with the use language:

> Giving orders, and obeying them--
> Describing the appearance of an object, or giving its measurements--
> Constructing an object from a description (a drawing)--
> Reporting an event--
> Speculating about an event--
> Forming and testing a hypothesis--
> Presenting the results of an experiment in tables and diagrams--
> Making up a story; and reading it--
> Play-acting--
> Singing catches--
> Guessing riddles--
> Making a joke; telling it--
> Solving a problem in practical arithmetic--

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[4] Ludwig Wittgenstein, Philosophical Investigations, trans. G. E. M. Anscombe. 3rd ed. (1967; reprint, Oxford: Basil Blackwell, 1984), sec. 2, p. 3.

[5] Ibid., sec. 23, p. 11.

Translating from one language into another--
Asking, thanking, cursing, greeting, praying.[6]

When I utter a statement, I am performing an action: I am attempting to alter my audience's epistemic state. When I heed and understand a statement, I am also performing an action: I am altering my epistemic state in conformity with what I suppose is the speaker's intent. Similarly for the other uses of language: a question is an attempt to elicit an informative response; a story is an attempt to elicit an imaginative state in the audience; a command is an attempt to elicit an action; and so forth. We are able to do this because as listeners we have learned how to act appropriately in response to the words of our language in their various contexts and combinations, and as speakers we have learned how to use language to elicit the sorts of responses we want.[7]

Languages are obviously very complex practices. It takes mentally competent humans years to master their first language, and our nearest simian relatives are only able to master a small part of language, if any. Language is not learned by learning a set of rules, nor is it used by consulting rules, any more than rules are involved in learning or performing the skill of keeping a bicycle upright while riding. Pointing may be employed in teaching a language, but as Wittgenstein argued such "ostensive definitions" cannot be seen as a set of rules, because we must also learn how to understand what is being pointed to. Nor can ostensive definition account for all of language

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[6] Ibid., sec. 23, pp. 11-12.

[7] Roy Harris, in The Language-Makers (London: Duckworth, 1980), calls the perspective on language described here *instrumentalism*, and the view which dominates the scientific ideology *surrogationalism*. As Harris points out (89-92), the instrumentalist or praxical perspective is not to be identified with speech-act theory. Speech-act theorists recognized the performance of an action as the function of only a certain class of utterances, not as the basic way of understanding how language works. J. L. Austin and other speech-act theorists based their accounts of the instrumental function of language upon a surrogationalist foundation.

learning, because many words--such as articles and prepositions--do not correspond to anything that can be pointed out.[8] Linguistic skill is learned by learning how words are used and how they are combined in order to carry out interpersonal actions. A second language may be initially learned by learning a set of rules for translation and grammar, but such rules quickly become so cumbersome that they must be transcended. To achieve any reasonable level of competence the language learner must learn how to use the language directly without the clumsy intermediary of rules.

To say that language is a system of practices involving learning the correct response to words must not be taken to imply that a behaviourist account is intended (as Wittgenstein has sometimes been interpreted). Overt behaviours may be the only evidence we have that an expression has been understood, but the overt actions do not constitute the meaning or understanding of language. In many cases the appropriate response is not describable in physical terms, but consists in a purely mental action such as framing an image or altering one's epistemic state. As well, language use and understanding are learned skills: actions, not conditioned responses. There may well be an element of conditioning involved; this could explain the power of language to move which is employed by orators and story-tellers, and may provide a partial explanation of hypnotism. But we generally have a choice in how we react to words. A charitable listener or reader will strive to respond in the intended way, and will pose questions and offer suggestions to check if he or she is responding correctly. An argumentative or obstreperous person will deliberately choose to respond in a way contrary to the one intended, to trip up and confuse the speaker and claim confusion. Words generally do not have a single correct kind

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[8] Wittgenstein, Philosophical Investigations, sec. 9, pp. 5-6.

of response, but a range connected by what Wittgenstein aptly described as "family resemblance," and a deep dependence upon the context of use. The listener and speaker both know the range of uses, and strive to frame their actions appropriately to the context within that range. This requires more than learned behavioural responses: it requires intelligence and skill, and sometimes invention and innovation.

In order for language to be possible as a means of communication, there must be some regularity and order in the system of linguistic practices: people must use the same words in the same way in similar circumstances, and maintain the similarity of use over time. Also, there must be some regularity in indicating the function of words and how they are being used--such as indicators of tense, number, and grammatical case--or the language would be too cumbersome to learn. Given a system of linguistic practices, one could abstract from it a set of descriptive rules: a syntax and semantics for the language. However, there are limits to how far such projects may be completed because languages typically change over time and different peoples may choose to use words differently. Languages can grow as human practices develop; new vocabulary may be added, or the use of words may change. People may choose to use words in unusual ways, as in poetry, metaphor, and puns, or may use words wrongly, as in spoonerisms and malapropisms. Groups as small as one or two individuals may choose to use words in special ways, as children and spies develop private codes. Scientists regularly introduce linguistic innovations to reason about and communicate newly emerging discoveries.

Philosophical theorists of language typically begin with the notion of a "language" as a pre-given structure, and attempt to elucidate such notions as meaning, reference, and truth, on this basis. The major objection I have to such approaches to understanding language is that they start at the wrong end: they presume the existence of something called "language" and attempt to explain linguistic practices and concepts on the basis of the structure of the "language." But from the praxical perspective the "language" with which they start is only an abstraction from the complex of concrete linguistic practices. Language use doesn't depend upon knowledge of linguistic structures; linguistic structures depend upon shared skills in linguistic practices.

In what follows I will sketch how the epistemologically central notions of meaning, reference, and truth, look when the linguistic stick is picked up at the other end. This changes the nature of the questions to be answered by an account of language: the question is not how words and sentences bear determinate meanings, but how speakers use words to effect their ends; not how words hook onto objects in the world, but how persons refer using words; not what makes a sentence true, but what is involved in saying something true.

MEANING

When language is thought of as a system of signs, "meanings" are frequently also hypostatised as objects that attach to words, and to sentences by syntactical composition. Wittgenstein showed how to avoid this hypostatisation with the slogan "meaning is use." This ought not to be read as "meaning is determined by usage"; to do so would retain hypostatised meanings as objects which become attached to words by conventions of usage. Rather, we should think of meanings as being identical with use: that is, the meaning of a word is the work the word does in concrete use. In order for it to be possible to use language to achieve interpersonal ends, language-users must learn the range of conventional ways of acting in response to words in their contexts of use. These conventional ways of acting in context constitute the standard uses, and hence the core meanings, of the words in the language. Understanding a language consists in knowing how to act in response to the words of the language in their common contexts of use; understanding an utterance consists in consciously knowing how to act in response to that utterance in its particular context.

Language is learned by learning how to respond (in act or thought) appropriately to words, where what is appropriate is determined by the ways the community of speakers has devised for acting in response to these words in this kind of situation. The range of ways of acting in response to words is as broad as all of the possible ways of human action; the range of ways of acting in response to an individual word is less broad; and only in a particular context of use--a sentence uttered in a concrete situation--may there be a unique way of appropriately acting in response to a sentence.

From this perspective there is no need to postulate "meanings" as entities that words "stand for." However, for some purposes one may postulate meanings as abstract entities, as "number" in mathematics is an abstraction from concrete instances of counting; and no doubt one can reason coherently and profitably about such abstractions. But it must be remembered that such meanings are abstractions from the concrete cases where language is used to effect some end. In order for communication to be possible, there must of course be shared linguistic practices: our interlocutors must react to our words in ways we expect (that is, their reaction must be as ours would be) or communication could not succeed. But there is nothing to "meaning" beyond such shared practices, which may change over time, and from one language-group to another, or by the conventional choice of a small group.

The praxical perspective on language highlights the important role context plays in determining meaning.

Language works by producing an effect in the audience (listener or reader), and that effect depends to a great extent on the state of mind of the audience, which is the result of all past and current circumstances: not only the words that preceded, but the audiences' expectations, the material surroundings, and the immediate past and more distant history. The result is that any word or utterance can mean virtually anything depending upon context. "Bad" means good in some American dialects; an ironic or sarcastic context can make "yes" mean no; and "Peter" can refer to Paul if the audience thinks that Paul's name is "Peter." I once knew a couple who, in order to resolve an impasse over whether to have a cat or dog for a pet, compromised by getting a cat and calling it a dog. In their home, when referring to their pet, "dog" meant cat. That this only caused momentary confusion for first-time visitors, who quickly adapted to the custom upon hearing the explanation, helps to illustrate how flexible an instrument we take language to be.

This deep dependance of meaning upon context explains why writing is so much more difficult than face-to-face speech. Given that language is a medium for affecting others, it is far easier to accomplish the desired effect where the listener's verbal, behavioural, or facial responses may be observed--and unintended effects immediately compensated for--than in writing where there is no direct feedback.[9]

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[9] This is a remark about an empirically observable fact familiar to anyone who has exercised both speech and writing, and in no way relates to Derrida's assertion that writing has primacy over speech. As I read Derrida, his assertion that the Western philosophical tradition mistakenly priorizes speech takes "speech" as a metaphor for a mode of language where there is immediate presence of the mind to meanings, which Derrida denies ever obtains. He is saying that we ought to conceptualize language on the model of writing rather than speech, because the impossibility of determinate meaning is clear in writing, where words can be torn out of context and multiply re-interpreted. Derrida, as much as those who theorize about language from the perspective of the

In the praxical perspective, the notion of linguistic meaning abstracted from any context is vacuous. The writings of a lost language such as Linear A have been abstracted from all context by the vagaries of history, and they are utterly meaningless and will remain so until the context in which they were used can be reconstructed. Without the practices that constitute the language, a sentence of the language is a mere noise or mark. With these practices, a sentence still has no determinate meaning abstracted from the context of its utterance. And without skill in the linguistic practice, the intention of the utterer may not be carried out, or it may not be discerned by the audience. It is only by virtue of skill in the linguistic practice, exercised in a context, that any utterance manages to have some desired effect: that is, that it means something. "Only in the stream of thought and life do words have meaning."[10]

Persons usually mean something by their utterances; what this means is that an utterance (or inscription) is intended to achieve some specific desired effect. Speakers exercise their skill, drawing on their knowledge of the effects words usually have in relevantly similar circumstances, to achieve the intended effect. The intention may fail due to lack of linguistic skill on the part of the speaker or the audience, or due to the speaker mis-reading the situation or mental state of the audience. Speakers often fail to achieve the intended effect, and in most cases the meaning cannot be disambiguated merely by examining the actual sentences and words in greater detail. In such cases, the speaker must use more words (or gestures, or whatever) to make the meaning clear. A request for the meaning of an

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scientific ideology, treats language as a system of signs; he only abstracts them even more completely from the context of concrete use in a practice where words have meaning by virtue of the honest work they do.

[10] Ludwig Wittgenstein, Zettel, eds. G. E. M. Anscombe and G. H. von Wright, trans. G. E. M. Anscombe, 2nd ed. (Oxford, Basil Blackwell, 1981), sec. 173, p. 30.

expression is not a request for something different in kind from the original expression (a "meaning" to attach to the original utterance). Rather, it is a request for more of the same: more words that may result in an unambiguous effect which the first words failed to achieve.

Intentions evidently play a role in this analysis, but they must not to be thought of as a surreptitious substitute for meanings. Intentions are not ontological items like propositions in the mind of the speaker; they are aims of action. It is often the case that a speaker or writer does not know, when beginning a sentence, how he or she will finish it. The intention of a speech act is not a preformed thought or idea existing in someone's mind. To think thus is to imagine a second language of thought in addition to the language of expression, as if meanings were preformed in the mind in "mentalese" and speech were a process of translation into English or some other language. The only language of discursive thought is the language of expression, and meanings only find form in the course of being expressed. Where we do know what we are going to say before uttering it, it is because we have mentally rehearsed it in the language of expression; that is, already formed the thought by putting it into words.

Similarly, understanding an utterance is not a matter of contemplatively grasping in mind the intention encoded in the utterance, which may then be acted upon as a separate stage; understanding is in the first place a conscious act performed in response to an utterance. In the normal course of understanding an utterance, we do not reason out the meaning or intention by consulting our factual knowledge of the meanings of the constituent words. This only occurs where there is a failure of understanding, perhaps because of an awkward grammatical construction or unfamiliar vocabulary. Understanding normally consists in an easy skilled response to words, like the actions of a cyclist responding to turns and bumps in the trail so as to keep upright and follow the path. This does not mean that we necessarily do or believe whatever we are told. What we do is alter our conscious state in response to the words so that fulfilling the intentions of the speaker becomes one of our possible courses of action. Altering one's conscious state in response to words is itself a skilled action: it is what we are doing when we are attending to an utterance.

Linguistic intentions are like the intentions an automobile driver has in relation to her goal: it is what is reached for in the performance of the act (of driving or speaking). The driver may have in mind a clear vision of the goal and how to get there; or she may only know the address, and have a vague idea of the route; or she may be driving merely for pleasure, and discover the route and the goal in the process. Similarly in speaking and writing, we may have a preformed thought we wish to express, and may have it phrased in our mind prior to speaking, but often we do not. The idea or effect aimed at may be vague and the means to accomplish it unformed; both may be discovered in the process. With speaking or writing, intentions are the not-yet-grasped goal aimed for, not something already complete that is encapsulated in sentences and transmitted from mind to mind. Communication is achieved--the intention is fulfilled and the meaning is understood--if the passenger in the linguistic automobile is brought far enough to see the goal the speaker aims for.

The concept of meaning advanced here in relation to language is closely connected to the meaningfulness-for-action introduced in the last chapter, and contrasts with the metaphysical objects ("propositions") that many philosophers prefer as the bearers of meaning. Adopting the praxical perspective de-propositionalises our understanding of language and, by extension, reasoning, knowledge, and thought. Instead of thinking of knowledge and reasoning in terms of sentential or language-like structures, we can think of them directly in terms of skilled actions and practices.

For example, knowing that the is cat on the mat need not be conceived of as having in one's mind a proposition corresponding to the sentence, "the cat is on the mat." Instead, we may think of this state of knowledge as knowing how to act correctly in the circumstance where the cat is on the mat. This know-how can be exercised in a variety of ways: by visually locating the cat (assuming one is able and knows how to see); by avoiding stepping on the cat (assuming one knows how to walk); or by informing someone that the cat is on the mat by uttering truthfully the sentence "the cat is on the mat" (assuming one knows how to speak English). There is no reason to suppose that the utterance of the statement is any more like an item in the mind of the knower than any of these other actions. This is what I meant by saying that the praxical perspective undermines the tendency to use language as a model for knowledge. If we think of language in terms of practices it loses its special status as a vehicle of representation, and thereby loses its appeal as a model for knowing. Knowing can then be conceived on the model of know-how, behind which there are no static mental objects figuring in calculative reasoning.

REFERENCE

From the praxical perspective, reference too is an act requiring skill in conventional practices, as opposed to an intentional act or a relation between words and objects. It is because persons have developed practices for using words to refer to things that the notion arises that words refer. But this is an abstraction from concrete instances of use. By themselves, words do not refer to anything; they do so only by virtue of the practices within which they are used. Reference may be seen as the act of getting another to take note of something in an appropriate way, and one of the ways this can be achieved is through the use of words. But gestures may also be employed, and learning the meaning of a gesture is much like learning the reference of a word. The learner (of a first language) observes the word or gesture used a number of times in different contexts. A relevant similarity between the cases is recognized, and the learner tries using the word in similar contexts. From observing the responses, the use of the word or gesture is corrected and confidence in its use is gained. Because everyone learns the same set of practices, it is possible to use words or gestures to elicit predictable responses.

Pointing is not something different from linguistic reference which may ground it (as by ostensive definition), but another way of referring. Whether using language or gestures, reference is a skill that must be developed both for the referrer and the other for whose benefit the reference is made. The possibility of communication rests on this basis of shared practices.

