

David N. Livingstone

Science and Society—Reflections on the Radical Critique of Science

It is nearly fifteen years since the Institute for Contemporary Arts here in London organized a series of lectures on a theme ominously parallel to ours today. Ours is 'The Nature and Nurture of Man'; theirs, 'The Limits of Human Nature'. During that series, the Marxist historian of science, Robert M. Young—to whose views we will presently return—voiced his concern that an Institute for Arts should turn deferentially to science for cultural wisdom and guidance about what constitutes 'human nature'. For Young, anything scientists might say about human nature would be at least as much a reflection of their own ideological preferences as about the 'nature of man'—whatever that might be. The reason is simply that, in his telling of the tale, the very models that biologists, psychologists and so on, use to explain human-kind are inescapably impregnated with social and political assumptions. No theory of human nature is ideologically immune.¹

Embedded in Young's diagnosis is the radical belief that the scientific enterprise and scientific knowledge are cultural products and political resources, and therefore nothing less than tools of ideological imperialism. So it is entirely appropriate that we should turn our attention to this so-called radical critique of science during this symposium if only because it is precisely in debates about human nature that some of the issues involved most clearly manifest themselves. Of course there are also contested philosophical and sociological issues at stake, and I will try to say something about these in due course. But in order to try to get a handle on the whole subject, I think it will be useful to begin with some reflections on an old chestnut: the story of evolution and religion. For many, familiarity with

Part of this paper is drawn from my forthcoming essay 'Farewell to Arms: Reflections on the Encounter between Science and Faith', in Mark A. Noll and David F. Wells (eds.), *Christian Faith and Practice in the Modern World* (Grand Rapids: Eerdmans).

1. Robert M. Young, 'The Human Limits of Nature', in Jonathan Benthall (ed.), *The Limits of Human Nature*, 235–274, (London: Allen Lane, 1973).

this topic has bred contempt. But it is precisely because it *is* such a well-worn theme that I want to begin here; for by looking at some of the new ways in which this familiar story is now being told, we will begin to understand the claims of the radical critics and to assess what they amount to. My purpose, at least in part, is to show how coherent the radical critique can be, especially against the background of the 'gut-feeling' that science is disinterested, neutral, and inherently objective.

As I see it, there are basically four ways in which we can tell the story. Traditional histories of the subject, Whiggish in spirit and triumphalist in character, resorted to the language of warfare and struggle in their depiction of religion's encounter with the new evolutionary natural history. This CONFLICT model rapidly caught on, and one book after another was issued which charted the history of the battle between science and Christianity—a battle whose outcome was increasingly being resolved in a predictable direction. Certainly there was a case to be made. Did not Charles Hodge not claim in his last book *What is Darwinism?* that Darwinism was—simply—atheism? For him there was a direct conflict between the claims of natural selection and those of natural theology. Again, when Alexander Winchell, a prominent American Wesleyan and geologist, issued his 400-page *Reconciliation of Science and Religion* in 1877, his self-appointed task evidently assumed some mutual antagonism. Besides, in our own day, the vocabulary of hostility is rarely far from the lips of creationists . . . and their evolutionary opponents.²

Still, as the documents of the scientific past have been ransacked, this 'conflict' reading has been dismantled with forensic precision by a squad of historical revisionists. In the years before 1850, for example, it has long been recognised that the vocabulary of hostility is just simply inappropriate. The new science of geology, to take one case, counted numerous clergymen among its practitioners. Besides, throughout most of the Victorian era, science was practised in a context derived from natural theology. Even for the Darwinian period, the conflict interpretation has for too long deflected attention from the numerous evangelicals who found it easy to make their peace with

2. Charles Hodge, *What is Darwinism?* (London and Edinburgh: T. Nelson and Sons, 1874); Alexander Winchell, *Reconciliation of Science and Religion* (New York: Harper and Brothers, 1877). A useful review and critique of the 'conflict' interpretation of science and religion is provided in Colin A. Russell, 'Some Approaches to the History of Science', in Open University, *Science and Belief: from Copernicus to Darwin*, Block 1, Unit 1, *The Conflict Thesis and Cosmology* (Milton Keynes: The Open University Press, 1974).

evolution. I have charted this unfamiliar territory elsewhere. And—perhaps most interesting of all—the Wilberforce-Huxley melodrama so colourfully portrayed on BBC television now appears more the product of later historical recreation than a description of what really happened.³

