seat of general political power for its leading officials, and is thus of some account in national affairs. Every country, as the saying goes, gets the government it deserves – and nowadays science is thrown in with government, for good measure.

### *Further reading for chapter 14*

The machinery of the government of science in Britain is described by

P. Gummett, *Scientists in Whitehall*. Manchester: Manchester University Press, 1980 (pp. 20–53, 214–237)

Basic documents on British science policy are collected in

J. B. Poole & K. Andrews (ed.), *The Government of Science in Britain*. London: Weidenfeld & Nicholson, 1972

Brief accounts of the 'science systems' of the United States and the Soviet Union are given by

M. N. Richter, *The Autonomy of Science*. Cambridge, Mass: Schenkmann, 1980 (pp. 79–130)

The 'criteria for scientific choice' are given in

A. M. Weinberg, *Reflections on Big Science*. Oxford: Pergamon, 1967 (pp. 65–100)

The problem of control is discussed by

R. Johnston & T. Jagtenberg, 'Goal Direction of Scientific Research', in *The Dynamics of Science and Technology*, ed. W. Krohn, E. T. Layton & P. Weingart, pp. 29–58. Dordrecht: D. Reidel, 1978

and by

H. Brooks, 'The Problem of Research Priorities'. *Daedalus*, Spring 1978, (pp. 171–90)

The rôle of science in politics is analysed at length by

D. K. Price, *The Scientific Estate*. Cambridge, Mass: Harvard University Press, 1965

The political and economic background of military R & D is described by

H. M. Sapolsky, 'Science, Technology and Military Policy', in *Science, Technology and Society*, ed. I. Spiegel-Rösing & D. de Solla Price, pp. 443–71. London: Sage, 1977

Ziman, J. M. *An Introduction to science studies: the philosophical and social aspects of science and technology.* USA: Cambridge University Press, 1996.

# 15

# The scientist in society

'When you see something that is technically sweet, you go ahead and do it and you argue about what to do about it after you have had your technical success. That is the way it was with the atomic bomb.' *J. Robert Oppenheimer*

## *15.1 Towards a social psychology of science*

Science is what scientists do. The scientific life is notorious for the demands it makes on the mind and on the spirit. The social psychology of science is thus an essential metascientific discipline, along with philosophy, sociology, politics and history.

The traditional academic ethos (§6.3) lays great stress on the individuality of scientists, and thus emphasizes the distinctive mental and emotional traits that tend to separate them from the mass of people and from one another. The naïve history of science is a chronicle of heroic or saintly *personalities* who have triumphed through their innate abilities and virtues. More seriously and soberly, psychologists have tried to delineate or discover the personality types that are characteristic of scientists in general, or of scientists in particular disciplines, such as theoretical physics or experimental biology.

Unfortunately, these investigations have not proved very conclusive. Mature scientists, and even science students, are not, presumably, 'just like everybody else', but careful empirical research on their personality traits has not provided reliable insights that are superior to everyday 'folk' understanding of these matters. Scientists have to be reasonably intelligent in a conventional sense – if only to master the academic knowledge they need to get to the research frontier – and they have to be well motivated to maintain individual initiative in research. But it is not clear how their successes and failures are really associated with deeper forces and factors, such as intellectual convergence, introversion, indifference to authority, sublimation of neurotic tendencies, etc., as advocated by various schools of individual psychology. If anything, these studies simply draw attention to the bewildering variety of personality types to be found amongst scientists, and to the uniqueness of every scientist as a person.

From our present point of view, however, the social psychology of science is complementary to its sociology. Academic science, for example, is not anarchical, in spite of its individualism. The traditional scientific community functioned through the rules and norms that its members had learnt to follow (§6.1). The collectivization of science has changed many of these rules (§12.5), but contemporary scientific institutions are not machines: they operate by the coordinated actions of people who are conscious of what is expected of them as events unfold around them, and who voluntarily perform as expected. The personalities of scientists as individuals are thus less significant than the *rôles* they are called on to play as members of these institutions.