The ability to refer to something depends upon a shared practice for picking the thing out or otherwise dealing with it in some way. Some objects (medium-sized dry goods) appear to be given in pre-linguistic experience, but the illusion of pre-givenness depends upon practices shared by virtue of having a human body: the things are constituted as objects by virtue of being graspable, movable, desirable, recognizable, or otherwise separable from their surroundings. Other things (such as molecules, atoms, and other theoretical objects of science) only appear as objects with the development of advanced practices for picking them out or dealing with them. The former kind of case is an apt model for theories that treat language as separate from the world and see reference as a pairing of (human-created) words with (pre-given) objects. But the latter kind of case is a more appropriate model for reference when language is seen as continuous with our other instrumental and perceptual practices for dealing with the world. The intimate relation between perceptual and linguistic skills is neatly illustrated by Michael Polanyi in the following example, probably from his personal experience:

> Think of a medical student attending a course in the X-ray diagnosis of pulmonary diseases. He watches in a darkened room shadowy traces on a fluorescent screen placed against a patient's chest, and hears the radiologist commenting to his assistants, in technical language, on the significant features of these shadows. At first the student is completely puzzled. For he can see in the X-ray picture of a chest only the shadows of the heart and ribs, with a few spidery blotches between them. The experts seem to be romancing about figments of their imagination; he can see nothing that they are talking about. Then as he goes on listening for a few weeks, looking carefully at ever new pictures of different cases, a tentative understanding will dawn on him; he will gradually forget about the ribs and begin to see the lungs. And eventually, if he perseveres intelligently, a rich panorama of significant details will be revealed to him: of physiological variations and pathological changes, of scars, of chronic infections and signs of acute disease. He has entered a new world. He still sees only a fraction of what the experts can see, but the pictures are definitely making sense now and so do most of the comments made on them. He is about to grasp what is being taught: it has clicked. Thus, at the very moment when he has learned the language of pulmonary radiology, the student will also have learned to understand pulmonary radiograms. The two can only happen together.[11]

The interpretive skills and language of pulmonary radiology are just two aspects of the practices shared by pulmonary radiologists. Because they share the same set of practices, members of the community are able to refer to and talk about a mutually accessible system of objects. The language is embedded within the system of skilled practices for revealing and dealing with the objects of their profession. The perspective that sees language as a system of signs standing opposite objects implicitly presupposes the system of practices within which objects are revealed

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[11] Polanyi, Personal Knowledge, 101.

and language exists for dealing with them. As a consequence it has trouble dealing with both the development of practices, which may reveal the objects differently, and the possibility of different aims of practice, which may reveal a different set of objects and relations in the same subject area.[12] (Traditional philosophy of science, being wedded to the scientific ideology, usually presupposes the practices of contemporary science and theorises about meaning, reference, and truth within this framework.)

The fact that reference depends upon practices for picking out and dealing with the objects in a sphere of action must not be taken to imply that everyone must possess skill in these practices in order to refer successfully. There must of course be some who possess such skill (and the practice must be "real," not illusory), but, in Putnam's words, there is a "division of linguistic labour" in the work of referring.

In an argument against the existence of "meanings" as mental entities that determine reference Putnam writes, "Cut the pie any way you like, 'meanings' just ain't in the head . . . there is a *division of linguistic labor*. We could hardly use such words as 'elm' and 'aluminum' if no one possessed a way of recognizing elm trees and aluminum metal; but not everyone to whom the distinction is important has to be able to make the distinction."[13]

In a similar argument against intentional theories of reference, Garth Hallett writes,

> There is no need for a mythical act of the mind, intending one object. Nor must mental feelers reach across the Atlantic and somehow make contact

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[12] Ian Hacking makes a similar point in "Language, Truth, and Reason," in Rationality and Relativism, eds. Hollis and Lukes, 48-66.

[13] Hilary Putnam, "The Meaning of 'Meaning,'" in Language, Mind, and Knowledge, ed. K. Gunderson, Minnesota Studies in the Philosophy of Science VII (Minneapolis: University of Minnesota Press, 1975), 131-93; reprinted in Mind, Language and Reality: Philosophical Papers, Volume 2 (Cambridge: Cambridge University Press, 1975), 227.

> with the country mentioned. The name "Switzerland" does that. One country and one country alone is caught in the verbal web woven by that name in its various forms: the name on *that* country's stamps, *its* borders, *its* documents, *its* buildings, *its* travel brochures, and not on others'; the name by which citizens, visitors, and others refer to it and not to other countries. It is held secure, Gulliver-wise, by a thousand Lilliputian strands. No mental act could weave such a complex pattern, but language can.[14]

Putnam's "division of linguistic labour" and Hallett's "Lilliputian strands" are no more than the language-users' shared practices for dealing with the world. Reference is quite unmysterious when it is seen to reside in such shared practices. When language is treated as a system of signs the practices which give language its being become invisible; words and objects are then seen as objects on an ontological par, and reference appears as a mysterious property linking the two. The remarks on reference advanced here are not intended to constitute a theory of reference to be compared with those which treat language as a system of signs. Rather, I am arguing for adopting a perspective which does not make the abstraction from concrete practices on which such theories depend. The praxical perspective brings out the fact that reference depends upon shared practices for picking out objects, and the knowledge that speakers must have in order to refer is skill in those shared practices.

Reference can of course fail; this occurs when there is no stable way of dealing with the entity in question. For instance, "ether," "phlogiston," and "caloric" were found to have no reference because it proved impossible to develop effective practices for dealing with the purported entities so named. On the other hand, reference can remain stable over changes of meaning (contrary to Kuhnian arguments for "incommensurability" and "scientists living in different worlds after a scientific revolution" which underlie some

[14] Garth Hallett, Language and Truth (New Haven: Yale University Press, 1988), 45.

relativist positions.) This occurs because the effective ways for dealing with the objects of reference are permanent achievements (acquired skills and practices) which survive regardless of changes in the theories of the objects. These matters will be dealt with further in the next chapter, but first some remarks must be made about truth.

TRUTH

From the perspective of the scientific ideology, knowledge resides in the possession or apprehension of truths. A definition of knowledge which has been the subject of much philosophical discussion of late and forms the focus of many undergraduate courses in epistemology defines knowledge as justified true belief, and the aim of science is commonly described as the pursuit of truth. The concept of truth is therefore of central importance in any epistemological discussion.

However, the praxical perspective demands a different account of truth than the correspondence or coherence theories which the scientific ideology usually employs. If we characterise science as the pursuit of truth, and describe truth in propositional terms (modeled after either the correspondence of sentences to reality or a maximally coherent set of sentences), then science will be seen as the quest for such propositional truths. This is how the scientific ideology has usually described science: as a cognitively rational enterprise for attaining true theories. I am arguing that we ought not to understand science as the quest for propositional truths (knowledge-that), but as the development of abilities (or know-how). And since it seems eminently reasonable to describe science as the pursuit of truth, it follows that I need a different account of truth.

From the perspective of the scientific ideology, knowledge is identical with the possession of propositional truths. But from the praxical perspective, true statements are just one way that know-how may be expressed through actions in the world.

Philosophy of science conducted from the perspective of the scientific ideology frequently imports a formal linguistic concept of truth into epistemology via the intermediary of the concept of beliefs. The scientific ideology's bias is clear in this move: rationality and intelligence are conceived as ratiocination, so beliefs are treated as the axioms and theorems of the rational agent. When beliefs are treated as propositional entities, true sentences become perfectly adequate representations of them, and formal concepts of truth and falsity can be applied.

However, it is perfectly reasonable to ascribe beliefs to beings who lack language, and therefore lack the capacity for propositional reasoning. For instance, one may say that the dog is barking because it believes there is a bear in the tree. It is not at all clear that the dog's mental state can be adequately represented as the possession of a proposition and some sort of ratiocination to result in the barking action. (Except as a metaphor, as when we ascribe states of knowledge and belief to computers.) And it is also not at all clear that there is any principled distinction between the state that underlies the dog's action and most human actions. Of course we do sometimes entertain sentential beliefs, but most of what we believe is inarticulate. We reach in a pocket for our keys, and afterwards explain it by saying that we believed that is where the keys were; but at the time the action was almost automatic, and certainly not accompanied by any propositional ratiocination.

Conceiving language and knowledge to reside within practices, instead of as systems of signs and truths, reverses the order of conception of proposition and action. Beliefs and knowledge are non-propositional states that are the springs of action, and statements a form of resulting action. ("Propositions" are metaphysical inventions, modeled after statements, that the scientific ideology's perspective projects upon utterances and the minds of agents who make them.) Judging a statement's truth is therefore a judgement about the correctness of the linguistic act and practices.

The scientific ideology usually sees truth as an ideal relation of representation or of correspondence between statements and states of affairs, which, if not all-or-nothing, only admits of variation along a single dimension: the statement may better or worse represent or correspond with the state of affairs, or in some other manner be nearer or further from some unitary ideal, The Truth. The praxical perspective, on the other hand, reveals truth as a concept with two interrelated pragmatic dimensions: one is the correct use of terms within a system of practices, and the other is the adequacy or perfection of those practices.

As Hilary Putnam has moved a considerable way towards this view of truth during the last few years, a formulation he has recently published will provide a convenient starting point. He writes, "The suggestion I am making . . . is that *a statement is true of a situation just in case it would be correct to use the words of which the statement consists in that way in describing the situation.*"[15] Garth Hallett offers a very similar formulation, which expands somewhat on what "correct use" consists in: "the criterion of verbal truth, insofar as there is one, is . . . agreement between the use made of words and their established uses,"[16] and "for a statement of fact, or informative utterance, to be true it suffices that its use of terms resemble more closely the established uses of those terms than it does those of rival, incompatible terms."[17]

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[15] Hilary Putnam, Representation and Reality (1988; reprint, Cambridge, Massachusetts: The MIT Press, 1991), 115.

[16] Hallett, Language and Truth, 69.

[17] Ibid., 91.

It is important to note that it is agreement in the practices for using the *words* (their *established uses*) that is important for the truth of the *statement*, and not merely agreement about the statements. This cancels the potential objection that these formulations make truth a matter of mere convention. As Wittgenstein put it, "'So you are saying that human agreement decides what is true and what is false?'--It is what human beings *say* that is true and false; and they agree in the *language* they use. This is not agreement in opinions but in form of life."[18] To illustrate this point, imagine a mythical time when it was agreed by all that the earth is flat. Universal agreement would not make the statement "the earth is flat" true, because (if we suppose that "earth," "is," and "flat" are used pretty much as we use them) a little investigation would show that "flat" cannot properly be predicated of the earth.

Putnam describes correctness of use not in terms of agreement in language, but as *warrant*. He continues the above quote,

> Provided the concepts in questions are not themselves ones which we ought to reject for one reason or another, we can explain what 'correct to use the words of which the statement consists in that way' means by saying that it means nothing more nor less than that a sufficiently well placed speaker who used the words in that way would be fully warranted in *counting* the statement as true of that situation.[19]

Putnam uses the phrase "fully warranted" here to avoid epistemic relativity. Elsewhere he writes "My own view is that truth is to be identified with idealized justification, rather than with justification-on-present-evidence."[20]

However, because Putnam separates conceptual change from the concept of warranted truth, he appears to avoid

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[18] Wittgenstein, Philosophical Investigations, sec. 241, p. 88.

[19] Putnam, Representation and Reality, 115.

[20] Hilary Putnam, "Why is a Philosopher?" in Realism with a Human Face, ed. James Conant (Cambridge, Massachusetts: Harvard University Press, 1990), 115.

epistemic relativity only to fall into conceptual relativity: a different set of concepts could change the warrantability conditions, and thus the truth-value, of many statements. Putnam denies this form of relativity in an important footnote to the above passage:

> The proviso 'provided the concepts are not ones which we ought to reject for one reason or another' is important here; it is precisely the mistake of cultural relativism, in many of its forms, to ignore the fact that rejecting the concepts which are current in a particular 'culture' at a particular time can be a *reform* and not just a *change*. In saying this I am, of course, rejecting the 'fact/value' dichotomy which underlies many versions of relativism.[21]

In the work quoted Putnam does not elaborate on the dynamics of conceptual reform, but he evidently conceptualizes it in cognitive terms: a ratiocinative process based on reasons and evidence, including epistemic and value judgements. In this respect he remains largely committed to the perspective of the scientific ideology. He construes knowledge to reside centrally in propositional truths situated within a conceptual system, which progresses via science, and language as a system of signs for encoding propositions.

The quotes from Hallett and Wittgenstein above stress, as Putnam's formulation does not, the relevance of linguistic practices to judgements of truth. When language is viewed as a system of practices rather than as a system of signs for encoding a conceptual structure, the linguistic practices that give words their meaning and the epistemic practices that underwrite judgements of truth become intimately interrelated and woven into the larger practices of the community. The development of epistemic practices is therefore inextricably linked with changes in language, meaning, and ways of life, and the notion which Putnam's

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[21] Putnam, Representation and Reality, 134 n. 14.

formulation suggests of ideal justification within a conceptual system becomes largely vacuous.

The distinction Putnam marks between truth as justification within a conceptual system and reform of a conceptual system is important, but I would express it differently. Rather than the cognitive notion of a conceptual system, I see the frame in which knowledge and truth reside as the totality of linguistic and epistemic practices. One dimension of truth is correct use of terms within a given system of practices; another is the perfection and development of those practices. The former dimension may be characterized as the avoidance of error within a practice; the latter as the development of knowledge by developing new or better practices.

To illustrate: saying "the cup is on the table" in a situation where the cup in question is not on the table, but is on a nearby counter, would be false by virtue of incorrect use of some of the terms "cup," "on," or "table," in the situation as it obtains. The practices we have for identifying and speaking of such objects as cups, tables, and the relationship of "being on" appear to admit of no improvement; so the error here consists entirely in either mis-using the terms or mis-perceiving the situation.[22] The error may be linguistic, perceptual, judgmental, or a failure of memory; but the practices for identifying the objects and talking about them are not at fault.

A different situation obtains where the practices do admit of improvement. For instance, in the expression "force equals mass times acceleration" there was no misuse of the terms involved at any time between (approximately) Newton

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[22] Actually, one can imagine a situation where these terms may require revision. For instance, if the experience of operating within a weightless environment became common we might become familiar with new kinds of containers, so that "cup" might come to include bottle-like containers, and we might revise the use of the term "on" to mean something like "in contact with (or adjacent to) the conventionally upper (or working) surface of."

and Einstein; but as the practices of physics developed to incorporate electromagnetic phenomena, it was found necessary to change the uses of the terms "force," "mass," and "acceleration." The expression "force equals mass times acceleration" was not (until this century) false by virtue of incorrect use of the terms within a practice; what occurred was that the practices within which such terms and expressions are used underwent development. The point I wish to make is that this development ought not to be viewed as a cognitive shift in a conceptual system, but as a development of practices. This is a major component of the epistemic progress resulting from science's pursuit of truth.

To view the goal of science as the quest for propositional truths--as the scientific ideology tends to--is to conflate these two dimensions into a one-sided notion of knowledge modeled on truth within a given set of idealized practices. This is why philosophy of science has traditionally portrayed science as a cognitively rational enterprise and focussed on the logical relations among theories and evidence, while largely ignoring experimental research and the development of technical know-how. One consequence of this cognitive focus has been an anxiety over relativism, occasioned by the observation that there have been radical shifts in conceptual systems and corresponding shifts in the meanings of terms and the expressions we accept as true. (These points will be discussed in greater detail in the next chapter.) The praxical perspective is not prone to this kind of episodic or cultural relativism because the practices which ground our uses of terms are not historically or culturally arbitrary choices, but are real epistemic achievements: the hard-won know-how of skilled practices for acting in the world.

There is, however, an innocent kind of relativism in the praxical perspective. Within a system of practices, judgements of truth are relative to practical purposes. In carpentry it is foolish to insist that a board is not ten feet long if it is close enough to ten feet for the purposes at hand. Similarly, Newtonian mechanics was not thrown out wholesale because it was proven "false" by the theory of relativity. The results provided by Newtonian mechanics are perfectly adequate for terrestrial engineering purposes, so it is retained for those purposes. It is the development of new practices for which old usages are not adequate that results in the judgement that old conceptions were false. And yet the old language is retained for pragmatic purposes while new technical uses are added to the old. "Mass" means something different in Newtonian and relativistic dynamics, as do "time" and "distance." The context of use determines which is meant and what standards of truth apply.[23]

The two dimensions of truth, avoidance of error within a given practice and the development of practices, are intimately interrelated. Determining whether a term is being used correctly in a given situation may result in a development of epistemic practices; and a development of epistemic practices can result in a refinement and elaboration of linguistic practices.

For a simple example, consider again the mythical ancestors who believed that the world was flat. Presumably they would have discovered their error when their practices evolved to take in such large portions of the world that its curvature became apparent and important to them, as for instance by developing maritime navigation. This larger perspective would result in a change in their conception of the world, and thus in their practices for using the words relating to the world. They have not only learned that they were wrong to say that the earth is flat, they have gained knowledge of a greater portion of the world and developed

[23] The scientific ideology conceives the statements of fundamental science as context-free or "absolute" truths, and the end of science as obtaining the complete body of such absolute truths. From the praxical perspective there are no context-free or absolute truths, and no "end of science" but the progressive improvement of scientific know-how.

further practices for dealing with it. No longer would "world" evoke only thoughts of the familiar regions in their immediate vicinity, but a vast and diverse globe containing many different peoples and places with which they could have commerce. Their terms for "earth" and "world" would in effect have changed meaning as their practices for living in the world developed.