By-and-large then, the conflict interpretation has done little to advance our understanding of the encounter between evolutionary theory and theological belief. So some historians of science have recast this model in a more restricted vein. Here, the conflict is transmuted into a COMPETITION, and is applied not so much to science and faith *per se*, but to scientists and theologians. In other words, there was a Victorian competition between the new scientific professionals and the older ecclesiastical hierarchy for cultural power in society. The new thrusting scientific elite wanted to wrest social authority and initiative from the old-fashioned clerical sage. Science, therefore, became a tool in the hands of the new middle-class professionals to serve their own social interests. So when Victorian men and women fell on hard times whether because of the threat to harvest, cattle plague, or typhoid in the royal household, it was questionable whether they should heed the clergy's call to prayer, or turn to the new agricultural, veterinary and medical experts. If the choice was initially hazy, the problem was rapidly resolved in a predictable direction. The manifest success of sanitary engineering, preventive medicine, and surgeon's knife, heralded an increasing privatization of religious observance. And with that there was an accompanying transfer of societal kudos into the hands of an all-too-willing scientific fraternity. As Frank Miller concludes: 'If the movement from religion to science in western culture represented, as some would contend, the exchange of one form of faith for another, it also meant the transfer of cultural and intellectual leadership and prestige from the exponents of one faith to those of another . . . It was a clash between established and emerging intellectual and social elites for popular cultural pre-eminence in a modern industrial society'. Another historian of the Victorian period concurs, adding that the 'conflict between science and theology' sprang at least in part from 'the effort by scientists to improve the position of science. They

3. David N. Livingstone, *Darwin's Forgotten Defenders. The Encounter between Evangelical Theology and Evolutionary Thought* (Grand Rapids and Edinburgh: Eerdmans and Scottish Academic Press, 1987). On the Wilberforce-Huxley encounter see J. R. Lucas 'Wilberforce and Huxley: A Legendary Encounter', *Historical Journal*, (1979), 22, 313-330; Sheridan Gilley and Ann Loades, 'Thomas Henry Huxley: The War between Science and Religion', *Journal of Religion*, (1981) 61, 285-308.

wanted nothing less than to move science from the periphery to the centre of English life'.⁴

The historical analysis has direct bearings on the whole question of the radical critique of science, for it emphasizes that science serves human interests. This is a point to which we will return. In the meantime it is just important to note that the competition model takes seriously the immediate links between science and society, and it does certainly throw light on some infernally stubborn problems in the history of evolution-religion saga. It helps explain, for example, the rise of the Wilberforce-versus-Huxley legend. The later passion to purge the British Association of the stain of clerical dilettantism would evidently favour a reconstruction of that debate with the clergyman as the vaudeville villain, and the scientist as the archangel of the enlightenment and the disinterested pursuit of knowledge, let the chips fall where they may. More generally, the competitive reading clarifies much of the otherwise ambiguous rhetoric on the lips of certain scientific publicists. Huxley's craving for a molecular teleology, Galton's hankering after a 'scientific priesthood', and Geddes's substitution of Darwin for Paley, invite such exegesis. After all, as Ruth Barton has recently reminded us, Huxley's 'chief aim' was 'the secularization of society through the cultural domination of science'.⁵ Indeed, if intellectual authority in modern society has not passed to the professional scientist, why is it that cries of 'pseudoscience' are so frequently on the lips of creationists and evolutionists alike? And why is it that religious believers and unbelievers alike continually resort to science for ideological self-justification? As Eileen Barker pithily puts it in the conclusion to her sociological wanderings through a variety of scientific gatherings:

The Biblical literalist, the Evangelical revivalist, the political visionary and even the slightly perturbed old priesthood of the established theologies turn to the new priesthood [of science] for reassurances that their beliefs have not been left behind in the wake of the revolutionary revelations of science. The new priesthood has not been found wanting. Sometimes with formulae, sometimes with rhetoric, but always with science, the reassurance is dispensed.⁶

4. Frank Miller Turner, 'Rainfall, Plagues, and the Prince of Wales: A Chapter in the Conflict of Science and Religion', *Journal of British Studies* (1974), 13, 65; T. W. Heyck, *The Transformation of Intellectual Life in Victorian England* 81-83 (London: Croom Helm, 1982). See also Frank Miller Turner, 'The Victorian Conflict between Science and Religion: A Professional Dimension', *Isis* (1978), 69, 356-76.

5. Ruth Barton, 'Evolution: The Whitworth Gun in Huxley's War for the Liberation of Science from Theology', in D. Oldroyd and I. Langham (eds.), *The Wider Domain of Evolutionary Thought*, 262, (Dordrecht: D. Reidel, 1983).