Laboratory life is not, of course, precisely scripted and stereotyped. If one studies it in detail, one finds as much diversity in the parts that people play as in the personalities that colour their actions. Indeed, as we all know, there is no way of separating the social rôle from the person who plays it – just as there is no way of separating nature from nurture in the making of each individual. The significant point is, rather, that any one scientist may have to play several different rôles, depending on the social group or circle in which he or she happens to be situated. Most people have this experience in relation to family life, on the one hand, and working life on the other; the rôle of the parent, for example, is sharply differentiated from the rôle of, say, the customs official, even though the same person performs both these rôles in the course of a single day. A salient feature of contemporary scientific life is that it can no longer be experienced as the performance of a single vocational rôle. Quite apart from his or her normal rôles as a member of a family and as a tax-paying, property-owning, law-abiding citizen, the modern scientist may be called upon to play several distinct professional rôles, within the world of science or in society at large. A brief account of these rôles will give some idea of what is involved when we talk nowadays of 'the place of the scientist in society'.

### *15.2 The scientist as intellectual entrepreneur*

The individualism of academic science casts every scientist in the rôle of an *intellectual entrepreneur*, undertaking research on his or her own initiative on the basis of a personal assessment of the likelihood of making a discovery, and rewarded with personal recognition if successful (§5.1). The traits of character appropriate to this rôle are familiar to every aspiring scientist: *curiosity*, to pick up the first hint of a serendipitous discovery (§2.5); *intelligence*, to grasp contemporary theory and to formulate new research problems (§2.15); *persistence*, to carry through a long and laborious investigation to a convincing conclusion; *honesty*, to validate one's own results objectively (§3.2), and to present them fairly to others (§4.3) – and so on.



These traits have been so idealized and eulogized in the folklore of science that some people have come to believe that they are features of a specific 'scientific attitude' which would work miracles if only it were applied to all the practical problems of life. This naïve view ignores some of the other traits that are inseparable from this rôle, such as *narrowness* of view, to attain mastery of a specialty (§5.3), and *egoism*, to concentrate on a topic, and to prevail against competition (§5.2). These vices of academic life are not apparent in the formal literature of science, which is carefully scripted to conform to the traditional norms (§6.4), but they are probably just as essential to the dynamical stability of academic science as are the virtues that are so widely praised.

To describe the academic scientist as an 'entrepreneur' is to suggest a direct comparison with the rôle of the commercial or industrial entrepreneur in a capitalist society. Scientific work is thus treated as a productive process in which publishable 'contributions' are exchanged in an intellectual market place for 'recognition' (§5.1). This metaphor is sometimes extended further, by applying terms such as 'resources' and 'capital' to the symbolic entities that enter into this process. Whether or not this extension of the metaphor is justified, the comparison is apt: historians of science are generally agreed that the scientific revolution of seventeenth-century Europe was closely linked with the transformation from feudalism to capitalism in the political and economic structures of society as a whole. This transformation was associated with a religious reformation which provided powerful spiritual and moral support for the rôle of the capitalist entrepreneur. The historical connection between protestant theology and the natural philosophy of science is much disputed, but there is no doubt that the individualism of the traditional scientific ethos harmonizes perfectly with the protestant ideal of an 'inner-directed' personality obedient to internalized norms of behaviour and striving towards transcendental goals.

In countries such as the Soviet Union, where science has been fully collectivized (§11.5), the notion of the scientist as an intellectual entrepreneur is repudiated by the official ideology, although it still lingers on as a motivating factor in the lives of many scientists. But in some countries where private enterprise is a dominant economic force, particularly the United States, this feature of the academic ethos is actively reinforced by the funding procedures for basic and strategic research. Even scientists with permanent tenure as university professors have to compete individually for the material resources they need for their work. Like small farmers or shopkeepers seeking business capital from a bank, they must apply to a funding agency for a grant that will pay for apparatus and assistants – even for a proportion of their own personal salaries (§14.4). They are thus forced to play the rôle of the individualist entrepreneur very earnestly indeed, often transgressing the norms of communalism and disinterestedness (§12.5) in their anxiety to survive as active scientists.