A real, but therefore much more complex, example is provided by the change from Ptolemaic to Copernican astronomy. It is well known that the change did not come about by the simple discovery of error with the Ptolemaic view; both views could account equally well for most of the astronomical phenomena known during the period of the "Copernican revolution." The book in which Copernicus presented his theory, <u>De revolutionibus orbium coelestium</u>, was published in 1543, but heliocentric astronomy was not widely accepted until some time after Galileo's death in 1642, and then in a form quite different from Copernicus' original theory. A number of developments in the intervening period contributed to the "revolution" in astronomy. Tycho Brahe made new measurements of planetary positions more accurate than any previously available. On their basis Kepler developed his three laws of planetary motion that replaced the cycles and epicycles of Ptolemaic (and Copernican) astronomy with a simpler set of mathematical relations. In addition, the telescope was invented and turned to the heavens, introducing phenomena unknown to earlier astronomers including the moons of Jupiter, the phases of Venus, and evidence that comets traveled beyond the moon's orbit. Although these developments were difficult to square with the Ptolemaic view they were not decisive proof against it, and one major objection stood in the way of heliocentric astronomy.

This objection was the fact that Copernican astronomy attributed motion to the earth, a notion which seemed contrary to experience. Nothing seemed more certain than that the earth stood still, humans and other beings toiled over its surface, and the heavens wheeled above. Much of the rhetoric of Galileo's Dialogue Concerning the Two Chief World Systems is directed at this problem.

The established view of motion had its philosophical elaboration in Aristotelian theory. The ancient Greeks saw motion as a species of change, and change as an organic phenomenon. Motion, as change, originated from the inner essence of a thing: as seeds grew into plants, eggs into birds, and babies into adults unless interfered with from outside, so motion from place to place originated either from the nature of the thing or was impressed by an outside influence. The heavenly bodies by nature turned in perfect circles, earthly things tended by nature to the centre of the earth, plants grew by their inner nature, humans and animals moved themselves, and other motions were forced by external influence. This fit well with the experiences and practices of the time, for it manifestly took effort to walk or pull a cart from one place to another. One problem with this view was that it could not account for the continued motion of arrows and other hurled things after the force that set them in motion had ceased to be applied. This was solved in medieval times by the notion of impetus: the original applied force imposed an impetus on the object which kept it in motion until the impetus was exhausted.

Within the Aristotelian scheme, continuous transverse motion required a continuous action to sustain it, and this did not fit well with the postulated motion of the earth in Copernican astronomy. We should feel such rapid motion, easterly winds should blow continuously, and objects dropped from high towers should be left behind as the tower whirled away with the motion of the earth, none of which occurred in experience. The conceptual shift that Copernican astronomy demanded, and Galileo argued for, was to see all motion as relative, so that objects were in themselves indifferent as to whether they were in motion or at rest and only changes in motion needed to be forced. This is essentially the modern conception of inertial motion.[24] The shift in view entailed a shift in what was at question in motion, from what kept things moving to why they stopped or changed their state of motion.

This is usually viewed from the perspective of the scientific ideology as an important conceptual shift which permitted truer theoretical knowledge in astronomy and dynamics, with resulting technological progress. Viewed from the praxical perspective, however, what occurred was a change in linguistic practices accompanying developments in epistemic and technological practices. Galileo was a great inventor of mechanical instruments and spent a considerable amount of time in the armories of his patrons developing instruments of war, discussing the art of artillery with soldiers, and calculating cannon trajectories. He lived in an age of pendulum clocks and clockwork machines, hoisting and pumping engines, great ships and global navigation. The organic world of the ancient Greeks was being left behind with the advent of a technological age, where different phenomena were important and different questions were asked. Aristotle's organic language of motion was no longer adequate, and Galileo worked hard to forge a more adequate language for the times.[25]

To see the Copernican revolution in astronomy as the rejection of one conceptual scheme and the adoption of another does not do justice to the richness and continuity of the developing practices of the time. The gain in knowledge did not reside simply in the development of "truer" theories of dynamics and planetary motion; those theories were merely consequences and expressions of the rich development of epistemic practices which accompanied

[24] Except that Galileo's conception of inertial motion was circular rather than linear.

[25] See Feyerabend's discussion of the inadequacy of reasons and the role of rhetoric in Galileo's arguments for the Copernican scheme in Against Method, chaps. 6 and 7, 55-76.

them. The technological innovations and instrumental measuring practices were developed first, then language adequate to deal cooperatively with these practices was forged and with painful effort introduced against the opposition of centuries of custom. New knowledge has come about through these developing practices. Afterwards, we look back and see the developing practices reflected within the language, and see something simple there: a new concept or theory has appeared, as if a new coin of knowledge were minted fresh in someone's mind, tested, proven, and put into circulation. But this hindsight vision is distorted by the lens of the scientific ideology. Knowledge does not reside in the abstract realm of concepts, but in what we know how to do.

6.

PROGRESS AND RATIONALITY IN SCIENTIFIC PRACTICE

> It must be true, because it works!
> --A physicist quoted by Sharon Traweek in Beamtimes and Lifetimes

The previous three chapters provide a foundation for a different vision of science than that bequeathed to us by the scientific ideology. As I argued in chapter two, the latter perspective sees science as a cognitively rational enterprise for producing authoritative knowledge-that. Many of the central issues in philosophy of science, as well as many aspects of the popular image of science, can be seen as direct consequences of this cognocentric perspective. Some of these issues will be discussed in the present chapter, but my aim is not so much to sort out and resolve the issues as to illustrate the different vision of the territory furnished by adopting the praxical perspective.

By adopting the scientific ideology's view that knowledge is essentially knowledge-that, traditional philosophy of science, especially in the last century, naturally situates scientific knowledge and progress in theories. This results in a highly unrealistic view of scientific practice which largely ignores the hard material work that scientists perform in their laboratories and field investigations. As Ian Hacking notes, philosophy of science has almost totally neglected experiment except as a source of evidence and data, despite the fact that experiment is obviously an important and integral aspect of scientific practice.[1] This has been rectified to some extent in the

[1] Hacking writes, "No field in the philosophy of science is more systematically neglected than experiment." "Experimentation and Scientific Realism," in Scientific Realism, ed. Jarrett Leplin, 154.

past decade, but Hacking remains one of the few philosophers to seriously examine scientific experiment. To find detailed examinations of actual scientific practice and experimentation, we have to turn to sociologists, historians, and anthropologists, a number of whom have recently made scientific practice a theme of their investigations. While these researchers represent a wide variety of epistemological positions, the view of science that emerges from their studies reinforces the praxical perspective. I have drawn on this work to some extent in previous chapters, and will employ it further in what follows.

Another effect of philosophy's traditional collusion in the scientific ideology is the venerable distinction between the context of discovery and the context of justification. When knowledge and rationality are seen as propositional possession and computation respectively, the discovery of new knowledge appears to be beyond the reach of the rational. Only confirmation of knowledge is seen to be ratiocinative and therefore amenable to formal explication. This results in the tendency of theories in philosophy of science to be normative rather than descriptive, and adds to the unreality of the philosophical view of science: the actual practices of scientists are seen to be less important than the supposed rational structure which underlies their activities and provides the warrant for their assertions.

As Churchland has pointed out, "it is difficult to find a current approach to normative epistemology that is not in some way an instance of what I shall call (with a little licence) the *ideal sentential automaton* (ISA) approach."[2] The ISA approach assumes that, for the purposes of epistemology, the knowing agent or enterprise may be modeled as a logical inference machine that computes sententially-representable epistemic outputs from sententially-

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[2] Churchland, Scientific Realism and The Plasticity of Mind, 125.

representable inputs and initial states. Knowledge is assumed to be knowledge-that from start to finish. This perspective encompasses not only such obviously ISA approaches as positivist inductivism, Popper's model of bold conjecture and logical refutation, Bayesianism, Hesse's "learning machine" model, and Quine's neo-positivism, but also underlies most post-empiricist approaches to philosophy of science where the formal structure of the epistemic kinematics is less obviously foregrounded.

The cognocentric perspective in philosophy of science notoriously leads to the apparent viability of two positions anathematic to the scientific ideology: relativism and irrationality. The two cannot be easily separated, and there are many possible routes to each, but the basic sources of the problems can be sketched briefly.

When knowledge is thought to reside in propositional entities such as theories and statements of fact that represent the world, the great epistemic dichotomy mentioned in the second chapter is introduced, and along with it the problem of bridging the gap between the world and our knowledge of it. Logical empiricists thought knowledge could be grounded by empirical observations or observation-sentences, but this raises numerous problems: theories typically go beyond the evidence cited to support them (the underdetermination thesis), so many theories may correspond with one set of data. Conversely, many different configurations of reality may result in data consistent with any given theory. In addition, the arguments of Hanson and Kuhn that observations are theory-laden raise the possibility that we may be so caught up within the circle of theories that there is no firm link to the "real world outside."

In addition to these sources of relativism one may add the problems of theory-change. Duhem noted long ago, and Quine more recently, that evidence contrary to a theory only tells us that something is wrong, but does not say what the problem is. There are many possible responses to a piece of contrary evidence, from modifying auxiliary hypotheses to wholesale rejection of the theory and invention of a new one. The distinction between the contexts of discovery and justification suggests that the generative aspect of the process may be beyond the reach of a rational account. Hanson tried to argue in Patterns of Discovery that theory-creation proceeded on the basis of sound reasons, but the spectre of irrationality was again introduced with Kuhn's account of scientific revolutions as paradigm-shifts in which the meanings and reference of terms change and scientists find themselves working in different "incommensurable" worlds. Kuhn explained the appearance of progress across revolutions as a matter of perspective: since the new paradigm provided the terms and standards by which evidence is judged, any theory in another paradigm would appear inferior.[3] Some of his readers interpreted Kuhn as implying that there could be no rational means for choosing between theories in competing paradigms.

Kuhn and others have argued that there are rational grounds for theory-choice even across paradigm shifts (scope, simplicity, unification, elegance, and problem-solving power are some of the grounds typically cited), but they act as values which different individuals may legitimately weight differently. Theory-change then becomes not a matter of cognitive or calculative rationality, but of judgement, sometimes likened to Aristotle's notion of practical reasoning in ethical decision-making.[4] Others have argued, often on the basis of the under-determination and theory-ladenness theses, that no rational grounds can

[3] Thomas S. Kuhn, The Structure of Scientific Revolutions 2nd ed. (Chicago: University of Chicago Press, 1970), ch. XIII, 160-73.

[4] Thomas S. Kuhn, "Reflections on my Critics," in Criticism and the Growth of Knowledge, ed. Imre Lakatos and Alan Musgrave (Cambridge: Cambridge University Press, 1970), 259-63; see also, e.g., "-rold I. Brown, Perception, Theory, and Commitment: The New Philo. hy of Science (Chicago: University of Chicago Press, 1977), 145-51.

determine theory-choice, and have sought extra-empirical, non-rational grounds for explaining the direction of scientific knowledge. Frequently these grounds are sought in social factors: some of the most ardent relativists today are sociologists of knowledge who argue that scientific knowledge is socially constructed.[5]

The scientific ideology's cognocentric conception of the rationality of scientific practice as the consideration of theories in the light of evidence underlies the popular image of the scientist as a coldly detached rational agent: a hard-nosed, no-nonsense, unemotional entertainer of facts and evidence. But empirical examinations of individual scientists quickly reveal the image of the detached coldly rational scientist to be a flimsy tissue of ideological illusion. Scientists tend to be deeply attached to and emotionally involved in their work and their subjects. Evelyn Fox Keller describes this attitude in her study of Barbara McClintock, summing it up in her title, "A Feeling for the Organism." A detached attitude may be appropriate for testing formulaic methods which can be performed according to rule, but it is antithetical to the development of skills and practices which go beyond rule-governed procedure. "Like all good scientists," Keller writes, "her understanding emerges thorough absorption in, even identification with, her material."[6]

The characteristics that McClintock exemplifies can be found in all truly creative scientists. "Good science cannot proceed without a deep emotional investment on the part of the scientist."[7] June Goodfield reveals the same kind of intimate involvement in the subject matter in her study of Anna Brito: "If you really want to understand about a tumor,

[5] Barry Barnes, David Bloor, Bruno Latour, and Steve Woolgar are some representatives of this approach.

[6] Evelyn Fox Keller, <u>A Feeling for the Organism: The Life and Work of Barbara McClintock</u> (New York: Freeman, 1983), xiv.

[7] Ibid., 198.

you've got to *be* a tumor," Brito says.[8] Einstein wrote something similar: "The state of feeling which makes one capable of such achievements [perceiving fundamental general laws] is akin to that of the religious worshipper or of one who is in love."[9] The attachment to the subject is probably rarely expressed because of the scientific ideology's image of science as a matter of detached reasoning, but science could hardly develop were it not for scientists learning to feel their way about in the areas they explore. "Scientists often pride themselves on their capacities to distance subject from object, but much of their richest lore comes from a joining of one to the other, from a turning of object into subject."[10] This feeling comes about through long association and close attachment, and only with great skill is it possible to advance a practice and reveal new structures. And only after such structures are revealed in experience can they be articulated in theory.

Keller describes the moment of discovery as the point where "rationality finds its own limits." McClintock says, "When you suddenly see the problem, something happens that you have the answer--before you are able to put it into words."[11] On the next page Keller relates a revealing example: While studying a group of plants which according to established theory should have had 50% sterile pollen, a post-doc noticed that there were some that were 25 to 30% sterile. He was disturbed, and brought it to the attention of McClintock.

> McClintock was disturbed too--so much so that she left the field, down in the hollow, and walked up to her laboratory. There she sat for about thirty minutes, "just thinking about it, and suddenly I

[8] June Goodfield, An Imagined World: A Story of Scientific Discovery (London: Hutchinson, 1981), 226.

[9] Quoted in Gerald Holton, Thematic Origins of Scientific Thought: Kepler to Einstein (Cambridge, Massachusetts: Harvard University Press, 1973), 378.

[10] Keller, A Feeling for the Organism, 118.

[11] Ibid., 103.

> jumped up and ran down to the field. At the top . . . I shouted, 'Eureka, I have it! I have the answer! I know what this 30% sterility is.'" When she got to the bottom of the hollow, the group of corn geneticists working there gathered around her, and she realized that she couldn't provide the reasoning behind her insight. "Prove it," they said. "I sat down with a paper bag and a pencil and I started from scratch, which I had not done at all in my laboratory. It had all been done so fast; the answer came, and I'd run. Now I worked it out step by step--it was an intricate series of steps--and I came out with what it was. [The post doc] looked at the material and it was exactly as I'd said it was, and it worked exactly as I'd diagrammed it. Now why did I know, without having done a thing on paper?"[12]

McClintock explains the process by likening the mind to a computer which does most of its work below the level of consciousness, but this is just to invoke a mythical computation process in order to retain the rationalism of the scientific ideology. I would describe the process as being more like the skilled perception of structures meaningful for action described in chapter four. Keller recognizes the similarity to perception as well: "what for others is interpretation, or speculation, for her is a matter of trained and direct perception."[13]

This creative perception rests upon the highly developed and specialized skills in corn genetics McClintock and very few others possessed. "As she grew older, it became less and less possible to delegate any part of her work; she was developing skills that she could hardly identify herself, much less impart to others."[14] She was able to see more than others because she had developed her skills in the practices of corn genetics to a higher degree than others. Many of her findings were not readily accepted by the mainstream establishment because McClintock was a maverick,

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[12] Ibid., 104.

[13] Ibid., xiii. In An Imagined World, Anna Brito expresses her own experience in similar terms: "I was seeing, and seeing creatively." Goodfield, 223.

[14] Keller, A Feeling for the Organism, 103.

following her own path. She saw things others could or would not see because she had developed skilled practices in a different direction than the mainstream of corn genetics.

The close involvement of the researcher with the subject matter is necessary at the forefront of research, because it is there that skills are being developed which have not yet been articulated in theory and reduced to rules and procedures common to the practice. Creative researchers are feeling their way forward, learning how to do new things and perceiving new structures through their involvement in the subject-matter. Only when the new skills become a routine part of the practice, either by being articulated in accepted theory or embodied in instruments and procedures, can the structures perceived, and the skills required to elicit them, be reduced to rules and procedures and brought into rational discourse.

The scientific ideology's conception of science as a cognitively rational enterprise also underlies the popular conception of the relation between science and technology. From this perspective technological success is seen as a consequence of the knowledge contained in scientific theories: first one acquires an accurate picture of the nature of reality, then one may employ that knowledge in the construction of useful devices. One frequently reads in popular accounts that science makes technology possible, as if technology were separate from, and dependent upon, science. Very expensive advanced scientific research is often defended on the ground that it will eventually produce knowledge that will result in technological benefits for humankind. Science and technology are seen as separate enterprises, with science being a cognitively rational enterprise carried out in laboratories and theoretician's armchairs, producing knowledge which industrialists subsequently use for technological purposes.