6. Eileen Barker, 'Thus Spake the Scientist. A Comparative Account of the New

Plainly this approach has much to commend it; but it surely cannot accommodate all aspects of the question. Religious knowledge, to be sure, cannot be cut loose from religious 'knowers', nor scientific theory from scientific practice. Both are rooted in society, and it is well to remember that they can serve particular group interests. What this portrait does not do, so far at any rate, is to tell us much about the *nature* of religious or scientific understanding. A separate case has had to be mounted by those claiming that social interests *necessarily* and invariably condition the contents of scientific knowledge. Whatever the legacy of history may have been, the philosophical adequacy of a scientific faith, as opposed to a religious one, remains thoroughly contested. Then too, by focussing on the *social* struggles of the theologians and scientists for cultural power, the competition model solidly ties both enterprises to the moorings of popular culture. Clearly this has advantages in explaining the flowering of Victorian naturalism. (Though we need to remember that as a source of religious scepticism, science probably did less harm than the ethical revolt against conventional morality, the explosion of biblical criticism popularized in *Essays and Reviews*, working-class defection from institutional religion, and inter-denominational feuding). But the substitution of popular confidence in hygiene for the faith of vernacular superstition leaves quite untouched the relation between scientific naturalism and Christian theism. My own hunch is that Victorian folk-religion bears about as much relation to biblical Christianity, as the theology of the average Jesus-freak does to modern biblical exegesis. There were many who simply saw no conflict between a religious and a scientific account of the world order. So doughty a defender of orthodoxy as B. B. Warfield, for example, told his readers that 'teleology is in no way inconsistent with . . . a complete system of natural causation. Every teleological system implies a complete 'causo-mechanical' explanation as its instrument'.⁷

Predating this re-reading of the record is an alternative interpretation which emphasizes the CO-OPERATION science has received from Christianity. For earlier periods the case has been made by Hooykaas, Torrance and many others. This audience does not need to be reminded of the details of their argument. For the Darwinian period, Jim Moore's monumental survey of Protestant responses to

Priesthood and its Organisational Bases', *Annual Review of the Social Science of Religion* (1979), 3, 99.

7. B. B. Warfield, *Review of Darwinism Today* by Vernon L. Kellogg, *Princeton Theological Review* (1908), 6, 649. I have examined the attitude of the Princeton theologians to evolution in 'The Idea of Design: The Vicissitudes of a Key Concept in the Princeton Response to Darwin', *Scottish Journal of Theology* (1984), 37, 329-57.

Darwin suggests, as a broad generalization, that it was among orthodox believers, who retained a firm hold on Calvin's doctrine of Providence, that least religious nervousness was experienced.⁸ Indeed I myself have found a vibrant tradition of evangelical evolutionists which has been ignored or suppressed by certain propagandists.

This general scheme of interpretation is plainly attractive. For one thing it accommodates both intellectual and social dimensions of the subject. It takes seriously both the input of theological ideas and the human networks in which scientific practice was rooted. In the United States, for example, it was the close relationships between three evangelicals—Asa Gray, James Dana, and George Frederick Wright—that helped keep Darwin's theory alive in the New World. Still, there are problems with this scheme. If Christianity was so central to the growth of science, how can we explain its secularizing ethos, its reductionist and materialist inclinations, its undercutting of the natural theology canopy? And of course there is the ethical challenge forthcoming from those frankly critical of scientific rationality itself and therefore of its Judaeo-Christian underpinnings. In this latter case, the co-operative model is a knife that cuts both ways.

Perhaps the most coherent effort to transcend these readings is the argument for ideological CONTINUITY most forcefully articulated by Bob Young, to whom I have already referred. In a number of influential articles—now mostly gathered together as *Darwin's Metaphor: Nature's Place in Victorian Culture*⁹—Young advanced the proposal that 'conflict' readings of the great Victorian debate on 'Man's Place in Nature' have only obscured the fact that both religion and science are socially sanctioned ideologies. In developing his critique Young has made use of the old idea of theodicy, a doctrinal move essentially designed to address the problem of evil. A theodicy, of course, was a means of justifying the ways of God to humanity. Despite apparent indications to the contrary, divine purposes were justified by showing how they ultimately benefited the human race. What Young does in this case is to argue that the theodicy grounded in natural theology (justifying, as I have said, the ways of God to men and women) has been replaced by a scientific theodicy (justifying the ways of nature to society). In both cases the existing social order is

8. James R. Moore, *The Post-Darwinian Controversies. A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America 1870-1900* (Cambridge: Cambridge University Press, 1979).