### *15.3 Citizen of the republic of science*

The norm of communalism (§6.2) casts the academic scientist as a member of a cooperative community. This rôle thus counteracts the extreme individualism of the legendary 'lonely seeker after truth'. In its idealized 'Mertonian' form, the scientific community functions as a self-governing republic, where every qualified scientist claims the rights and the responsibilities of a free citizen. To perform this rôle satisfactorily, a scientist must therefore be ready to *communicate* research results (§4.3), *cite* the work of other scientists (§§4.2, 5.2), give voluntarily of time and effort as a *referee* or *editor* (§§4.4, 4.5), take part in scientific *meetings* (§4.7), *reward* notable scientific achievements (§5.1), defer to the *authority* of more esteemed colleagues (§5.6), and perhaps, eventually, if fortune smiles on his or her endeavours, bear graciously and wisely the burdens of scientific leadership in a learned society, a university, a government department or an industrial firm.

This rôle is evidently characterized by the social contexts in which it has to be played, rather than by the personality traits of the actor. Many of these contexts, such as those that arise in scientific meetings, are customary rather than formally defined, and call for conventional forms of action that are easily learned, such as praising a very dull speaker for his contribution, or asking a controversial question in an unaggressive tone of voice. Other contexts, such as those associated with the formation and management of a learned society (§7.2) may be more systematically codified, and may demand a good deal of personal initiative and social sensibility. The academic ethos takes for granted that these functions will be carried out by somebody – preferably by a scientist of high research ability – but offers little encouragement to do the job well. The sociological reality is that the progress of science is very dependent on the competence and conscientiousness with which these major rôles are assumed and performed by a relatively small minority of the scientific community (§5.6).

The collectivization of science has affected the communal responsibilities of scientists by bringing the scientific community under firmer external control (§11.5). In countries where the traditional institutions of science have been incorporated in the state apparatus, scientists are now expected to act as state functionaries, rather than as citizens of a 'republic of learning'. In most other countries, academic institutions such as universities and learned societies are expected to account in some detail for the subsidies they receive from the State (§14.1). They are thus obliged to rationalize and codify their practices, and to set up administrative structures where working scientists have much less occasion to act out their traditional communal rôles. Duties that used to be performed voluntarily, such as editing a learned journal or negotiating the stipend of a research assistant, have become so heavy and complex that they have to be put in the hands of paid professionals. This may free the scientists



for their real work of research, but diminishes their personal involvement in the affairs of the academic community.

A major characteristic of the scientific community is that it is not, in principle, bounded by national frontiers. In academic science, every invisible college is trans-national in membership (§5.4). Scientists travel to meetings all over the world, and often work abroad for months or years. National academies and learned societies maintain fraternal links, and are formally associated in international unions. In recent years, scientists from many nations have collaborated closely in a number of major research projects, through networks such as the International Geophysical Year, and international institutions such as CERN (the European Council for Nuclear Research) (§11.4). Although the resources for these projects come from national governments or intergovernmental organizations such as the United Nations, the scientists themselves take part as members of the world scientific community rather than as international civil servants or citizens of their respective nations.

But this cosmopolitan tendency is not to be trusted in times of political crisis. There may once have been a time when 'the sciences were not at war', but this has certainly not been true in the twentieth century. In both World Wars, the scientists lined up patriotically to serve their respective countries, and even indulged in propaganda campaigns against their colleagues on the other side.

Calls for international solidarity with all those working for the advancement of knowledge have not been without moral force amongst 'pure' scientists, whether in the name of peace or in the name of human rights. The first Pugwash meetings in the late 1950s played some part in breaking the diplomatic ice of the Cold War, by exploiting the trans-national contacts of scientific notables from East and West. But these are little more than gestures in the face of a world divided into heavily armed camps, where something like a third of all scientific work is connected with preparation for war. The rôles of scientists as members of a transnational community directed towards benevolent transcendental goals is tragically subsidiary to their individual rôles as loyal citizens of particular nation-states (§10.3).