But the priority of skilled know-how to cognitive or theoretical understanding demonstrated above in the case of individual scientists is also reflected on a larger scale in the relation between science and technology: technological know-how is generally prior to theoretical (scientific) understanding.

Historians of science have long noted that the relation between science and technology is much more complex than the popular image of a dichotomous hierarchy. Technological developments frequently precede scientific understanding. This occurs in two dimensions: technical innovations often arise outside of organised science in advance of any theoretical understanding of how they work, and within science the progress of theoretical knowledge is frequently driven by technical developments in instrumentation and practices. The technological advances are retained even while the theories which are put forward to explain them undergo radical change. The permanent epistemic achievements in natural science reside in technical know-how, not abstract theory.

The ancient Chinese are famous for having developed many articles of technology which the West later considered important elements of science--including the compass, gunpowder, and metallurgy--but the Chinese never developed science. In the West, alchemy was an entirely unscientific enterprise from the theoretical perspective, but it represented the highest development of chemistry, metallurgy, and medicine well into the modern scientific period. It is well known that the telescope and microscope were developed before adequate optical principles were well available.[15] The existence of these instruments was a major driving force behind the development of optical science by people such as Descartes and Newton, but their optical theories were based on corpuscular accounts of light which

[15] See Feyerabend, Against Method, 3rd ed., 82-3.

were later rejected in favour of wave theories, and then partially rehabilitated in modern quantum-mechanical photon theories. There was a steady progress of optical instruments across these radical revolutions in optical theory.

Ian Hacking has reviewed the complex interaction between science and technology in the case of the steam engine, and concluded that "The development . . . involved endless 'experiment' but not in the sense of Popperian testing of theory nor of . . . induction. The experiments were the imaginative trials required for the perfection of the technology that lies at the heart of the industrial revolution."[16] Historians of this episode in history have summed up the relation between science and technology with the slogan, "science owes more to the steam engine than the steam engine to science."[17]

Gibbons and Johnson have examined the interaction of science and technology in the more recent case of the development of the transistor, and concluded that it would be more accurate to describe it as a technological than theoretical/scientific development. "The transistor arose primarily as a result of technology building on technology--in this case, rectifier technology. The role of Wilson's theoretical model of the conduction process in semiconductors was undoubtedly of great importance but . . . it was just one of many factors contributing to the final result." Most historians and sociologists of science today share Gibbons and Johnson's view that "the relation between science and technology is symbiotic," rather than the earlier view of the scientific ideology of a hierarchical relation where technology depended upon the theoretical knowledge delivered by science.[18]

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[16] Hacking, Representing and Intervening, 162-4.

[17] Don Ihde, Instrumental Realism: The Interface Between Philosophy of Science and Philosophy of Technology (Bloomington: Indiana University Press, 1991), 137.

[18] M. Gibbons and C. Johnson, "Science, Technology, and the Development of the Transistor," in Science in Context: Readings in the

In another dimension, it is clear that technical developments from one field of science can lead to advances in another field. The development of the telescope immediately led to important discoveries in astronomy, and the radio telescope again opened up whole new fields of phenomena to investigate. Chemical assay methods and radiocarbon dating contributed greatly to archaeology; and advances in high energy physics parallel advances in particle accelerators and detector technology.[19] These underscore the point introduced in chapter four that what is revealed to our experience and cognitive understanding depends upon our practices: know-how is prior to factual knowledge.[20]

The scientific ideology's image of science as a cognitive enterprise separate from and prior to technical application continually inspires philosophers to try to explain how science progresses by virtue of the cognitive rationality of the scientific method. From the praxical perspective this approach is wrong-headed, a judgement which is supported by the empirical observations about the relation between science and technology mentioned above. Technological progress is not the consequence of increasing access to truth; judgements of truth are a consequence of

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Sociology of Science, eds. Barry Barnes and David Edge (Cambridge, Massachusetts: The MIT Press, 1982), 177-85; quotes are from page 83.

[19] The latter point is documented in detail by Andrew Pickering in Constructing Quarks: A Sociological History of Particle Physics (Chicago: University of Chicago Press, 1984).

[20] See also Don Ihde, "The Historical-Ontological Priority of Technology over Science," in his Existential Technics (Albany: State University of New York, 1983), 25-46 for an extended argument on the priority of technology to science. Ihde draws on Heidegger's "The Question Concerning Technology," in Basic Writings, ed. David Krell (New York: Harper and Row, 1977) for the conceptual (ontological, in Heideggerese) priority, and Lynn White Jr., Medieval Technology and Social Change (Oxford: Oxford University Press, 1962), for evidence of the historical priority of developing technology in the middle ages.

the success of the practices within which the statements (theories, etc.) are situated. From the praxical perspective scientific progress hardly needs explaining: the development of workable technical practices simply is the aim implicit in the practice of the natural sciences. The progress of science is the progressive development of skilled (instrumental) practices.

While some low-level technical skills (such as manual lens-grinding and brass-working) may be lost as they are superceded by technological means of achieving the same ends, and others (like McClintock's skills for working with maize genetics) come and go as the goals and dominant practices of science change, there is a clear sense in which each generation of scientists (at least among the natural sciences) is able to *do* more than the previous generation. With allowances for material restrictions such as funding and freedom to work, this has uniformly been the case since science began. Science's high-level practical abilities are never diminished even during the most radical scientific revolutions where it may be supposed that for a time some scientists do not know what is true or what their findings mean. Adopting an excessively cognocentric perspective obscures the hard-won achievements resulting from the work that scientists must do in laboratories to get a piece of equipment or technique to function reliably so that any sort of result can be obtained. This is much more a matter of developing skills and practices than rational cognition.

Seeing scientific progress as the progress of instrumental know-how is not limited to those sciences where the researchers are involved in developing new techniques for manipulating material and creating phenomena, but can also be seen in sciences which are more purely observational. Astronomy, for example, is largely led by developments in instruments: progress within the practice depends upon developing skills and know-how for perceiving interesting and meaningful structures. Since Copernicus brought the heavens and the earth onto a common plane, astronomy has ceased to be the perception of structures meaningful in terms of signs and portents--as it was in astrology--and has become a physical science concerned with the development of practices for perceiving structures meaningful in the terms of material physics. A similar point can be made with respect to field biology, such as primate research and behavioural studies of other animals. It takes great skill to see more than a bunch of apes hanging around eating bananas and scratching themselves; researchers spend years learning to perceive social and behavioural structures, and these skills are inscribed in descriptive accounts and passed on to others. The factual knowledge so gleaned is not to be discredited, but it must be remembered that for its significance and meaningfulness it is situated within the context of skilled practices and highly developed forms of know-how. Factual knowledge does not consist of bare facts abstracted from any context, but exists within and opens up a field of possible practices.

Situating the progress of natural science in technological know-how rather than theoretical understanding reconfigures how we conceive the rationality of the process. It is not the abstract, calculatively rational process of considering propositions and evidence painted by philosophers who adopt the ISA approach. Rather, it is a complexly situated pragmatic rationality.

While we are capable of calculative reasoning, it is something we rarely engage in, and is not necessary for normal non-irrational action. For the most part we act without prior reasoning. Often we do not have--or have time to develop--adequate rules or an adequate propositional description of the situation with which to reason. Nonetheless, we may describe our actions as "rational" or "irrational," according to whether they are of the relevant sort to carry forward our plans and goals. It is irrational to keep trying the locked door: one seeks a door that yields, or finds a key.

Andrew Pickering illustrates the practical rationality of scientific practice in his history of particle physics, Constructing Quarks. He calls this pragmatic rationality "opportunism in context": taking advantage of those situations that offer some hope of progress. "Research strategies . . . are structured in terms of the relative *opportunities* presented by different contexts for the constructive exploitation of the resources available to individual scientists."[21] In a later work, Pickering expands on this theme:

> Doing science is real work; real work requires resources; different scientists have different degrees of access to such resources; and resources to hand are opportunistically assembled as contexts for constructive work are perceived . . . if one understands scientists as working this way then one can understand, in some detail, why individuals and groups acted as they did in the history of particle physics.[22]

And as Karin Knorr-Cetina observed in her anthropological study of scientific practice: "it is success in making things work which is reinforced as a concrete and feasible goal of scientific action, and not the distant ideal of truth which is never quite attained."[23] What Pickering's study of high energy physics shows is that the central aim implicit in even the most rarified realms of pure science is not the bare discovery of truth but the production of something that works and is useful in practice; and the rationality of scientific behaviour is largely structured by this practical, instrumental aim.

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21 Pickering, Constructing Quarks, 11.

22 Andrew Pickering, "Knowledge, Practice, and Mere Construction," Social Studies of Science 20, (1990): 692.

23 Karin D. Knorr-Cetina, The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science (Oxford: Pergamon Press, 1981), 4.

The model of scientific rationality as opportunism in context provides a means of understanding not only the actions of scientists working within research traditions, which Pickering describes in some detail in Constructing Quarks, but also their differential responses across Kuhnian "revolutions" or "paradigm shifts." It has often been noticed that in cases of major revolutions in science, some scientists commit themselves to new theories long before adequate substantiating evidence is forthcoming, while others continue to cling to outmoded theories long after the majority of scientists have rejected them. Albert Einstein was convinced of the truth of general relativity before any direct supporting evidence was available, but never accepted the Copenhagen interpretation of quantum mechanics. Priestly never accepted Lavoisier's oxygen theory of combustion, and Kelvin never accepted the electromagnetic theory.[24]

Given that rationality is considered the guarantor of scientific progress, those who cling to outmoded theories are frequently considered to be acting irrationally. Kuhn is kinder, saying that the holdouts cannot be accused of being irrational, though they may be considered unreasonable. But according to Kuhn the historian may be justified in saying that "the man who continues to resist after his whole profession has been converted has *ipso facto* ceased to be a scientist."[25] These seem rather harsh judgements, since the holdouts are usually older scientists, often with long and distinguished careers behind them. But it is also difficult to conceive of any robust notion of rationality according to which the young enthusiasts who jump to new theories in advance of adequate evidence are acting rationally, without defining "rationality" retrospectively so that whatever turns out to have been right is considered rational.

These problems arise as long as rationality is restricted to the consideration of theories in light of

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[24] Kuhn, Structure of Scientific Revolutions, 150-51.
[25] Ibid., 159.

evidence, whether one considers rationality to be cognitive algorithmic ratiocination (as in ISA accounts) or a matter of practical reasoning. Practical reasoning accounts, where the virtues of theories (such as simplicity, scope, elegance, etc.) act as values which different individuals may legitimately weight differently, permit a wider range of theories to be up for consideration; but unless such accounts can explain why the majority of scientific opinion eventually settles on one theory rather than another they are in danger of stripping "rationality" of any meaningful content, and rendering it irrelevant to scientific judgement.

In any account where scientific rationality consists in judgements of the likelihood of truth on the basis of evidence according to universal canons of rationality, adopting a new theory that is less well-supported by evidence than an old theory must appear as irrational as clinging to an old theory that is less well-supported by evidence than a new theory. That such enthusiasm and conservatism may serve functional roles in scientific progress by providing an impetus for innovative research and a forum of sceptical second opinion does not help the judgement of individual irrationality. By any robust cognitive account of rationality, it appears that at least some scientists, and these not only the kooks and failures, must sometimes act irrationally.

A different and kinder assessment of scientists' rationality follows from the praxical perspective, where progress rests in the successful development of practices rather than in the cognitive sphere.

A great deal of scientific work is a matter of getting some piece of equipment to work, or getting some phenomena to be reliably manifest. As Pickering points out, getting things to work involves the acquisition of skills, the assembly of materials, equipment, and skilled personnel. Those scientists who quickly move to embrace new theories are usually younger researchers at the beginning of their careers, who have little investment in resources or skills in a particular line of research, and are seeking an opportunity where significant contributions can quickly be made. Often they are wrong, and those who never finish their Ph.D.s are forgotten by history. Science only remembers its heroes.

Those who cling to old theories, on the other hand, are usually older, senior researchers who have built their careers around a particular form of practice. Often they head laboratories, have developed great skill in their field, and have amassed a considerable amount of equipment and personnel relevant to the tradition in which they have spent their lives. All this represents an investment of time, money, and effort. A new theory (or paradigm) may render these practices obsolete or uninteresting, and hence devalue the investment. But some scientists may yet see scope for further development of their practices. This is why old theories are rarely overthrown by being disproven; their adherents just eventually die out. We need not consider the diehards irrational merely because they did not accept the new theory. By their own lights, in the context of their own resources, the theory to which they remained committed offered scope for development; so it was not irrational to continue working in that matrix. They are not acting irrationally, because the rationality that is at issue isn't a matter of cognitive commitment but involvement in practices.

Pickering admits that his model of "opportunism in context" is very compressed and schematic, failing to capture the full richness of the episodes he described.[26] As other anthropological and sociological studies of scientific practice reveal, the detailed behaviour of scientific practice is guided and constrained by numerous influences

[26] Pickering, "Knowledge, Practice, and Mere Construction," 692.

besides the resources to hand and the aim of getting something to work. Funding sources, egos, politics, ideologies, personalities, and the vagaries of history all influence scientific practice in some respects.[27]

At least since science has become professionalized, it is imperative that scientists produce publishable results to maintain and further their careers. But "truth," "verisimilitude," and the like are not among the most important factors that determine publication; results must also be considered interesting by the journals' anonymous referees. Interesting results are those which contribute to existing practices: results, techniques, or products that others can use and build on.

Often, contrary to the popular notion of the importance of the replicability of experimental results and traditional philosophy's emphasis on verification, scientific results are not tested for truth, but merely put into use. This can be seen in the famous case of the determination of the chemical structure of the thyrotropin releasing factor (TRF) examined by Latour and Woolgar in Laboratory Life. Isolating enough of the material to permit a determination of its chemical composition involved processing tons of sheep's brains, a process far too time-consuming and expensive to warrant repeating. Isolation of TRF was important not because establishing the statement "TRF is Pyro-Glu-His-Pro-NH_2" added to a fund of verifiable truths, but because isolating the substance meant that it could be synthesized and produced in large quantities, thereby giving other researchers a tool to work with: a product with known properties which could be used in further research.

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[27] The literature examining the micro-structure of the influence of "extra-epistemic" factors on scientific knowledge has grown so rapidly in recent years that only a few prominent names in the field may be listed here. Among them are: F. L. Holmes, Martin Rudwick, Michael Lynch, S. Shapin, Karin Knorr-Cetina, and H. M. Collins.

The fact that it is the usefulness of results and not abstract truth that is important in science means that experiments are often not repeated to verify the truth of their results, but only by their results being put into use by others. This, as William Broad and Nicholas Wade illustrate through numerous examples, leaves the door open to scientific fraud: unscrupulous scientists occasionally publish invented or spurious results to gain publication credits to further their careers. Frequently the fraud is not discovered until others attempt to put the results into use in another context and find the methods and results do not work as they should.[28]

Situating scientific knowledge in know-how rather than knowledge-that erodes the distinction between the context of discovery and the context of justification, and broadens the conception of theory. As many have noted since the decline of logical positivism, the term "theory" in scientific practice refers to many different kinds of discourse which often bear little resemblance to axiomatic systems or sets of sentences held for true. Scientists distinguish between "phenomenological" and "realistic" theories, and use both; and there is often dispute (especially in high energy physics and quantum mechanics) over what status a particular theory has. What scientists refer to as a "theory" can vary from analogical models consisting of vaguely described visual images (as the "plum-pudding" model of the atom, or the "planetary" model) to sets of equations which are often only approximations or only apply in special circumstances.[29] Practitioners must develop skill in using and interpreting such theories, and in interpreting their findings in the light of such theories. From the praxical

[28] William Broad and Nicholas Wade, Betrayers of the Truth: Fraud and Deceit in the Halls of Science (New York: Simon and Schuster, 1982), passim.

[29] Nancy Cartwright's "ceteris paribus laws," e.g. How the Laws of Physics Lie (Oxford: Clarendon Press, 1983), 46-53.

perspective, these are the skills of perceiving the meaningful structures revealed in the practice, and of engaging in the linguistic discourse the community of practitioners has developed for communicating about these structures. As Karin Knorr-Cetina found in her study of scientific practice, "in place of the familiar alienation between theory and practice, we find an action/cognition mesh to which the received notion of a theory can no longer be adequately applied."[30]

From this perspective, discovery is not so much a matter of the invention of propositionally expressed theoretical structures which are subsequently tested against observational data, as perceiving previously unseen meaningful structures in the context of developing new practices. These structures are then articulated in language. This may require linguistic innovation: adding terms or changing the meaning of existing terms in the language, and disseminating these innovations and the practices which give them meaning. Rational theory is necessary for explaining and revealing structure to others; it does not exist at the forefront of scientific investigation, but is developed after discovery for the purposes of sharing the vision of meaningful structure revealed through the skilled practice.