9. Published in 1985 by the Cambridge University Press.

10. R. J. Berry, 'Happy is the Man that Findeth Wisdom', *Biological Journal of the Linnean Society* (1982), 17, 1-18.

ratified and therefore science, no less than religion, supports the *status quo* by advocating principles of adjustment and conformity.

Young's historical programme is, predictably, Marxist through-and-through. Social conditions and political beliefs are, to use his word, 'constitutive' of scientific theorizing. And of course under a capitalist regime, repressive and manipulative policies produce repressive and manipulative science. Now, it would doubtless be easy to dismiss Young's diagnosis as a piece of historicist rhetoric, were it not for the fact that he really has compiled an imaginative travelogue which guides us very well through the maze of the Victorian intellectual landscape. The much-vaunted talk of a 'Church Scientific', lay sermons, a Scientific Priesthood and what-not, do begin to make sense in the context of a transition to a new theodicy. So too does the widespread belief that social salvation could be achieved through the practice of eugenics. Indeed the ostentatious burial of Charles Darwin in Westminster Abbey only a few feet from the bones of Sir Isaac Newton, with the choir singing 'Happy is the Man Who Finds Wisdom',¹⁰ seems to symbolize the very ideological continuity of which Young speaks. Jim Moore believes it was the 'trojan horse of naturalism entering the fortress of the church'.¹¹

Let me briefly mention one particularly dramatic instance of this kind of conceptual manoeuvre, where the pressing of evolution into the service of ideology is all too clearly paraded. Throughout the nineteenth century, numerous individuals were intoxicated with the hope of isolating some scientific measure of racial differences. A whole subfield of anthropology—anthropometry or somatometry—came into being to provide standard ways of measuring living bodies and dead bones. So far so good. However, many practitioners of this new art believed that by it the superiority and inferiority of different races could be established. Scientific racism, as this view could be styled, drew on disciplines as diverse as evolutionary biology, physical anthropology, environmentalist human geography, and Teutonic theories of history.¹² These sciences easily furnished ammunition for a battery of social policies ranging from eugenics to immigration restriction. Here, if I may again use Young's words, the 'constitutive role of evaluative concepts' in science is all too clear. The significance of this example should not be missed. It would be all too

11. James R. Moore, '1859 and all that: Remaking the Story of Evolution-and-Religion', in Roger G. Chapman and Cleveland T. Duval (eds.), *Charles Darwin, 1809-1882: A Centennial Commemorative*, 194, (Wellington, N.Z.: Nova Pacifica, 1982).

12. Some of the strategies are outlined in David N. Livingstone, 'Science and Society: Nathaniel S. Shaler and Racial Ideology', *Transactions of the Institute of British Geographers*, N.S., (1984), 9, 18-210.

easy to say that these writers were yielding up their science to their politics: not so. So far as I can judge, they really believed they were doing 'objective' science. Indeed Christians in science were not immune from these machinations. Consider the judgements of two prominent evangelical scientists in the America of last century. First Arnold Guyot—Professor of Physical Geography and Geology at Princeton and guest lecturer to the Seminary students for many years. He believed the Creator had 'placed the cradle of mankind in the midst of the continents of the North . . . and not at the centre of the tropical regions, whose balmy, but enervating and treacherous, atmosphere would perhaps have lulled him to sleep, the sleep of death, in his very cradle.' Here the Creator is invoked to justify the 'white's' place in nature. Then consider the only-slightly later words of Alexander Winchell, the Methodist and geologist I have already mentioned in passing. 'Nature,' he writes, 'conscious of the 'irremediable estrangement' of the black races, has condemned them to inhospitable and inaccessible regions of the globe.' In the declarations of these two writers, a clear shift can be observed from the Creator to Nature as the legitimation of white superiority.¹³

There are, certainly, technical objections to Young's portrait. For example, it is now clear that the earlier natural theology tradition was nowhere-nearly as coherent as he implies. And there are always glorious exceptions to his rule. In the case of racism, the names of Warfield and Asa Gray readily come to mind as evangelicals who used science to oppose racism. But I do not want to dwell on these infelicities for the moment, because it is with Young's retelling of the evolution and religion story, that we come face to face with what a radical history of science might look like. Some may already be thinking: It's all very well to pull out these one or two examples of science being misused by partisans; we can really rather easily spot such abuses and scotch them. Personally I am not so sure, though I will presently try to outline some of the ways in which a Christian might respond to the scenario. But for now I want to turn to the philosophical and sociological input to the debate, because here we will encounter arguments that *all* science is socially impregnated, and that it simply cannot provide us with objective knowledge about the world. This, truly, is a radical claim.