### *15.4 The scientist as technical worker*

Industrial science (§10.6) employs scientists as *technical workers*. Their rôles in governmental or industrial R & D organizations are much the same as those of other skilled employees. They are expected to apply their talents conscientiously in support of the policies of their employers, and to work diligently at the tasks prescribed for them. Their rights and responsibilities are limited by their contract of employment; in general, they are bound to follow the instructions of their organizational superiors and to manage the work of those below them in the spirit of those institutions.

As highly qualified professionals, research scientists are often given much more autonomy in the organization of their activities than other workers. They may be at liberty to come and go as they please, to attend scientific meetings in a personal capacity, and to contribute papers to learned journals in their own names. But despite these superficial resemblances to the academic life style, the rôle in which they are cast is quite different. The personality traits demanded of them are those of the 'organization man' (or woman) whose behaviour has to be closely coordinated with the behaviour of others and calculated to advance the interests of the specific organization to which they belong.

As one moves towards the more 'relevant' end of the spectrum of R & D organizations (§12.2), this rôle becomes more and more the norm. Scientists involved directly in the technological development of new commercial products or military hardware are not essentially different from the engineers, production managers, sales staff or military personnel with whom they work. The notion that scientists have a special social rôle cannot be sustained in these circumstances – which are, in fact, precisely those under which the majority of people with advanced scientific training are now actually employed.

The contradiction between the 'academic' and 'industrial' rôles is the source of many dilemmas in the management of collectivized R & D (§12.4). For example, should young scientists be given 'academic' freedom to choose their own basic research themes, or should they commit themselves to the interests of the organization by being put on to immediate practical problems? To what extent should scientists be permitted to criticize the technical perspectives of their employers, in the name of scientific scepticism? Must some scientists be discouraged from taking an active part in the affairs of the scientific community because of their involvement in secret research? What achievements should be rewarded with promotion – contributions to scientific knowledge or the improvement of productive techniques? Should there be a special career ladder for very able researchers who do not desire, or are not fitted for, high managerial responsibility? These dilemmas arise because the stereotype of the scientist as intellectual entrepreneur is simply not compatible with the stereotype of the scientist as technical worker: these conflicting rôles cannot be harmonized without considerable psychological adjustment and spiritual compromise (cf. §12.5).

## *15.5 The scientist as expert*

In principle, every fact or theory known to science is contained in the public scientific literature (§4.1); in practice, this information is only intelligible to a specialist in the relevant field (§5.3). Whenever a practical question arises where such information is needed, a research scientist will probably have to be called in as an *expert*, not



only on the published literature but also on the tacit knowledge that relates to it (§3.3). This expertise may be required in a variety of circumstances. An academic physicist doing research on semiconductors might be hired as a *consultant* by an electronics company. A professor of entomology might be asked to give evidence as an expert *witness* in a court case about insect infestation. A microbiologist might be appointed an *adviser* to a public commission on the regulation of genetic engineering – and so on.

Scientific workers employed by large R & D organizations perform this advisory function as part of their normal duties. Outside consultants hired to give confidential advice are in much the same position as 'in-house' experts in that the opinions they offer are understood to be essentially their own. But a person appearing as a scientific expert in public is usually understood to be speaking on behalf of 'science', and is thus being cast in a much less individual rôle. The scientist acting as a *public* expert is supposed to be simply a medium by which objective scientific knowledge is being brought to bear upon the practical problems of the world.

Where the information required is essentially well-established (§3.8), this rôle presents no difficulties in principle, although it may call for considerable skill in practice. But the questions that arise in technology, law, commerce and politics are seldom posed in the contrived and bounded terms of research problems (§2.15), and almost always call for information that is not validated, or has not even been 'discovered' in a scientific sense. The sheer ignorance of science on many weighty issues is very evident, for example, in the development of nuclear power, where it is largely a matter of conjecture what would happen if there were a major reactor accident.