Confirmation and discovery become conflated because discovery is a matter of extending a practice or developing a new one, not abstract theoretical invention. The perception of data required to confirm (or even formulate) a theory depends upon the development of the practices within which that theory arose: there is no practice-independent way of confirming a new theory. Theories are rooted in the practices which give them meaning, so from their first expression they are already as well-confirmed as the practices which they articulate, and are only further

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[30] Knorr-Cetina, The Manufacture of Knowledge, 4.

confirmed when others put the practice to work in different contexts.

The praxical perspective situates scientific knowledge, progress, rationality, and discovery in the practical realm of developing know-how rather than the traditional sphere of propositions and truths. But this must not be interpreted as demoting the status of theory to a mere calculating device or a summary of empirical observations. Nor am I denying that theory can sometimes be an important stimulus to scientific discovery. These points should be clear if one considers the implications of the conception of language developed in the last chapter. Language is a form of practice or meaningful action, and its meaning derives from how it is embedded in and interacts with the other meaningful dimensions of our dealings in and with the world. Language is not a system of signs standing for objects or ideas existing independently of our practices; therefore, as a form and component of skilled practice, it can act as a catalyst (and sometimes hindrance) for the larger complexes of skilled practice (such as science) of which it is a part.

In making theory more radically a part of practice, the praxical perspective goes beyond many other views of science as practice with which I am otherwise in sympathy on many points. For instance, Pickering speaks of an interplay between theory and practice. On his formulation theory and practice are closely interrelated, but theory is still implicitly treated as a cognitive object and practice predominantly as physical manipulation. On the praxical perspective, there are no "theories" to stand as cognitive objects opposite the world, and no sharp boundary dividing mental thought from physical behaviour.[31] As knowing agents we act meaningfully in the world and the world is

[31] There may of course be some pragmatic purposes for which such a distinction is useful; the point is that the praxical perspective undercuts any tendency to make a metaphysical distinction.

constituted as meaningful by those actions; among the ways we act in the world are the uttering and using of the sentences and representations that make up what we refer to as theories. These theoretical utterances and other acts serve to enhance our practical dealings in the world, particularly (but not solely) in our co-operative actions with others. The forms of utterance that count as scientific theory are therefore as various as the forms of scientific practice, and their epistemic status is only as secure as those practices.

Practices are ways of acting; like riding a bicycle, a skilled practice is more than the sum of past successful responses to situations encountered. It is a way of acting that is able to adapt and work in novel situations. Similarly, theories go beyond the data previously encountered because theories are not mere representations of data but ways of acting. Theories are linguistic elements of scientific practices; in a sense, theorising is a form of higher-order skilled practice that encompasses the skilled practices in which the theories are formulated. In this way, theories serve as an effective means of coordinating the skills that make up scientific practices and extending these skilled practices into other domains.

Theories are frequently extendable beyond the data originally encountered for the same reason and exactly to the same degree that the practices within which they are embedded are extendable to different circumstances. Just as when one learns to ride a bicycle in one's own back yard one can extend the practice successfully to ride around the world, so a theory devised in the context of one configuration of equipment in one laboratory will usually be generalizable to other configurations and other laboratories. Theories are one means by which scientists share and disseminate scientific know-how and communicate the structures perceived in the context of their developing practices.

Theories can also serve as preliminary maps to a territory, thus bringing into synoptic vision features seen only separately in experimental practice and thereby revealing probable structures and entities not yet discovered in the laboratory. This function of theories meets an objection some may raise to my earlier arguments for the priority of technological know-how to scientific knowledge-that. There have of course been cases where theoretical predictions predated the development of the technology or experimental practices required for their verification. The gravitational time-dilation effect predicted by Einstein's general theory of relativity provides an obvious example. According to the scientific ideology, particularly as expressed by scientific realists, this demonstrates that science has a method for grasping truths (theoretical knowledge-that) that go beyond available (empirical, factual) evidence. Among the ways some have tried to account for this mysterious faculty are Peirce's concept of abduction and contemporary arguments for a principle of inference to the best explanation. From the praxical perspective, however, the predictive power of theories is not a function of their correspondence to a hidden reality; rather, it derives from the role that theories play in our practices. Because theories are rooted in technological know-how, and such know-how (if not illusory) is itself potentially extendible, theories can act as guides to further action and perception. As a map sketched in a preliminary survey can suggest features not initially visible from the ground, so a theory can suggest possibilities for action not initially revealed in the development of the practices in which the theory was first developed.

This point is nicely illustrated by Frederic Lawrence Holmes in chapter three of Lavoisier and the Chemistry of Life. Here he describes in detail how Lavoisier developed his theory of respiration through the interplay of a series of experiments with his efforts to organize his laboratory experiences at his writing table:

> It appears that he developed much of the theoretical interpretation after the experiments were over, as he strove to place his immediate results into a framework composed of his own broader experience and the state of knowledge about respiration into which he was injecting his contribution.[32]

The fact that in this case discovery was a slow process largely occurring at the writing table does not contradict the point made earlier (with respect to McClintock's sudden flash of insight) that discovery is a matter of skilled perception rather than cognitive calculation. On the contrary, it brings the linguistic act of theoretical expression into the process of skilled perception of structures that have become meaningful for a developing practice. As Holmes writes,

> the mind cannot readily encompass at one time the entire structure . . . Only by putting it on paper . . . can one construct the conceptual edifice which has not at any single instant existed in complete detail in the center of one's mental field.[33]

Of course we can be mistaken about whether we really have a workable practice, and so we can be mistaken about the entities and relations postulated in the theoretical expression of that practice. I may think that I have a sure method for winning at roulette because I have won six nights consecutively, but I may suddenly be disappointed when I start to lose. All our practices may be this epistemically precarious: there is no guarantee that the systems in which we intervene are not more complex than previous successful

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[32] Frederic Lawrence Holmes, Lavoisier and the Chemistry of Life: An Exploration of Scientific Creativity (Madison, Wisconsin: The University of Wisconsin Press, 1985), 89.

[33] Ibid., 90. Holmes' idiom suggests that he conceives of theory as a cognitive entity standing opposite and making sense of the world; again, the praxical perspective re-interprets this situation so that the act of theorizing is an extension of the practices in the laboratory, rather than a separate kind of act.

practice has led us to believe. The point is that the problem of the projectibility of theories is not different from the problem of the projectibility of any kind of practice. It happens that the environment in which we act is so constructed that many aspects remain constant over time or change in regular or cyclical ways. If it were not so, it is doubtful that there could be conscious beings.

From the praxical perspective there is no need to postulate a mysterious faculty of abduction or a special principle of scientific rationality such as inference to the best explanation to account for science's ability to discover true theories. Nor need we appeal to a correspondence theory of truth to account for the success of science. Science is not a means of making metaphysical contact between scientific propositions and "reality" existing on the other side of the epistemological gap; it is just an extension of our other human practices for dealing with the world. Science's theoretical expressions spring from the same know-how, embodied in scientist's skills, procedures, and instruments, as the practical doings of science.

Being a human practice, science has a social dimension. "Truth," conceived in the scientific ideology's sense as a transcendent epistemic ideal, is not a unitary goal which guides the direction of scientific research. There are many social and historical reasons why scientists pursue particular directions of research. This does not reduce scientific knowledge to a social construct or leave it at the mercy of historical contingency as some social constructivists argue. What renders radical social constructivism highly improbable is the manifest success of science evidenced in technological progress. The praxical perspective takes account of this: scientific knowledge is always anchored in what it is possible to do, not in social conventions or individual preferences about what to believe.

Although the foregoing may suggest a radically deflationary view of truth, the account of language developed in chapter five provides a perspective according to which truth can be seen as a goal of scientific practice. Truth, on this view, is a matter of the successful co-ordination of linguistic actions with other forms of skilled practice. This, in turn, suggests why it is recommended that the praxical perspective be adopted: it highlights the fact that, while science may aspire to truth, its scope for action extends to nothing more (and nothing less) than the perfection of *scientific* practices. We cannot make knowledge in whatever form we wish by different social arrangements or epistemic commitments, but we can choose the kinds of practices we develop. This means that there may well be more that we could know and, crucially, more ways in which we can know, than we now think possible. This is the issue of the next chapter.

7.

SOME CONSEQUENCES OF THE PRAXICAL PERSPECTIVE

> There are more things in heaven and earth, Horatio,
> Than are dreamt of in your philosophy.
>
> --Shakespeare, Hamlet

The scientific ideology is not an abstract theory of knowledge, but is embedded in our epistemic practices: what we value as legitimate knowledge and the characteristic ways we go about achieving it. Consequently, it is not to be supposed that the praxical perspective merely replaces a false epistemological theory with a better one and leaves our epistemic practices essentially untouched. Several consequences of adopting the praxical perspective will be examined in this chapter, falling roughly into three related areas: the status of materialism and the physical sciences, the relation between the physical and social sciences, and the boundaries between science and non-science.

The epistemological bias of the scientific ideology toward knowledge-that at the expense of know-how may also be characterised as the view that knowledge consists in cognitive possessions rather than abilities. This conception of knowledge leads to the belief that there exists a universal rational method, somewhat like a calculating technique, for gaining or confirming knowledge. From this perspective it follows that this method, and the associated standards and criteria of epistemic adequacy, must be most perfectly embodied in those fields that lend themselves most easily to computational reasoning techniques. I suggest that this may be the reason why physics has predominantly been taken as the model for a universal epistemological method, and why other practices are judged "scientific" to the degree that they emulate the methods of physics in their own fields.

The notion of a universal epistemic method underlies the view that the sciences, by virtue of embodying this method more or less perfectly, potentially lead to a complete and true account of reality. The various sciences are arranged hierarchically according to their subject-matter and the degree to which they can emulate physics in their methods and success: physics provides an account of the ultimate constituents of reality, and chemistry, biochemistry, biology, psychology and the social sciences deal with progressively larger and more complex aggregates of fundamental matter. On this view the content of each science must be at least compatible with--if not reducible to--the previous science in the hierarchy, and ultimately all science must be compatible with the materialism of physics, the fundamental science.

Thus the sciences together are seen potentially to encompass all possible knowledge. The limits of what is real and possible are given by science, and science has discovered, by turning its methods to ultimate reality, that the world is essentially material. This material world provides the arena within which we must frame our actions, our choices, hopes and dreams. To stray beyond these limits is to be irrational, superstitious, ignorant, or primitive.

A considerable body of traditional philosophy of science has been concerned with articulating this presumed scientific method. But for all its importance in delivering the world-view within which we live, there is no consensus on the nature of the scientific method. Attempts to articulate the scientific method fill the philosophy of science shelves of our libraries: Mill's methods, logical positivism's hypothetical-deductivism, Popperian falsification, Quine's and Hesse's reticulated models of theory-change, Bayesian epistemic kinematics, evolutionary schemes, "bootstrapping" models, and on and on. While each seems to capture some elements of science's cognitive rationality, neither individually nor together do they seem to capture that unique method which the scientific ideology imagines to exist.

There is no need to trace out here the myriad problems occasioned by all these attempts to rationally reconstruct the scientific method. The general shape of that project, and its problems, derive from the scientific ideology's view that knowledge is fundamentally knowledge-that. From that perspective, the scientific method necessarily appears to be a cognitive process of propositional calculation or interpretation. The praxical perspective provides a different view of the nature and scope of scientific knowledge.

If knowledge be considered to rest in know-how rather than knowledge-that, then the universal epistemic method is that means by which we develop any workable practice. This is not a matter of cognitive reasoning, but directed effort and practice. One must practice under the tutelage of skilled practitioners until mastery of established practices is achieved; in order to further the practice, practitioners must try new things and modifications upon established methods, and follow up those that offer promise of furthering the practice and discard those that thwart progress. This is essentially the method behind the pragmatic rationality of scientists described in the last chapter.[1]

This description of epistemic method is supra-cognitive, because language, reason, and rationality are themselves situated within the practices developed. A dog learns to fetch the paper or catch a ball by essentially the same "method" that science develops new techniques of genetic engineering, with only the obvious difference that

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[1] This is similar to the point Feyerabend made with his famous slogan, "anything goes." However, he overstated the case. I would say, "whatever works."

the dog does not use language or theory. The theoretical language used by scientists is not something over and above the skilled practice; it rests upon the skills developed in the practice. The meaningful structures revealed to experience in the context of developing the practices are acted upon in many ways, one of which is by being expressed in sentences and theories.

The praxical account of universal epistemic method is obviously not limited to the sciences. It includes all manner of non-scientific skills and practices, including sports, games, politics, the arts, and morality. Therefore, we cannot delimit the sciences from other practices by their distinctive cognitive epistemic method, nor can we delimit the individual sciences by the subject matter to which this presumed method is turned. Part of what distinguishes science is of course its cognitive focus: science is dedicated to making know-how articulate. But this alone cannot differentiate science from many non-scientific practices, including religion and astrology. It is a universal human tendency to develop language for talking about everything we do.

However, there is something epistemically distinctive about the forms of science upon which the scientific ideology confers the highest priority. There is a sense in which physics is the most scientific of our epistemic practices. But what this priority consists in, and what it means to be "scientific," appears quite different from the perspective of the scientific ideology than from the praxical perspective. The shift from the former perspective to the latter can be characterised as a shift in focus from the cognitive sphere of reasons and propositional truths to practices and know-how. The praxical perspective reveals that what it is to be scientific lies not in the cognitive structure of our reasoning, as the scientific ideology presumes, but in the characteristic nature of what we are doing: the kind of skills and practices that are employed and developed.

From this perspective, the physical sciences may be characterised as the development of instrumental practices. I mean "instrumental" here in a quite literal sense, referring to the use and development of fabricated instruments and rule-like procedures which may be modeled or instantiated in fabricated instruments. "Instruments" refers to mechanical devices which work in reliable and predictable ways, always yielding the same results in the same circumstances irrespective of who uses them or what their wishes or beliefs may be at the time. What enters into understanding through the employment of instruments are the structures that are important for the development of instrumental practices: those features of reality that are regular and repeatable, and which may be measured and manipulated through the use of instruments.

My characterisation of the natural sciences as instrumental in the sense described above is conceptually different from the view expressed by Habermas in Knowledge and Human Interests in a number of ways.[2] On his account, the instrumental character of natural science derives from a universal human interest in manipulation and control. My use of the term "instrumental" differs from Habermas's in not being co-extensive with prediction and control. Also, I do not share Habermas's characterization of science as the consequence of a pre-existing interest, and I am more metaphysically modest in my conception of the origin of the human interest in instrumental practices. The instrumentality of science in my terms resides not in its ends of technical control, but in the fact that it employs fabricated instruments. Because I conceive of practices as discovered possibilities for action, I think of the interests inherent in practices also as something

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[2] Jürgen Habermas, Knowledge and Human Interests, trans. Jeremy J. Shapiro (Boston: Beacon Press, 1971).

discovered. On my view, the human interest in instrumental practices of prediction and control emerged along with the development of practices for making and using instruments. This possibility may have always existed as a human potential, but I do not claim that it is a pre-existing universal human interest that drives the development of science. The instrumental practices of science are something that humans happened to discover and develop; not something that we had to develop in some form or other.

It is a consequence of the scientific ideology that we often only recognize those ends which could be effected by means of instruments, and relegate the radically different practices sometimes discovered in other cultures to merely social categories of religious belief, ritual, or superstition. But there may be other ends than instrumental ones, and some of the ends which we now achieve through instrumental means (such as health) may be possible to achieve with other, non-instrumental practices.

The practices which we dignify as sciences, however, are almost entirely instrumental. Astronomy became a science when people developed instruments to track and measure the paths of the stars and planets. Progress in astronomy has been led by the development of more advanced instruments and techniques for using them, from early astrolabes and telescopes to radio-telescopes and orbiting observatories. The progress of physics, similarly, may be measured by the development of progressively more advanced instruments for measuring and interacting with material objects, from early scales and clocks to ever more powerful particle accelerators and more subtle detectors. Chemistry evolved from alchemy as the focus of the practice shifted from studying mystical and symbolic interconnections to developing instrumental techniques for measuring and manipulating substances. Where alchemists discussed secret signs and spiritual powers, chemists developed and worked with air pumps, collecting flasks, delicate scales and measuring devices, and focused exclusively on what could be done with these devices. In developing these techniques they discovered the substances and relations that are important for reliable instrumental manipulation and measurement of chemical substances.