13. Arnold Guyot, *The Earth and Man. Lectures on Comparative Physical Geography in its Relation to the History of Mankind*, 251, (New York: Scribner's, 1879, orig. 1849), Alexander Winchell, *Preadamites; or a Demonstration of the Existence of Men before Adam; together with a Study of their condition, Antiquity, Racial Affinities, and Progressive Dispersion Over the Earth*, 157 (Chicago: S. C. Griggs, 1880). On the 'Preadamite' theme see David N. Livingstone, 'Preadamites: the History of an Idea from Heresy to Orthodoxy', *Scottish Journal of Theology*, (1986) 39, in press.

The input from philosophy and sociology of science

So far I have outlined four ways in which the history of science and religion can be told, and have tried to show that good cases can be made for insisting that scientific knowledge is a cultural product and a political resource. As a matter of historical fact, I believe this to be so. But what about the further argument that science is all ideology, or at least that it is entirely relative to particular groups and not a depiction of the way the world really is?

In the present context it is not necessary to spend time reflecting on the errors of logical positivism and its critique by philosophers like Popper. That story has been told often enough. Instead I want to begin with Kuhn, because it is with him that the relativist case begins to have real bite. In Kuhn's idea of 'paradigms', historians, philosophers and sociologists of science found a new toy to happily engage their imaginations.¹⁴ By 'paradigm' Kuhn roughly meant—and he was confessedly ambiguous, at least initially—a tradition with historical exemplars. In other words, a mature science is conducted within a social and conceptual framework that sets the standard for relevant research, specifies the puzzle-solving objectives, coordinates the disparate work of its member scientists, and initiates its students into the ways of the tradition. Now, Kuhn went on, scientific revolutions occur when the accepted paradigm is replaced by another which gives rise to a completely new programme. The changeover from Newtonian mechanics to Einsteinian physics is a classic case. It is like a Gestalt-switch—suddenly seeing an old picture in a new way. The new model may accommodate more information; it may be more elegant; it may be more psychologically satisfying; it may be more theoretically fertile; it may have greater explanatory scope. But there are no *independent* rational criteria for deciding between them. This is because what *counts* as a rational explanation is determined by the paradigm itself. Indeed the problems to be investigated by the scientists working in the new paradigm cannot be expressed in the language of the old. The puzzles that geologists who accept the theory of Plate Tectonics try to solve would simply not make sense to the geologists of the nineteenth century.

Plainly Kuhn had introduced a thoroughly relativist note into the philosophy of science. Since the paradigm involves a set of criteria for determining what problems are worth solving and how the solutions are to be recognized, there will not be any mutually agreed basis for deciding which competing paradigm is best. The results of science

14. T. S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1970).

are therefore *relative* to the scientific tradition within which research is carried out, and are not straight-forward descriptions of the way the world really is.

The relativist temper of Kuhn's interpretation, moreover, has been pushed to the very limits by the anarchist philosopher Paul Feyerabend. To him, science is a completely free-wheeling business. Without the availability of paradigm-free logic—implicit in Kuhn's story—literally anything goes. This, of course, means that everything goes. Indeed Feyerabend rejects the notion that science is superior to any other form of knowledge whether poetry or drama, or more fringe pursuits like astrology or voodoo.¹⁵

Following the broad contours of this critique, Richard Rorty maintains that we should give up the notion that science is travelling towards an end called 'correspondence with reality', that science can, to use his own metaphor, 'mirror nature'. To Rorty, the scientific tradition has simply been the hunt for a vocabulary that helps us to predict the world better, and to control it. Some vocabularies work better for this purpose than others: Galileo used terminology that helped, Aristotle didn't. But to Rorty, these languages are emphatically *not* 'Nature's own vocabulary'—that is, the way Nature would describe itself to us if it could. As he puts it: 'scientific breakthroughs are not so much a matter of deciding which of various alternative hypotheses are true, but of finding the right jargon in which to frame hypotheses in the first place.' (For students of human nature, sometimes a behaviourist language serves the purpose; on other occasions hermeneutic talk is better.) Thus to him scientific method means having a good list of topics or headings—a good filing system. Scientific rationality means obeying the conventions of your discipline, not fudging the data too much, and listening to your colleagues. It is what he calls 'epistemic good manners'. It is NOT, let me repeat, Nature's Own Language. That is just simply not a useful concept.¹⁶

What has provided even more ammunition for the relativist armoury has been the post-Kuhnian alliance between sociology and the history of science. This critique has emerged from several sources. There is, for example, the work of those like Young who tie science and ideology tightly together. We have already scrutinized this effort. And then there is the impressive writing from the pen of Jurgen Habermas who argues that *all* human knowledge is value-