From a strict philosophical point of view, a scientist faced with such a question should repudiate the rôle of an expert altogether. But that would be an antisocial attitude, since it would effectively deny access to whatever relevant information might have been gleaned in the course of research, however uncertain or controversial it might be. The conscientious expert should then present this information very tentatively, indicating its low epistemological status by, say, estimates of the probability of inferred generalizations (§3.5).

This is a council of perfection, based upon an unrealistic philosophy of science. Scientists cannot cast off their emotional commitments, even in scientific controversies, and are bound to express opinions weighted towards their personal inclinations. It is neither surprising nor shocking that they cannot be relied on individually to play the rôle of perfectly objective advisers. The 'truth' and 'objectivity' of scientific knowledge derive from its collective character (§§8.4, 8.5), and are not inherent in the experiences or notions of any single person.

The difficulty is, however, that the supposedly 'scientific' uncertainties cannot be disentangled from other factors in the situation. The sociology of knowledge (§8.2) teaches that the scientist is playing a part in a social drama, and cannot give advice without reference to his or her personal opinions or interests. Indeed, in law suits and planning inquiries the divergent interests of the technical witnesses appearing for the various parties are so notorious that their credibility as experts is normally put to public test by adversarial procedures such as legal cross-examination. For the same reason, it is desirable to arrange support for research pluralistically (§14.4), so that all the scientists competent to advise on the policies of a particular governmental or commercial organization are not dependent upon it for their employment or research facilities. The academic norm of 'disinterestedness' (§6.2, §12.5) is an ideal towards which most scientists may strive, but the rôle of the scientist as an independent, neutral adviser in public affairs can only be sustained within a social framework in which this behaviour is encouraged and esteemed.

## *15.6 Social responsibility in science*

Science is extraordinarily influential in modern society, and yet scientific work is carried out in laboratories and offices that are far removed from the scene of its applications. The isolation of most scientists from the practical outcome of their research is an inevitable effect of the way in which it functions, epistemologically and sociologically. Until recently, this isolation was actually fostered and celebrated in the ethos of 'pure' science (§10.7), undertaken 'for its own sake', without regard for the consequences. Nowadays, however, it is generally agreed that scientists should endeavour to show some responsibility in their actions, especially where the results are socially destructive through political oppression and war.

How should this ethical notion of 'social responsibility in science' be put into practice? First and foremost, every scientist is an ordinary human being and an ordinary citizen (§15.1); there is no case for denying the normal responsibilities of these rôles just because one happens to be a scientist. Unfortunately, in their rôles as individual intellectual entrepreneurs (§15.2), scientists are bound to ignore the wider effects of their research (which are almost incalculable, anyway) and to follow it wherever it leads. The traditional academic ethos reinforces this attitude, which is entrenched in the charters and policies of many of the institutions of academic science.

Nevertheless, as a member of a scientific community (§15.3), every scientist has some responsibility for the 'external relations' of that community (§10.5), which can no longer be disconnected from other societal structures. National academies, learned societies and universities are institutionally involved in political, commercial and military issues, where the ethical sensibilities of their members can play a very



important part. In the role of 'citizen of the republic of science', a scientist can join with others in opposing, say, research on biological weapons, even though this might not be an easy position to maintain as an individual subject to the pressures of personal employment.

Scientists employed as technical workers (§15.4) have usually had to surrender much of their ethical independence to the organizations that employ them. The prime act of irresponsibility in this rôle is to work for an organization – e.g. an industrial firm producing faulty goods – whose activities one deplores. At this point, however, more general ethical and legal issues enter the argument, such as the responsibility of the subordinate carrying out orders from above, or the grounds on which an employee should be permitted or encouraged to 'blow the whistle' on the antisocial acts of his or her employers. Scientists tend to be caught in the dilemmas of this rôle because their job is often to predict or monitor the consequences of corporate policies, and they thus become uneasily aware of the defects of these policies.