Physics has priority as a science not because it most perfectly embodies the cognitive method the scientific ideology presumes to be the distinguishing feature of science, but because it is the most instrumental of epistemic practices. Other fields of endeavour have become sciences, or are judged to be scientific, to the degree that they have become instrumental. Biology is now almost entirely instrumental, with only the small area of animal social behaviour standing somewhat outside that sphere. More interestingly, the applicability of instrumental practices to the study of persons has always been questionable, with the result that the status of social research as a science has always been problematic. Before turning to that question, though, a number of issues relating to the status of materialism and natural laws may now be addressed from the perspective of the scientific ideology.

Viewing the natural sciences as instrumental practices rather than a universal epistemic method turned to "nature" alters the status of the materialism which is such a central part of the scientific world-view. At the dawn of modern science materialism was advanced as a metaphysical postulate, sometimes argued for on epistemological grounds.[3] Lately, from the perspective of the scientific ideology, it has come to appear that the materialist postulate was a good guess which the success of physical science has subsequently thoroughly verified as the true ultimate nature of reality. From the praxical perspective, however, materialism appears

[3] As by Descartes, especially in rule 12 of "Rules for the Direction of the Mind," in The Philosophical Writings of Descartes, trans. Cottingham, Stoothoff, and Murdoch, 39-51.

as a consequence of the instrumental character of natural science. "Matter" is not the discovered nature of ultimate reality, nor an interpretation we place upon revealed objective data. Rather, materialism is inherent in the instrumentality of our epistemic practices.

Joseph Rouse, who has developed a very similar perspective to that advanced here, expresses the point as follows:

> The manifestation of nature as dead, inert, noncommunicative, and fit only for manipulation to suit our ends belongs to our configuration of practices, not to a "real," uninterpreted nature of things. The point is not that we ascribe crudely anthropomorphic characteristics to nature or that nature is our "construct." We encounter "nature" through our practices, as it fits in and is revealed intelligibly in that context. What it is to *be* natural is at issue in our dealings with the world (we must not forget that distinctions like natural/social, natural/artificial, natural/deviant articulate a field of meanings). It is not that different cultures live in different worlds, but that the world has a different hold upon them.[4]

It is because our most valued epistemic practices use and develop instruments and instrumental techniques to interact with the world that the world appears as material. Instruments are devices which work according to rule, regardless of who uses them or their state of mind at the time. Anything which does not function according to rule is not amenable to instrumental measurement and control. As a consequence, non-materialistic objects and processes barely enter into consciousness in the context of developing instrumental practices, except as noise, error, or not-yet-understood complexity.

Rouse develops his view within the idiom of continental hermeneutics, which tends to suggest that our understanding of the world as material is a cognitive interpretation we place on something pre-existing. He argues against this

[4] Rouse, Knowledge and Power, 181-2.

reading, but he must fight against the tendency of the hermeneutic tradition to propositionalise understanding and knowledge. My position may be clarified by emphasising that the distinctions (natural/social, natural/artificial, natural/deviant) are not linguistic or propositional categories which we impose upon an undifferentiated world, or which impose their structure on our understanding, but are already inherent in our ways of acting. It is on the basis of our practices, which have been developed in dealing with the world, that these distinctions are expressed in our language. Practice precedes propositional interpretation.

I would also turn Rouse's last clause around: it is not that the world has a different hold on different cultures, but that different cultures have a different hold on the world. My difference with Rouse may be more a matter of emphasis and style of expression than substantive, but I must stress that it is not a question of how (a presumably pre-existing) nature fits in our practices, or how our configuration of practices causes nature to be interpreted as material: it is simply that our practices are predominantly instrumental. Within these practices, only instrumentally manipulable or predictable structures are presented to experience. Given these practices, we have no choice whether to describe nature in materialist terms or not, because the meanings of terms in the language we use to describe these entities is anchored in the practices through which the objects and processes emerge into our understanding. We live in a material world not because of our choice of interpretive language, but because of our choice of how to act in the world. The materiality of the world was chosen, not discovered.

What is said here about the materiality of nature also goes for the status of natural laws. There is a close connection between the conception that fundamental reality is dead matter and the conception that all the complexity of reality may be captured by a few simple laws which describe the behaviour of fundamental matter. Whether scientific laws be considered as merely descriptive (as with David Hume and more recent positivists) or as real principles of nature (as in scientific realism), it is a constant tenet of the scientific ideology that scientific laws represent deep truths about reality. It has also been generally supposed that the fundamental laws of current physics come close to capturing the very essence of reality, so that if only we had adequate powers of computation we could explain all events in the history of the universe on their basis.

From the praxical perspective, however, scientific laws are not so much representations of deep truths about reality as expressions we find important and useful for the instrumental practices we have developed and given highest epistemic status. Obviously what we may do is not dependent solely upon our whim: the laws we have depend upon the practices we have been able to develop in the world. But the character of natural laws--quantitative rule-like relations--rests in the instrumental character of natural science's practices. Because we develop practices for measuring and manipulating the world through the medium of instruments and techniques which are only considered valid because of their inertness and rule-like character, nature is revealed as inert and rule-governed.

It is arrogance to suppose that the practices which we hold in highest regard reveal the most fundamental truths about reality. Beings who developed very different practices would doubtless find different principles important; and they may well believe that those principles reflected the ultimate truths about reality. Law-like relations are important for the configuration of our practices, but there is no reason to suppose that they have any metaphysical reality or revelatory importance beyond that. Laws of nature are something we create for and within the practices we develop; they are not something lying ready in the world to be discovered by a transparent epistemic method.

The scientific ideology supposes that all that is humanly possible must be performed within the arena revealed by natural science. Having discovered that the world is material, all we can do is manipulate it to our ends, and manage things for our benefit. But the praxical perspective reveals that the vision of the world as a material arena resides only within the configuration of our practices. By honouring knowledge-that over know-how, and modeling all our epistemic practices upon the instrumental practices of natural science, we have developed our capabilities as instrumental manipulators at the expense of other possibilities. Material/instrumental manipulation is how we have developed ourselves and our way of being in the world. We think that because we have a superior (correct) way of knowing in science, the world is as it is depicted in that way of knowing. The praxical perspective reveals the possibility of a wider vision of the world.

A hint of a wider vision of reality than the material world of natural science is actually present in our everyday lives. We are all aware of our own consciousness and agency, and we are usually aware that others with whom we relate (including our pets) are not mere machines, but are also conscious beings with qualitative perceptual and emotional experiences and volition. These mental phenomena do not fit easily into a materialistic world-view. It is quite mysterious why there should be any subjective experience of what it is like to be some configuration of matter. If this subjectivity is accepted as a fact, a further problem remains: materialism can only account for the course of events as the result of previous states evolving according to deterministic or stochastic laws. That is, everything that occurs is either inevitable or accidental. Yet we remain convinced that we control some events through our choices. Our moral lives are predicated on the belief that it really does matter what we think and choose.

This undeniable aspect of experienced reality is sometimes addressed (though it is more often ignored) from the perspective of the scientific ideology as the so-called problem of consciousness. The approach generally taken is to discover a way to account for or dismiss the conviction or appearance of subjective experience and volition within a materialistic world-view. Very few today accept the approach of Cartesian dualism.

The praxical perspective provides a very different view of the problem. From this perspective, the perception that others exercise agency and have conscious experiences rests upon the fact that our practices for relating to them are not merely instrumental: we deal with others as consciously aware persons. If we dealt with others only by manipulating and measuring them through the medium of instruments they would be revealed to us as mere machines. Such a mechanistic vision is approached in highly technical medical science, physiology, and behaviourism. But our everyday practices for interacting with others encompasses a broader range of practices than instrumental manipulation and measurement, and therefore reveals a broader reality.

It may be objected that this still leaves the nature of the relation between material and mental phenomena quite opaque, and so offers no solution to the problem of consciousness. However, the aim here was not to solve this problem, but only to reconfigure the issue. Discovering how to integrate the mental and the material would require developing practices which harmoniously encompass both, not developing a reductive theory. Nor would the problem be one of discovering a relation between two distinct kinds of substance, matter and mind. Modern material science, after all, does not reveal matter as a single substance. Depending on the particular configuration of instrumental practices, the material world is revealed either as various kinds of particles and fields in space-time, or a multi-dimensional geometric continuum, or a quantum field with various sorts of properties. The mental realm is no doubt at least as richly multi-dimensional, but our epistemic practices for dealing with it are--largely due to neglect--much less developed than our instrumental practices.

The scientific ideology has always had difficulty accommodating those epistemic practices where other persons and minds are encountered. On the one hand are those who argue that the social sciences and psychology, in order to be properly epistemic, ought to resemble the natural sciences in their methods and results. Observing that there is little apparent agreement on method or progress of results in the social sciences and psychology, this view leads sometimes to calls for more scientific rigour in these fields, sometimes to the conclusion that these fields still await proper methodological or theoretical foundations or research paradigms to set them on the road to science, and sometimes to the denial that these fields as practiced ought even to be called sciences.

On the other hand are those who argue that the social sciences are essentially different from the natural sciences, and so require a different method or form of practice. This distinction generally derives from the observation that the social sciences deal with agents whose actions are based on their understanding of their situation, rather than on immutable laws of nature. In this view the social sciences must be directed towards an understanding of socially constituted meanings, rather than the discovery of facts as in the natural sciences. The appropriate method for the social sciences has therefore been variously described as akin to philosophy, translation, or, increasingly, interpretation.[5]

[5] See, respectively: Peter Winch, The Idea of a Social Science and its Relation to Philosophy (London: Routledge and Kegan Paul, 1958;

There are many positions among and between these, but this rough sketch will be adequate for the present purposes. With some liberty, I will refer to the latter approaches as interpretive, and the former ones as positivist. Two issues can be separated here: the status of social research as science, and the appropriate methods for such research.

Whether to call social research science depends on what is meant by the term "science." The scientific ideology traditionally equates science (from the Latin *scientia*, meaning knowledge) with all valid knowledge, but because it misrepresents the character of knowledge it only recognizes as valid those epistemic practices which relevantly resemble natural science. From the positivist perspective, the interpretive approaches to social and psychological research appear non-scientific because they abandon the logical methods of natural science. However, those who adopt interpretive approaches have not, in general, completely abandoned the scientific ideology. They usually still situate knowledge in the propositional sphere of discursive understanding, and they commonly call their approaches scientific, on the ground that they are seen to be epistemic and yield discursive understanding.

Earlier in this chapter I suggested that what delimits those activities that lie at the core of the scientific ideology is not their unique cognitive method, but their instrumentalism. In doing so I am abandoning the traditional equation of knowledge and science. Other forms of practice can be successfully developed, hence also constitute knowledge. There are non-scientific epistemic practices. This definition of "science" preserves the scientific ideology's traditional extension of the term, including the problematic status of the social sciences. The natural sciences are wholly scientific, being entirely instrumental

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reprint, 1986); Stephen P. Turner, Sociological Explanation as Translation (Cambridge, Cambridge University Press, 1980); and Interpretive Social Science, eds. Rabinow and Sullivan.

in their methods, but the distinction cuts through the social sciences and psychology. Instrumental methods are partially applicable in these fields, but problematic.

There is little doubt that social science practices can be developed on the model of the natural sciences, as positivists since Comte have argued and advocated. What this amounts to, from the praxical perspective, is not the correct ("positive") route to true sociological knowledge, but the development of instrumental practices for measuring and manipulating persons. In fact, a considerable part of the social sciences and psychology have been developed in this direction. Sociologists are fond of calling their surveys and questionnaires "instruments," quantitative measurements and statistical techniques are frequently preferred over qualitative ones, and psychology tends toward behaviourism and psycho-chemistry. This instrumental form of social research is perhaps most highly developed in marketing, where profits depend upon effective manipulation of the aggregate behaviour of consumers through instruments of communication.

The fact that it is possible to develop instrumental practices for dealing with persons argues against the view that social research is essentially different from natural science. However, this must not be taken to mean that social science is necessarily just an extension of natural science's methods into the social sphere, as positivists argue. There are familiar ethical and practical limitations on how far instrumental practices may be developed in dealing with persons. It is difficult--and often immoral--to conduct controlled experiments with persons; laws appear scarce in the human realm; and human actions generally appear to result from free choice based upon the agent's understanding of the situation, rather than on objectively determinable behaviouristic laws.

By abandoning the notion of a unique epistemic method for achieving knowledge, the praxical perspective leaves open the possibility of other ways of knowing than the instrumental practices at the core of the scientific ideology. These different forms of epistemic practice are especially relevant where other agents and social life is concerned.

Note that my account differs substantially from Rouse's on this point. He assimilates the natural and the social sciences to a common model of interpretation in order to undercut the scientific ideology's exemption of objective science from political critique.[6] As a consequence he minimizes the distinctively instrumental character of the natural sciences, and this leaves him with little or no ground to develop the possibility of different ways of knowing. The praxical perspective, on the other hand, emphasises the possibility of different forms of epistemic practice. This difference of emphasis has the effect of re-locating the meaning of our practices (and the locus of critique) directly in what we do, rather than in the interpretations we place on our actions and the world.

What epistemic practices in the social realm might look like from the praxical perspective can be indicated by analogy with the material sciences. I have characterised the latter as the development of instrumental practices for measurement and manipulation, rather than as a cognitive method for discovering truths of nature. If there be specifically social epistemic practices, then, the praxical perspective would characterise them as the development of social practices. It seems eminently reasonable that such practices can be developed on at least two levels. One may develop social skills within an existing culture, and the social practices of a community may be improved as a whole.

The praxical perspective clearly reveals that understanding a foreign culture (or a sub-division of one's own culture) is not an abstract descriptive task, but one

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[6] Rouse, Knowledge and Power, ch. 6.

must learn the practices of that culture. Researchers must immerse themselves in the other culture, adopt their practices, and learn to see the world from their perspective. For this to be more than a personal learning experience, the experience must then be communicated to the researchers' intended audience. Both aspects of this first dimension of a social epistemic practice raise some familiar problems.

It is often difficult to see beyond one's own cultural practices and categories. There is a strong tendency to judge different cultural practices by the standards of one's own culture, and find them wanting. This is especially the case when encountering so-called "primitive" cultures where magical, spiritual, and occult practices are common. The scientific ideology provides a strong presumption that science has discovered that these practices are ineffective and illusory. From this perspective the researcher's task is to explain why these practices persist and are believed, rather than to learn from them. This will be discussed further shortly.

Assuming that one is able to get beyond the limits of one's own culture and learn the practices of another, the problem remains of communicating that experience to an audience that has not had the benefit of first-hand experience. In part this is a process of translation and interpretation, which requires considerable linguistic skill and may present deep problems. But contrary to Quine's indeterminacy of translation thesis,[7] it is possible to a large extent. As I argued in chapter five, the meanings of the terms in our language are rooted in our shared practices and know-how. All humans live in much the same natural world and share many practices. We all eat and drink and sleep, suffer from cold and heat and illness, fall in love and procreate and die, make friends and enemies, and many other

[7] W. V. Quine, Word and Object (Cambridge, Massachusetts: The MIT Press, 1960), ch. 2.

things as well. These shared practices and experiences form a common core which makes all human cultures at least partially familiar and renders all human languages partially intertranslatable.

The practices of our culture are very rich, and the correspondingly rich vocabulary provides enormous resources for translating the languages of other cultures and articulating their worlds. If our culture does not have an exact correlate of some foreign practice, we can often approximate it through comparison with similar practices. But this does not justify the ethnocentric presumption of the scientific ideology that the scientific world-view of the modern West encompasses all that is epistemically valid in other cultures and provides the correct standpoint from which to judge and interpret all forms of practice. Our existing linguistic practices may not have the resources to communicate all the experiences of persons with very different practices. The praxical perspective indicates that this problem cannot be overcome by abstract interpretive methods, but that those foreign practices which cannot be mapped into our own must be learned and shared for effective communication and understanding to occur.

This problem is not limited to the social sciences; a similar problem in the communication of knowledge can be seen within the natural sciences. In a study of the development of high-pressure gas lasers, H. M. Collins discovered that "a scientists who was to learn to build a successful copy of a laser nearly always needed to spend some time in close interaction with another who had already built one."[8] This direct apprenticeship was required because the skills required to construct the laser, make it function, and perceive when it was working correctly, could

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[8] H. M. Collins, "The Replication of Experiments in Physics," in Science in Context, eds. Barnes and Edge, 97; see also "The TEA Set: Tacit Knowledge and Scientific Networks," Science Studies 4 (1974): 165-86.

not be communicated through the written texts of journal articles only. Replication of the experiments was only possible once others had learned the necessary skills, which usually required direct apprenticeship and skill-transfer. Communication in natural science as well as social science is only possible through the dissemination of the relevant skilled practices.