15. Paul K. Feyerabend, *Against Method: Outline of an Anarchistic Theory of Knowledge* (London: New Left Books, 1975).

16. Richard Rorty, *Consequences of Pragmatism. (Essays: 1972–1980)* (Sussex: Harvester Press, 1982) esp. essay on 'Method, Social Science and Social Hope', Richard Rorty, *Philosophy and the Mirror of Nature* 191–210 (London: Blackwell, 1980).

oriented in the sense that its very status as knowledge derives from its orientation towards basic human interests. But here I want to focus briefly on the work of the so-called Edinburgh group who advocate what one of its spokesmen christened the 'strong programme' in the sociology of knowledge. Bloor, Barnes, Shapin and Mackenzie are chief among the practitioners of this new art, and they have increasingly made out the case for scientific knowledge as a relativist cultural product. Science, in other words, is merely the expression of social interests because social relationships insinuate their way into scientific practice at EVERY level. One or two examples will illustrate the approach.¹⁷

Consider first the professional vested interests of the community of scientists. Typically, scientists acquire technical skills during the course of their training. These may include survey techniques, mathematical proficiency, laboratory expertise, cartographic skills. In each case, they represent a set of vested interests that are therefore valued and defended within the scientific fraternity. Now, the argument goes, these interests directly condition the content of scientific knowledge. The dispute among twentieth century botanists over the correct classification of plants is illustrative. One group grew up on a diet of morphological studies and were taught that species were to be delineated on the basis of their structure; a second laboratory-trained set claimed that experimental work, often of a biochemical sort, was of crucial importance. The result? Two different taxonomic schemes, because each group construed botanical reality differently. The argument here is that the content of scientific knowledge is a direct reflection of the craft competences of the investigators rather than a portrait of reality.

Then there is the impact of the wider society on scientific knowledge. Take, for example, Darwin's use of Malthus's social theorizing, and his application of the lessons he had learned from his fellow pigeon-breeders at the Philopisteron. His theory of natural selection was essentially a metaphorical application of the idea of nature as a breeder, as was his belief in struggle as the engine power behind evolutionary change. On a different front Paul Forman has made out a strong case for seeing the acceptance of acausal modes of scientific explanation in Weimar Germany as being conditioned, at

17. For samples of their work see B. Barnes, *Scientific Knowledge and Sociological Theory* (London: Routledge and Kegan Paul, 1974); B. Barnes, *Interests and the Growth of Knowledge* (London: Routledge and Kegan Paul, 1977); David Bloor, *Knowledge and Social Imagery* (London: Routledge and Kegan Paul, 1977); Barry Barnes and Steven Shapin (eds.), *Natural Order: Historical Studies of Scientific Culture* (Beverly Hills: Sage, 1979).

least in part, by the anti-determinist historical views of Oswald Spengler. And finally the role of religion, particularly in Puritan England, in the advancement of seventeenth-century science further attests to the impact of cultural forces on scientific practice. The essential argument is that scientific knowledge is as much the result of social relationships between researchers, of the over-determining role theory, of cultural and political preferences, even of who controls publishing outlets, as of the natural phenomena.¹⁸

Responses to the Critique

There are, it seems to me, two separate, though related, issues raised by the radical critique of science which need to be faced. There is, plainly, a historical claim—a contingent claim if you will—that science, as a matter of fact, has been conditioned by various 'non-scientific' forces. And there is a philosophical claim—an 'in principle' argument—that science cannot provide truthful accounts of natural phenomena which realistically correspond to the way things are. Let me deal with this second claim first, because its implied epistemological relativism (no doubt as applicable to historical knowledge as much as to scientific) is something about which Christians have been, wisely I think, suspicious.

Initially I must remind you that I am not a professional philosopher of science. My work falls squarely within the history of science, particularly the behavioural and earth sciences. So I am merely suggesting one or two of the escape routes from this radical relativism, to which I feel instinctively attracted.

I feel sure that many may well have the feeling that the pragmatic success of science in so many spheres is ample testimony to the truth of its theories. Surely the fact that aeroplanes can fly is evidence that we have found out something about aerodynamics? Does landing men on the moon not prove that our lunar theories are true? Unfortunately this is not the case. All sorts of pragmatically successful conceptions about astronomical phenomena—for navigation for example—were held by people who believed that the earth was static and at the centre of the universe, and about physics by those who believed that all space was filled by an invisible ether. The instrumental success of a theory is no guarantee that it is a realistic depiction of the world, so other arguments have had to be mounted. I shall briefly mention three.