It goes without saying that the scientist acting as a public expert (§15.5), or taking a leading rôle in public affairs (§14.6) is in the most sensitive position from the point of view of social responsibility. This applies not only to the actual advice given, or the decisions taken: the scientific notable in this situation often claims to be speaking on behalf of 'science', and thus contributes significantly to the perceived rôle of all scientists in society. Scientific authorities (§5.6) are seldom elected democratically in contested ballots, nor are they usually answerable to the rank and file for the policies they pursue or the opinions they express; a heavy responsibility rests upon them to balance justly the personal, communal and societal considerations that arise in the politics of science and technology.

## *Further reading for chapter 15*


Relevant reviews are

R. Fisch, 'The Psychology of Science' (pp. 277–318); and S. A. Lakoff, 'Scientists, Technologists and Political Power' (pp. 355–91); in *Science Technology & Society* ed. I. Spiegel-Rösing & D. de Solla Price. London: Sage, 1977

The autonomy of the researcher is discussed by

W. P. Metzger, 'Academic Freedom & Science Freedom', *Daedalus*, Spring 1978, pp. 93–114

Some grave issues in the history of the 'republic of science' are discussed by

J. Haberer, *Politics and the Community of Science*. New York: Van Nostrand, 1969

An idea of the situation facing the expert witness is conveyed by

J. S. Oteri, M. G. Weinberg & M. S. Pinales, 'Cross-examination of chemists in drugs cases', in *Science in Context*, ed. B. Barnes & D. Edge, pp. 250–9. Milton Keynes: Open University Press, 1982

Cases of scientists as 'atomic spies' are described by
R. W. Reid, *Tongues of Conscience: War and the Scientists' Dilemma*. London: Constable 1969
The various rôles played by scientists in a major political issue are demonstrated in
J. Rotblat (ed.), *Scientists, The Arms Race and Disarmament*. London: Taylor & Francis, 1982

# 16

# *Science as a cultural resource*

'Physico-mechanical laws are, as it were, the telescopes of our spiritual eye, which can penetrate into the deepest nights of time, past and to come.'

*Hermann von Helmholtz*

## *16.1 Beyond the instrumental mode*

Scientific research is undertaken nowadays primarily for its eventual material benefits (§9.1). For this reason, our discussion of the external social relations of science has focused almost exclusively on its instrumental connections through technology. But the influence of scientific knowledge and ways of thought is far wider than the contributions of R & D to industry, medicine, agriculture, war and other typical human pursuits (§12.1). In this final chapter, therefore, we consider science as a general *cultural* resource, with significant societal effects beyond those directly due to technical change.

This is a large and diffuse metascientific theme, which can only be treated very schematically. Science is only one amongst the many elements that go into the making of contemporary culture. These other elements – psychic, political, philosophical, humanistic, aesthetic, religious, etc. – have to be appreciated in their own right and not looked at solely through eyes that have already been 'blinded by science'. *Scientism* (§3.9) is not just a philosophical doctrine; it has its sociological, political and ethical manifestations, which are equally misleading and dangerous.

Consider, for example, the topic of the previous chapter – the scientist's rôle in society. Some enthusiasts for science advocate a greater expansion of this rôle; they assert, in effect, that everything would be OK if scientists ruled. Now it is true that success in scientific work calls for impressive qualities, such as intellectual grasp, openmindedness, persistence and honesty, which might be of great value in a responsible political leader. Some scientists have, indeed, played a major part in political affairs (§14.6), whether through the machinery of government, as in the case of Robert Oppenheimer, or simply through the force of their moral example, as in the case of Albert Einstein. But the personal qualities desirable in those who govern the State is one of the great questions of political theory, going back to Plato. The scientistic view ignores other essential qualities for political leadership, such as sociability, persuasiveness in debate, willingness to compromise, appreciation of the needs of ordinary people, or even ruthless ambition, which are not at all characteristic of the 'scientific attitude' (§15.2). It is generally agreed by political theorists that if the *technocratic* tendency of science were allowed to prevail, it would rapidly degenerate into tyranny. In other words, the experience and attitudes gained in and through science are an inadequate guide to the way in which society works as a whole.