A further familiar difficulty for social research is the perceived problem of objectivity. This stems from the scientific ideology's presumption that valid scientific knowledge leaves a pre-existing "external" reality unchanged, and delivers a representation of it, or truths about it, to the understanding of the knower. While it is assumed that the natural sciences achieve this in that they only report but do not alter the laws of nature, this kind of objectivity is much harder to achieve in social research. Anthropologists going into "primitive" cultures must often purchase the cooperation of their subjects with artifacts not readily available locally, and at the least they bring with them an awareness of a larger world with different practices. As well, the process of questioning the subjects on their practices and presenting them with tentative explanatory accounts for their critique can bring the subjects to a level of reflexive awareness they may not previously have had. All these things may cause the subjects to alter their behaviour, and hence the social practices which were the presumed objects of study.

The perception of a significant difference between the social and natural sciences with respect to this sense of objectivity rests upon a deeply-rooted Western notion that humans somehow stand outside of the natural order. By shifting the conception of knowledge from the representation of reality to the development of practices, the praxical perspective locates the knowing subjects within the natural world, and thus provides a standpoint that largely erases this difference.

The development of instrumental practices in natural sciences does not leave nature alone, and not only in the Baconian sense that science puts nature on the rack to test its limits and discover its structures.[9] The objects of study in natural science are rarely phenomena found in nature; more often science deals with highly constructed artificial situations. In developing instrumental practices, science introduces new phenomena into nature. Ian Hacking makes this point with reference to the Hall and Josephson effects, which he notes do not exist outside the configuration of certain kinds of apparatus. Similarly, it is doubtful that there are any natural lasers; "lasing" is a phenomenon created by science.[10] Controlled nuclear fusion, electrical power generation and transmission, genetically manipulated organisms, high levels of organized radio waves, and many chemical compounds and their reactions are also new artifacts and processes that the development of science has introduced into nature. The implicit aim of scientific practice is not to describe nature without interfering, but to develop new workable practices. It is therefore somewhat of a myth that scientific laws are objective descriptions of the natural order; rather, they are guides to the structures revealed through the practices we have developed.

The development of new instrumental practices in natural science, and the concomitant introduction of new phenomena, parallels the development of social practices and the introduction of new social structures--a process which social research can hardly avoid. Consequently, it is misleading to say that the social sciences ought to leave the social order alone to be properly scientific; social research is similar to the natural sciences to the extent

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[9] "[N]ature exhibits herself more clearly under the trials and vexations of art that when left to herself." Francis Bacon, quoted in Merchant, The Death of Nature, 169.

[10] Hacking, Representing and Intervening, 225-7.

that it is explicitly oriented towards changing society and improving social practices.

This leads to the second dimension of social research mentioned above: the improvement of our social practices. Because of the scientific ideology's illusion of objectivity, this is not generally seen to be a proper epistemic goal, but a matter of politics. It is thought that political aims may be served by (value-free) social research, as industry is served by (objective) natural science, but politics itself is not seen to be epistemic, and social research usually aims to stand outside of politics. But from the praxical perspective the distinctions between abstract knowledge and the engaged aims of action and practice do not stand. The gain of knowledge in the natural sciences lies in the development of instrumental practices; similarly the gain of knowledge in the social sphere can be seen to lie in the development of social practices.

The difficulty of attaining objectivity in social research should not be seen as a flaw or a failure to be scientific, but as evidence that the practices are truly engaged in the development of knowledge. Even the most "objective" social research can hardly help but influence social practice. Making subjects aware of the structures within which they live and the history by which they have come to their present arrangements has long been recognized to contribute to social progress because of its capacity to uncover injustices, illusions, and ideologies, and reveal variability in structures that may be unquestioned or seem natural to unreflective consciousness. This function of social science can be strengthened by research that is directly oriented towards social improvement.

One especially good and vital current example of such politically engaged social research is feminist social science, which aims not only to describe injustices, but to eliminate them and thereby improve society. Contrary to the scientific ideology, the bias of feminism is not an epistemic weakness--a failure to be objective--but a strength, because it is oriented to the positive aim of social improvement.[11] Marxism provides another example of engaged social research which has served a positive role in some times and places, but it is flawed by an occasional tendency towards dogmatism and an ideological commitment to materialism.

The scope for developing how we ought to live is limited in a deep way by the scientific ideology. We expend little enough direct effort in developing how we ought to live in relation to other people; we expend almost none concerned with how we ought to live in relation to nature. Within the scientific world-view our relations to nature are seen as necessarily instrumental. But this can be seen to be a self-justifying consequence of the scientific ideology's belief that the instrumental practices of natural science constitute a transparent epistemic method for revealing true knowledge of reality. As argued above, the praxical perspective reveals that the conception of nature as material is not a revealed truth about "external" reality, but is inherent in the character of our instrumental practices.

One cannot deny the success we have had in developing instrumental practices and the power they have given us. Their seductive power is such that our social structures today are largely dictated by the instrumental practices we have developed. We of the modern world live by and for our technological powers. What is revealed as "nature" within the structure of those practices is a material realm, separate from and subordinate to human concerns, available for manipulation and exploitation. Nature is not seen as a subject of moral concern; moral questions arise only in

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[11] Sandra Harding makes this point in <u>The Science Question in Feminism</u> (Ithica: Cornell University Press, 1986), 249-51.

relation to the impact our actions on nature have on human concerns. The scope for possible social action is seen to lie entirely within the material order. Today no politician in the West can stand unless they work to develop policies that promote industrial growth and development. Industrial technology develops at a breakneck pace, and social progress is subordinated to technological progress. Political leadership tends to be pragmatic, technocratic, and materialistic, with both the means and the ends given by economic and social structures that are driven by technological developments.

In the opening pages of this thesis I pointed out that some of the most serious threats we face today are environmental, largely stemming from technological developments. How we ought to live in relation to nature is becoming deeply problematic; but the only approach the scientific ideology has to offer is more powerful science and more carefully applied technological management. The praxical perspective offers the possibility of a different vision.

The sharp division the scientific ideology draws between the social and the natural orders is based on a deeply-rooted idea that humans somehow stand outside of nature. This separation is a peculiarity of Western culture. "Primitive" cultures frequently did not make the distinction between the social order where moral concerns applied and material nature where only instrumental practices applied. Most peoples in the past have considered themselves to be part of the natural order and acted towards nature as towards an agent or agents. Nature was seen not as material, but as personified, containing a soul and subject to personal and moral relations. This has been expressed in many different ways: in the idea of an earth-mother goddess, in fertility rites, in the belief that certain geographical locations have spiritual power, and in the ideas of gods or spirits controlling natural phenomena or inhabiting places, plants, and animals.

The scientific ideology portrays the shift from earlier spiritual relations with nature to modern science as a progress from primitive ignorance and superstition to enlightened understanding of the truth about reality. From the praxical perspective it can be seen as merely a shift in the dominant form of practices.[12] This perspective does not deny the incredible success of instrumental practices, but it accommodates the possible validity of earlier forms of practice which the scientific ideology has rejected.

Proponents of the scientific ideology often argue against the epistemic validity of the mystical, spiritual, and magical practices of non-scientific cultures. It is argued that if there is anything to such practices--other than merely subjective psychological effects, however fascinating or beneficial to those concerned--there must be some objective scientific evidence for their validity. But, it is argued, there is no such evidence. The effects claimed cannot be explained scientifically except as illusion, error, or fraud. Gods, spirits, magic, and paranormal phenomena are not considered to be real, because they have no place in the material world of objective science.

In fact, though, there is considerable evidence for extra-scientific or "paranormal" phenomena. Surveys show that a large percentage of the population of Western countries claim to have had personal experiences of such paranormal events as precognition, extra-sensory perception, out-of body events, faith healing, ghosts, angels, spirits, and poltergeists. Dowsing is widely practiced and commonly recognized as a reliable method of locating water. In non-

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[12] While most histories of the early development of science have portrayed it as the triumphant victory of truth over ignorance, some recent works, among them Merchant, The Death of Nature, Morris Berman, The Re-enchantment of the World (Ithica: Cornell University Press, 1981), and Easlea, Witch Hunting, Magic, and the New Philosophy, adopt a more critical perspective.

westernized, "primitive" cultures, such phenomena are considered normal parts of everyday experience and are integrated into their world-views.

Nor is it true that there is no scientific evidence for such phenomena. A wide range of paranormal phenomena have been the subject of rigorous scientific investigation by a small fringe of researchers for at least a century. What is remarkable about this parapsychology or "psi" research when compared to other more respected branches of science is the near-complete lack of progress. All that a century of investigation has shown is that some such phenomena really do seem to occur. The statistical odds against the positive results being due to chance are convincing: odds against chance of ten million to one are sometimes cited; odds of 300 to one against are common. Such phenomena as precognition, telepathy, "distant seeing," and even psychokinesis have repeatedly been verified.[13]

However, there has been virtually no progress in explaining, predicting, or controlling these phenomena. They seem stubbornly erratic and scientifically inexplicable. A phenomenon clearly demonstrated one day may not be repeatable under near-identical conditions the next day or in another laboratory; subjects regularly lose their "psi skills" after repeated tests;[14] and individuals vary enormously in their psi skills. This lack of progress when compared with the steady march of natural science is often cited as evidence that the claimed paranormal phenomena are illusory or fraudulent.

While fraud has sometimes been discovered in this field, it is hardly as common as some debunkers try to argue. Paranormal research is frequently discredited on the

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[13] Some of the prominent journals where this research is reported are: Journal of the Society for Psychical Research, Journal of Parapsychology, The Journal of the American Society for Psychical Research, and Research in Parapsychology.

[14] This occurs so regularly that it has come to be known as the "decline effect" and is itself a subject of research.

basis of a demonstration only that fraud could have occurred, rather than any direct evidence that fraud did occur. Often very elaborate safeguards are used to prevent any cheating--either conscious or subconscious--on the part of the subjects and researchers. It is doubtful that much respectable scientific research, particularly in psychology and sociology, could stand up to the rigourous standards set for paranormal research.

If it is accepted that not all the positive results claimed in this field are fraudulent or illusory, why has there been no progress in developing or explaining the effects? Ironically, the reason may be the very scientific rigour by which paranormal research tries to gain epistemic respectability.

In order to appear properly scientific, paranormal researchers emulate natural science by using quantitative techniques and measuring instruments to isolate the phenomena as much as possible from human interference and subjective interpretation. But these techniques of natural science are not elements of a transparent epistemic method of universal applicability. The advance of natural science is not the gain of representational knowledge by means of a universal objective method, but the gain of instrumental know-how. Instrumental techniques are the means by which instrumental know-how is achieved. The phenomena and entities which appear as meaningful within natural science are those which are amenable to instrumental techniques of measurement and manipulation. Every phenomenon which can be reliably detected, measured, predicted, and controlled by instrumental methods is accommodated into natural science. Magnetism and electrostatic phenomena were once considered mysterious and occult, but as techniques were developed for their instrumental control and measurement they became familiar parts of material nature.

The paranormal, on the other hand, consists precisely of those phenomena and entities which are not amenable to instrumental means of measurement, control, and explanation. In attempting to be scientific, paranormal researchers avoid the very practices which may be necessary for eliciting and controlling the phenomena they are investigating.

In "primitive" cultures where paranormal phenomena likely form the basis of spiritual and magical practices, mental training, ritual, and other devices are employed for controlling the state of consciousness of the persons involved. Paranormal research, on the other hand, is typically carried out in a laboratory under the skeptical eye of white-coated researchers. An "observer effect," wherein results depend upon whether the experimenter is sympathetic or hostile to the purported phenomena under investigation, has been observed. The common response is to eliminate the conditions which make this effect possible, in order to isolate the phenomenon to the subject under investigation and control for the possibility of self-deception on the part of the investigator. But such effects may be an integral and necessary part of paranormal phenomena. The conditions of paranormal research are not conducive to developing non-instrumental practices, and make any but intermittent and spontaneous paranormal phenomena unlikely. It is as if one were challenged to demonstrate one's powers to split an atom without the proper tools and equipment.

It may be wondered why, if instrumental techniques reveal only material phenomena, any paranormal phenomena at all are revealed by these means. But it is notable that the paranormal phenomena which are revealed appear only as the baffling and inexplicable remainder which does not fit into natural science. There is evidence for some such phenomena, but no progress in developing or explaining them. And the phenomena which instrumental techniques can reveal are only a meager part of the paranormal. Many paranormal phenomena are very rare or subjective but deeply meaningful events. Out-of-body experiences, meaningful coincidences, occasional important precognitive visions, and the perception of ghostly or spiritual presences cannot be detected or verified by instrumental means. But these, rather than guessing hidden cards or influencing the roll of dice, are the more important elements in the magical and spiritual practices of primitive cultures.

The paranormal phenomena of which we are aware are only hints and indications that there may be more dimensions to reality than natural science can encompass with its instrumental practices. The occasional bit of magnetic rock found by medieval scholars hinted at dimensions of reality that they did not understand, but hardly indicated the direction that the practices of electromagnetic technology would develop. Similarly, we cannot extrapolate from the phenomena that spontaneously occur in parapsychology labs to the nature of non-materialistic practices that it may be possible to develop. I don't imagine that we can develop precognition to the point where anyone could win a lottery by looking forward to next week's numbers, or psycho-kinetics to a useful means of levitation, but these are the kind of pseudo-instrumental practices that the scientific methods of paranormal research implicitly aim towards.

The difficulty scientific methods have in detecting paranormal events can also account for the lack of progress in explaining them. All the scientific evidence for such phenomena is negative: they are the outcomes which cannot be explained by material science or attributed to chance. This provides no basis for explanation. Scientifically respectable explanations consist of mechanistic rules based upon the causal structures and entities which emerge as meaningful for developing instrumental practices. Paranormal phenomena simply lie outside of this realm, and the instrumental techniques typically employed in paranormal research do not contribute to a positively developing alternative practice.

In traditional cultures, the language used to discuss paranormal phenomena is typically anthropomorphic: the phenomena are attributed to spirits, gods, or forces with distinctive personality characteristics and human-like agency. This is not (as some scientistic anthropologists such as Robin Horton argue)[15] an inferior pre-scientific attempt to explain phenomena of which natural science has discovered the true account. In fact, the explanatory aim of paranormal discourse is usually that which natural science does not explain, and which is left as in principle unexplainable in natural science: good and ill fortune, meaningful coincidences, and the moral and spiritual meaningfulness of events.

This difference of explanatory aim can be clearly seen in E. E. Evans-Pritchard's account of witchcraft among the Azande. Azande use witchcraft to explain the occurrence of misfortunes: for instance, the collapse of a granary on a group of people sitting under it, or the burning of a hut when the owner went into it with a lighted torch to inspect his brewing beer, are attributed to witchcraft. Evans-Pritchard observes that these witchcraft explanations do not contradict material-cause explanations. The Azande know as well as we do that termites gnawed away the supporting posts of the granary, and that the owner's torch ignited the thatch of his hut, but they do not consider these processes to be fully explanatory. What their magical language and practices aim to explain is why the granary happened to fall just when these people were sitting under it, or why this man's hut caught fire from his torch at this time, when many

[15] Robin Horton, "African Traditional Thought and Western Science," in Rationality, ed. Bryan R. Wilson (Oxford: Basil Blackwell, 1970), 131-72; and "Tradition and Modernity Revisited," in Rationality and Relativism, eds. Hollis and Lukes, 201-60.

other people's huts do not catch fire under similar circumstances.[16]

Western science does not provide this type of explanation. Science has a great deal to say about the action of termite mandibles on wood, the strength of perforated wooden structures, and the ignition-point of straw; and for the average Westerner, it is difficult to see that there is anything left to explain after these mechanisms are exhaustively described. Science can only attribute the provenance of these events to the blind confluence of material processes: they are meaningless accidents. But is there really nothing left to explain? What the scientific world-view leaves out is exactly what the witchcraft explanations of the Azande try to explain, and what spiritual and magical practices in traditional cultures typically try to deal with: the significant fortuitousness and tragedy of events.[17] The very different kinds of explanation involved suggest that it is invalid to translate or interpret spiritual and magical practices in the terms of natural sciences.

If paranormal phenomena are real, why have they not been preserved and developed? Natural science is cumulative and progressive, while traditional spiritual and magical practices seem to be fading away. This is sometimes cited as the characteristic mark of science, that which distinguishes it from illusory practices and places knowledge on a firm pedestal of fact. Part of the reason is surely the systematic propaganda of the scientistic element of the scientific ideology, which wants to render instrumental science the sole arbiter of knowledge.

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[16] E. E. Evans-Pritchard, Witchcraft, Oracles, and Magic Among the Azande (Oxford: Clarendon Press, 1937; abridged edition, 1976), 22-25.