Part and parcel of Kuhn's model of scientific change was his

18. See review by Steven Shapin, 'History of Science and its sociological reconstructions' *History of Science* (1982), 20, 157-211.

rejection of any sufficient rational grounds for the shift from one paradigm to another. This has been challenged by Dudley Shapere.¹⁹ Too much, he says, has been made of the *discontinuities* between succeeding paradigms or research programmes. Even allowing that what counts as a legitimate theory, problem, or solution, may change radically over time, Shapere believes that there still is 'often a chain of developments connecting the two different sets of criteria, a chain through which a 'rational evolution' can be traced between the two'. What is needed here are case studies in the history of science to determine just what really happens during the course of a scientific 'revolution'. Certainly what passes for legitimate, even observational, evidence will change with time; however—and this is crucial—there are always compelling REASONS for the shift. Changes even in the standard of rationality—of what constitutes reasonableness in other words—can itself be a rational process.

A second strand of anti-relativist argument has its roots in the notion that scientific models are ultimately sophisticated metaphors. The argument runs like this. In their endeavour to come to grips with some aspect of reality hitherto unexplained, scientists look around for some broadly similar process that they do understand and interpret the problem under investigation in the light of this information. They construct a picture to represent what they understand to be the nature of the processes at work. Pictures of this sort are usually called models. But they are, for all that, analogies or metaphors—looking at something *as if* it were something else. The metaphor, in turn, becomes a kind of lens through which the subject is viewed; some aspects are ignored or suppressed while others are emphasised or organised in specific ways. Thus scientists tell us that sub-atomic particles behave *as if* they are a miniature system and that our brains function like computers.

On the face of it, it might seem, as indeed Mary Hesse develops the argument, that there are no direct corresponding links between our metaphorical talk about the world and the world itself. Shifting from one metaphor to another would seem to be just as radical a break as a paradigm shift. But for Ernan McMullin the metaphor notion can be deployed as a realist strategy. For him, spelling out the implications of a metaphor—suggesting new areas of investigation and predicting the discovery of novel facts—is a signal to its truth content. Plate tectonics is a notable case. According to this theory, the continents as well as the ocean floors are carried on vast plates which move on the

19. Dudley Shapere, 'The Character of Scientific Change', in Thomas Nickles (ed.) *Scientific Discovery, Logic and Rationality*, 61–116, (Dordrecht: D. Reidel, 1980).

outer shell of the globe. Invoking the idea of 'plates' is, of course, a metaphorical move from the outset. Moreover this metaphor can be extended by asking, 'What happens when plates collide?'. 'One is carried down under (subduction)' McMullin replies; 'the other may be upthrust to form a mountain ridge'. Now, McMullin goes on, here is a clue to the realist stake in metaphor. What best explains the predictive success of the metaphor 'is the supposition that the model approximates sufficiently well the structures of the world . . . for the scientist to take the model's metaphoric extensions seriously. It is because there is something like a floating plate under our feet that it is proper to ask: what happens when plates collide, and what mechanisms would suffice to keep them in motion? In other words, good metaphors have specific entailments and extensions that make them susceptible to testing procedures.'²⁰

Finally, the idea of the historical *resilience* of theories suggests another realist strategy. To pass muster as a claim to knowledge, a theory must display a certain resilience with the passing of time, a sort of survival quality in the face of changing scientific fashions. 'What counts, perhaps, most of all in favour of a theory is not just its success in prediction, but what might be called its *resilience*, its ability to meet anomaly in a creative and fruitful way'. Perhaps the theory of evolution will illustrate. Over the years since Darwin first put forward his version of the theory, there have been disputes and debates about the precise nature of the mechanisms involved, about the significance of genetic mutation, about the underlying social philosophy that it embodied and assumed, and so on. But the theory as held today is still recognizably Darwinian for all its modifications. Surely this provides some warrant for saying that the theory tells us something about the nature of the organic world. Certainly there may have been social factors endemic to the theory's formulation, but over time these will simply be filtered out.²¹

These, then, are some of the ways in which a defence against the radical relativism of earlier critics can be mounted. I am NOT claiming, of course, that this is a water-tight case. I am merely saying that for those of us who believe that science can tell us something about the way the world is, there is a case to be made. Equally, I emphatically insist that this is no simple return to a naive empiricism.

20. Ernan McMullin, 'A Case for Scientific Realism', in Jarrett Leplin (ed.), *Scientific Realism*, 8-40, (Berkeley University of California Press, 1984). I discuss the metaphorical character of evolution in 'Evolution as metaphor and myth', *Christian Scholar's Review* (1985), 12, 111-125.

21. Ernan McMullin, 'History and Philosophy of Science: A Marriage of Convenience?' *Philosophy of Science Association* (1974) 585-601.

All these defenders of realism know enough history of science to admit that social and other extra-scientific factors have insinuated their way into scientific practice at many levels. Political, metaphysical, professional, aesthetic concerns *have* conditioned the products of scientific knowledge. What they deny is that this provides grounds for a universal scepticism about science's cognitive claims. To my mind Martin Rudwick synthesizes matters well when he writes:

Scientific knowledge may indeed be a social construction ... and therefore a cultural product, but it does also claim to have a more-than-random relation to the externality of the natural world. It has become a commonplace of current thinking about science that the natural world greatly underdetermines the form that theories about it can take; but that insight should not lead us inadvertently into the position of implying that the natural world does not determine our theories at all ... To put it more simply, to see scientific knowledge as a social construction does not rule out the possibility of cumulative scientific progress.²²

If Christians are justifiably hesitant about the absolute relativism (to coin a term) of some philosophers of science, what about the work of historians and sociologists who provide a radical critique of scientific practice? My feeling is that where they make their case their critique should be welcomed with open arms. Surely it is never wrong to ask of any scientific theory questions like: Who propounded it? Who used it? What interest did it serve? When Marxists uncover the cultural roots, or ideological abuses of science, Christians should rejoice. Indeed the ideological captivity of science to particular group interests should come as no surprise to those who believe that mankind is defaced, scarred, distorted. More, Christians in science should be in the vanguard of scientific self-criticism, because of all people, they should best understand the irrepressible idolatry of men and women, an idolatry that has transferred the sacred from the spiritual to the scientific realm.

So when the Marxist shows up the 'theodicean' pronouncements of those who peddle ideology under the guise of innocuous academic neutrality, we must join forces. Take, for example, the strategies of the biological determinists.²³ When we are told what human values are really embedded in the laws of nature, and when we see the outworkings of such a doctrine in the excesses of behaviouristic

22. Martin Rudwick, 'Senses of the Natural World and Senses of God: Another look at the Historical Relation of Science and Religion', in A. R. Peacocke (ed.) *The Sciences and Theology in the Twentieth Century*, 252 (Henley and London: Oriel Press, 1981).

23. See Steven Rose, Leon J. Kamin and R. C. Lewontin, *Not in Our Genes. Biology, Ideology and Human Nature*, (Harmondsworth: Penguin Books, 1984).

psychology, manipulative eugenics, in functionalist social science, or psychoanalytic therapy, or environmental determinism, we will want to cry loudly 'ideology'. In the works of Lorenz, Ardrey, Morris, even Darlington, ideological prescription was blatant, a couple of decades ago. Now the sociobiologists have taken on the task of naturalizing values in ways stunningly parallel to the scientific religionists of the late nineteenth century. When E. O. Wilson tells us that the 'scientific ethos' is 'superior to religion' we are put on the alert. When Ralph Burhoe claims that: 'For us what is true and what is right and what will prevail are not determined by military force or by any other arbitrary human wishes or pressures but essentially by those forces presented in the scientific picture of the historical flow of events in history' we encounter scientific theodicy. Small wonder that John Greene described E. O. Wilson's book *On Nature*, and G. G. Simpson's *The Meaning of Evolution*, as the 'Bridgwater Treatises of the twentieth century.'²⁵

My point, let me repeat in closing, is not that science is all ideology, but the fact that it *has* often been so must be taken seriously. Indeed only by scotching the scientism that rules today, the sacralisation of science if you will, can we begin the task of discerning the legitimate role science *does* play in the understanding of human nature, while retaining the vitality and integrity of discourse about morality, politics, freedom and grace.

Let me conclude with some words from John Greene:

As a student of the history of ideas, I am convinced that science, ideology, and world-view will forever be intertwined and interacting. As a citizen concerned for the welfare of science and of mankind generally, however, I cannot but hope that scientists will recognize where science ends and other things begin.²⁶

24. On this I have derived much help from John R. Durant, 'Evolution and Ethnics. Ethnology, Sociobiology, and the Naturalization of Religious Values', Paper presented in the 'Science and Religion' Symposium at the XVIIth International Congress of History of Science, University of California at Berkeley, U.S.A., August 1985.

25. John C. Greene, *Science, Ideology, and the World View. Essays in the History of Evolutionary Ideas*, 163, (Berkeley: University of California Press, 1981).

26. *ibid.* p. 197.