[17] This is not limited to "primitive" cultures like the Azande; Western spiritual traditions embody similar practices and explanatory aims, but instead of magic and divination they rely on prayer and the guidance or intervention of God, Jesus, saints, or angels.

But paranormal practices have not been lost entirely, and are being regained in some areas. Dowsing has always been common, and the "new age movement" is regaining many traditional paranormal and spiritual practices. Alternative health practices such as acupuncture, therapeutic touch (a variant of the almost universal practice of healing by the "laying on of hands" in traditional cultures), visualization, and meditation are gaining popular acceptance.[18] Visualization is widely used in sports both to enhance performance and to speed healing following injury.

There is a sound reason why it may be more difficult to maintain paranormal practices than the instrumental practices of science. The paranormal seems to rely necessarily on individual skill and human involvement. Natural science, on the other hand, is based upon instruments which anyone can use and which outlast their makers. Spiritual and magical practices live and die with their practitioners, whereas instrumental technology leaves artifacts that work with minimum of skilled intervention. If tomorrow everyone with an understanding of the chemistry, physics, and technical skills necessary to construct and repair automobiles vanished, most people could still drive their cars to work. But once a practice requiring human mental skill is lost, it must be re-invented.

A supernatural world-view is not faulty science or metaphoric confusion for material things, but may well be a

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[18] This despite the official stance of the American Medical Association, which can only be described as hostile to any diagnosis which can not be reduced to a specific organic cause and any treatment other than chemical or surgical intervention. See John F. Zwicky et al., The Reader's Guide to Alternative Health Methods (Chicago: The American Medical Association, 1993). Because of the AMA's position, very few clinical tests of these practices make it into the established medical journals (although acupuncture and herbal treatments are recently gaining ground), so most of the evidence for its effectiveness is in the form of anecdotal accounts of the experiences of practitioners published in the popular press, and varies widely in quality.

possible and valid way of acting. The phenomena that mysticism and occult practices pick out can be recognized with practice, as most people can learn dowsing. We can learn to recognize them, they are there for our perception, but they are neither merely social nor physical phenomena. They are perceived in the intentional grasp of directed attention which lies prior to the passive object or the receptive subject. They lie within the grasp of a possible form of practice.

To view the world from the praxical perspective does not yet reveal the world to be different than the image presented by science. But it does reveal that that image is not given by the world, but in large measure is a product of our practices. The material, disgodded world is not something we must find if we only look closely enough, b[illegible] a consequence of our manner of dealing with the world. The disgodding of the world which has occurred since the scientific revolution is not the consequence of discarding false beliefs, but of developing almost exclusively instrumental practices. A richer world, filled with spiritual and moral significance, is not forever out of our reach, but lies close at hand, awaiting only the adoption of practices that reveal it.

The choice to seek such practices does not rest on whether they reveal what is true, but on whether they are possible and promote the quality of our existence. Science itself was developed and promoted as a morally and religiously superior form of practice designed to supercede a discredited scholasticism and the perceived dangers of natural magic and democratic spirituality. It is ironic that a practice designed to promote religion resulted in the elimination of God and spirituality as necessary elements of our world-view, but this does not mean that these cannot be part of a successful and superior form of knowledge practice. The same kind of good intentions that inspired the formation of scientific practice may serve to forge a superior successor practice, if we can see beyond the scientific ideology in which our culture is currently immersed. What is required is not more diligent and careful application of practices we know, but a willingness to develop a larger repertoire of practices.

8.

CONCLUDING REFLEXIVE AND PROSPECTIVE REMARKS

Weh! Weh! Du hast sie zerstört, Die schöne Welt, Mit mächtiger Faust; Sie stürtz, sie zerfällt! . . . . Mächtiger Der Erdensöhne, Prächtiger Baue sie wieder, In deinem Busen baue sie auf!	Woe! Woe! Thou hast it destroyed, The beautiful world, With powerful fist: In ruin 't is hurled! . . . . Mightier For the children of men, Brightlier Build it again, In thine own bosom build it anew! --Goethe, Faust

The scientific ideology is not limited to the provinces of science, but pervades much of modern life. Modern science began as a philosophical movement, and the characteristic epistemological perspective of science has an ancient pedigree in Western philosophy. Some have defined philosophy as the enterprise which essentially concerns itself with reasons, rationality, and truth. Rorty points out that philosophy has traditionally set itself up as the queen of sciences, the universal arbiter of claims of knowledge-that:

> Philosophy as a discipline . . . sees itself as the attempt to underwrite or debunk claims to knowledge made by science, morality, art, or religion. It purports to do this on the basis of its special understanding of the nature of knowledge and of mind . . . It can do so because it understands the foundations of knowledge, and it finds these foundations in a study of man-as-knower, of "mental processes" or the "activity of representation" which make knowledge possible.[1]

In presenting an alternative to the conception of knowledge as knowledge-that, some may see the present work as hostile to philosophy itself. In place of the traditional concerns of reason, truth, and epistemic foundations, the

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[1] Rorty, Philosophy and the Mirror of Nature, 3.

praxical perspective makes skills, know-how, and practices central. It shifts the focus of attention from cognitive processes towards actions; from what is rational to what is pragmatically possible and successful. It thereby may appear to oppose not only the epistemological perspective that underlies scientism but also the project of modern philosophy. What work is there for philosophy if knowledge is not founded in reason and cognitive representation--which is philosophy's area of special expertise--but only in ability?

This concern may be expressed as a reflexive question: if knowledge is not a matter of rationally founded cognitive truths but only of pragmatic abilities, what is the epistemic status of the present work? Is it not presented as an intellectual account in the form of a body of propositions purporting to be a true representation of the real nature of knowledge, and does it not thereby undermine itself by not adhering in practice to what it prescribes in content?

Similar charges of reflexive inconsistency are often leveled against relativist epistemologies. Relativism is said to be self-refuting because, by undermining the grounds for asserting the exclusive truth of any one theory, the relativist also undermines the grounds for asserting the exclusive truth of relativism. But the praxical perspective is not relativist, and this strong argument of reflexive inconsistency does not apply. Knowledge is firmly rooted in what we know how to do; the strongest anti-foundationalist assertion I make is that natural science is only one kind of know-how, and has no special epistemic status. Other forms of practice, within which other aspects of reality emerge, are also possible. Very different theories may seem reasonable and well-grounded within different traditions of practice, but if one has learned how to do something, it is possible for others to learn it.

It may appear that a weaker argument of reflexive inconsistency still holds: that I have presented an intellectual account that devalues intellectual accounts. But this is also an error. In shifting the locus of knowledge from knowledge-that to know-how, I do not deny the value of intellectual accounts and theories. Rather, my intent is to situate the latter within the domain of skilled practices of various kinds. Linguistic expression is itself a form of skilled practice which reciprocally interacts with the wider domain of human practices in which our expressions are meaningful. Scientific theories serve the instrumental ends of science: by providing laws and similar fixed rules, they help to replace or supercede human skills with instrumental methods. Scientific theories provide guides to the instrumental structures scientific practice discovers in nature, and thereby help make it possible to build machines that perform useful work. Philosophical accounts can also influence human practices.

One effect of the scientific ideology in philosophy is the expectation that philosophical accounts should in some respects resemble scientific theories. This leads to a style of philosophy, popular in analytic philosophy and philosophy of science, where rigorous formal definitions and rules are sought which are free from countervailing instances and which systematize some closely circumscribed subject area. That I have not advanced such theories here may appear to some as a shortcoming of the present work. I have only sketched a perspective and filled in few of the details. Questions of the detailed structure of what I have sketched may be asked: how, in detail, does meaning emerge within a practice? What are the formal structures of meaning-change and the development of skills and practices? What are the details of the relation between language and practice?

It may be possible to develop such theoretical accounts to a considerable extent; but I have not done so here because this would not serve the aims of this thesis. The theoretical style of philosophy shares the scientific ideology's conception of knowledge as passive contemplation, so that by reflecting clearly and reasoning well philosophical truths are revealed. From the praxical perspective, developing such pseudo-scientific theories of epistemic processes does not portray the objective truth, but advances instrumental forms of practice: where human judgement is replaced by rules, the richness of human experience is flattened down to the material world of atoms and the void, and we escape hard choices and the need to develop individual skills and responsibility.

Philosophy may be regarded as a reflective practice, but it is not merely passive reflection. Because language is embedded in our practices, it has the power to influence action as well as to express the meanings that emerge within practices. Intellectual practices, even such abstract ones as epistemology, are themselves engaged in the world. The appearance of reflexive inconsistency in this thesis evaporates when it is seen that the views developed here are not presented as abstract truths arrived at by passive contemplation, but are intended to influence thought and action. They are developed within and engaged in the traditional aim of philosophy: the pursuit of wisdom. Arguing that discursive thought and theoretical reflection are subordinate to practice does not devalue intellectual enterprises, but directs attention to the primary importance of the implicit ends and motivating aims of the practice.

The epistemological perspective sketched in this thesis could be given additional depth by developing descriptive accounts of concrete instances showing the details of how scientific theory and instrumental practices develop, and how social practices and language evolve in given cases. Some recent sociological and historical accounts that focus on science as practice are useful for this purpose. In such accounts, the stresses which bring about changes to theory are portrayed not as the cognitive dissonance of evidence versus theoretical prediction, but as the failure or success of developing practice, where something doesn't work or succeeds unexpectedly. These descriptions are given in terms of actions and goals, not thought and reason; what is being done, not only what is theorized and observed. But as indicated by the wide range of epistemological positions among sociologists and historians who have taken the turn to study science as practice, mere documentary attention to practice does not necessarily challenge the scientific ideology or entail the praxical perspective.

The praxical perspective suggests a deep and distinctively philosophical task beyond mere documentation. Purely descriptive accounts only aspire to one of the two dimensions of truth I described in chapter five: the correct use of language within a given practice. The other dimension is the improvement of our practices. Descriptions of episodes in the history of science written from the perspective of the scientific ideology take the view that present-day science is true and therefore provides the correct descriptive terminology. Recently, some historians have adopted an agnostic stance towards the truth of present-day science, and use the agent's terminology to render their descriptive accounts more objectively detached.[2] From the praxical perspective, present-day terminology is obviously better for instrumental purposes, but using the agent's terminology is better for revealing the internal struggle of a developing practice. The deeper philosophical issue, though, is not what the correct descriptive language is, but the moral question regarding how the development of practices and abilities furthers or affects our existence: not what is true, but what is wise.

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[2] A particularly fine example of this is Frederic Lawrence Holmes, Lavoisier and the Chemistry of Life. In this work one can see in some detail how theoretical structures emerged in the concrete struggle to get equipment and procedures to work.

The aim of this thesis has been to develop a perspective from which this question can be asked in regard to science as a whole. The position presented is metaphysically modest compared to the scientific ideology. The scientific ideology has the hubris to suppose that it is possible, through science, to understand the world as if from a god's-eye view. But we cannot step outside of the world; we are part of it, enmeshed and embedded in the very matrix of the world. No matter how we twist and turn, we cannot transcend our position and attain the mythical Archimedean standpoint.

The conception of knowledge presented in this thesis takes account of our human epistemic situatedness. Representations, truths, theories--in short, all knowledge-that--is always situated within a context of know-how. The progress of scientific knowledge is not a progressive uncovering of the structure of the world under the scientific microscope; it is rather the progressive development of the instrumental skills and practices characteristic of science. Scientific theories are only representations of the structures revealed within and meaningful for these forms of practice. Scientific theories, like other utterances purporting to be true, are not founded in reality itself, but are something we make, consequent upon the know-how we have attained through developing scientific practices.

The scientific ideology claims that scientific knowledge is objective (in the extra-moral sense) because it only represents what is the case, and that is indifferent to what we think is right or what we ought to do. Knowledge may give us power, but the choice of how to use that knowledge is entirely external to the knowledge itself. Knowledge of the truth is only an aid to actions chosen on independent grounds.

But if knowledge rests in know-how, the gain of knowledge is simultaneously the development of ways of

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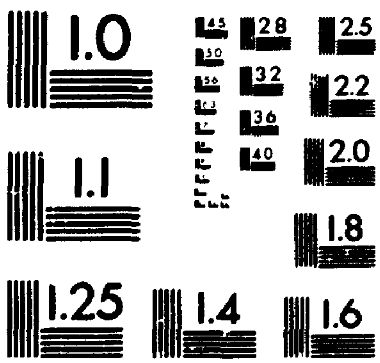

acting in the world. Our actions are not independent of our knowledge; we act as we know how to act. The know-how and skills we develop open up a range of possibilities for action: the skills we have give us the things we do as a matter of course. This is as true in the individual case as with science: one skilled in mechanics tends to do things of a mechanical nature. One skilled in social matters does social things. Socialites don't have yards full of old cars, and mechanics rarely throw formal parties. As science develops practices of instrumental manipulation, so what we of the modern West do as a matter of course acquires the character of instrumental practices. We become what we know how to do. This raises moral questions: is it right to develop these kinds of skills and practices, to accomplish these sorts of ends? Does it enable us to live better? Is it the best way to enable us to live better?

The founders of science believed that their new philosophy did answer these demands. It promised a route out of human misery and the vagaries of fate by giving power over nature; to harness it for the ends of development and provide some protection from natural disaster, plague, and famine. But after several hundred years, the limitations of this way of living are beginning to be apparent. And while many have pointed out the moral shortcomings of the scientific world-view and called for a more spiritual and moral approach to living knowingly in the world, what has stood in the way is the ideology which equates scientific knowledge with all valid knowledge, and the scientific picture of the world with the world as it really is in itself. The scientific ideology places science above the standards advanced in its favour by its founders; the praxical perspective re-situates science within the ambit of those standards, and provides a ground for its criticism.

Charles Darwin once wrote:

> My mind seems to have become a kind of machine for grinding general laws out of a large collection of

> facts, but why this should have caused the atrophy of that part of the brain alone, on which the higher tastes depend, I cannot conceive. A man with a mind more highly organized or better constituted than mine, would not I suppose have thus suffered; and if I had my life again I would have made a rule to read some poetry and listen to some music at least once every week; for perhaps the parts of my brain now atrophied could thus have been kept active through use. The loss of these tastes is a loss of happiness, and may possibly be injurious to the intellect, and more probably to the moral character, by enfeebling the emotional part of our nature.[3]

As with one person's mind, so with Western culture. The technological character of the modern West, which treats nature as a resource, animals as production machines, and persons as labour and consumer units, rests upon the scientific ideology's one-sided development of instrumental practices. That we do things in this way is not the consequence of political or economic arrangements that could be different without changing the character of scientific knowledge. Rather, these practices are intimately connected to the scientific ideology: science gives us these ways of acting, and so we act in these ways. Our actions are not chosen independently of the factual knowledge at our disposal, but framed within the know-how and practices we have developed. As a culture, we are like the rich man who is deeply unhappy, but only knows how to create more wealth which brings him no happiness. We have created our reality by developing one kind of ability, thinking it the key to all else, but have neglected all the rest that we may know.

By situating legitimate knowledge in one form of practice, the scientific ideology leads to a limitation of what we are and may be. The praxical perspective directs us away from the illusion of contemplative knowledge and

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[3] N. Barlow, ed., The Autobiography of Charles Darwin (Collins, 1958), 138-9; quoted in Brian Easlea, Liberation and the Aims of Science: an Essay on Obstacles to the Building of a Beautiful World (London: Chatto and Windus, for Sussex University Press, 1973), 282-3.

towards practice: it urges us to strive for wisdom, not merely to advance instrumental know-how.

By revealing that scientific knowledge is not extra-moral objective representation of the world as it is but a way of developing technological practices, and that the development of mystical, spiritual, and aesthetic practices may also be possible and constitute valid forms of knowledge, the praxical perspective opens the possibility of a different way of living in the world than that which the scientific ideology has parented. Such a way of being would incorporate a greater balance between the technological, aesthetic, mystical, and spiritual dimensions of existence. Technology would no longer be seen as the sole driving force behind social development; moral, spiritual, and aesthetic matters would no longer be seen as personal matters, extras sometimes decorative, sometimes dangerous, and sometimes assisting life, but as serious enterprises to be pursued. Their development would not be a matter of devising "true" theories from which to calculate how to act, thus absolving us of the personal responsibility of hard choices, but as the development of skilled practices.

We are a long way away from a form of practice which harmoniously incorporates all aspects of human experience, but a first step towards such a form of practice is the destruction of the scientific ideology which presents knowledge as those representations arising in the sciences. Instead, knowledge should be seen as knowing how to proceed, for which the technological sciences offer only a partial answer. It is hoped that this work has contributed to expanding our epistemic horizons, and bringing us again in touch with our humanity and the need to work on ourselves.

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