## *16.2 Public understanding of science*

How much science do people actually know? To judge by the questions and answers in television quizzes – very little indeed. Even amongst well-educated people, the most elementary scientific facts, such as the chemical symbol for sodium, or the physiological function of the liver, are regarded as highly technical and 'difficult'. Modern culture depends utterly on science-based technologies (§9.2); techniques derived from scientific practice and concepts drawn from scientific theory pervade everyday life (§9.4); yet few people have a general notion of what is now known to science.

This ignorance is deplored by scientists, who press for action to improve public understanding of science. Yet the machinery for this action is fully established. For more than a century, *science education* has been a major function of the school and university systems of all industrialized countries. By the end of their compulsory period of schooling, most young people have had at least a few courses in the basic sciences. Courses at every level, in every scientific discipline, 'pure' or 'applied', are open to suitably qualified students. There are plenty of opportunities to learn science, for those who want to. Science is also widely *popularized*, through books, magazines, newspapers, radio and television. Some of this material is sensational or opinionated, but one can easily find in the 'media' a solid stratum of scientific information presented skilfully by effective communicators. Nevertheless, for the great majority of people, science is a subject that one might have to learn as part of one's job, but is otherwise regarded as difficult, dull, and best soon forgotten.

All specialist groups deplore the lack of public understanding of their specialty and urge that it should be given greater emphasis in mass education and the mass media. But the case of science is instructive because it illustrates the difference between the viewpoints of 'insiders' and 'outsiders'. The outsider's view is overwhelmingly instrumental (§9.1). The whole purpose of science education is taken to be vocational. Science subjects were introduced into the elementary school curriculum, and technical universities were founded in order to train workers, managers and technical experts for industry. The 'attentive public' for popular science is very limited, except where it touches upon material issues of personal health and safety.



From the inside, on the other hand, science is seen primarily as a conceptual scheme by which observable facts are ordered and mapped (§3.8). The emphasis is not so much on utility, as on the possibilities of discovery and of validation. In the opinion of most scientists, what people ought to be made to understand is the 'scientific world picture', in greater or less detail. They tend, therefore, to structure the science curriculum around the central cognitive themes, with very little regard for their applications in everyday life.

There is thus a serious mismatch between the interests of those who are already inside science, and the motives of those whom they would like to draw in. Most people find great difficulty in getting to understand the conceptual schemes of the sciences, which seem so very unlike the familiar structures of the life-world (§3.9). A few young people are attracted to the idea of discovering new representations of reality: the great majority see this as a relatively fruitless task, irrelevant to their personal lives, and calling for more time and effort than they can spare, whether in formal education or in informal learning. Novel educational curricula on the theme of 'science, technology and society' can encourage students and teachers to bridge this gap, but science remains a distinct sub-culture whose actual contents are practically unknown to all but a tiny fraction of the population.

## *16.3 Folk science, pseudo-science and parascience*

Just because people are ignorant about science does not mean that they lack reliable knowledge on which to base their actions. In every human culture, people know very well when to plough their fields, how to treat minor ailments, or what to make of the behaviour of other people. The ordinary problems of life are dealt with by reference to rituals, rules and maxims which may not have been codified and tested scientifically but which are often sharply observed and based soundly on experience (§9.3). Whether or not we want to call such traditional knowledge 'scientific', it was the original starting line for the development of all our natural sciences and technologies.

In the societies studied by anthropologists, everyday knowledge of the life-world (§3.2) is either taken for granted, or is referred back to a loosely articulated system of legends, myths and religious doctrines. In modern society, however, religion has lost much of its authority in relation to practical knowledge, and the efficacy of magic is doubted. People are ready to follow custom, or a convenient rule of thumb in the minor decisions of life, but in really serious matters they feel they must put their trust in science. When they are gravely ill, for example, they demand medical treatment by the most up-to-date scientific methods.

This faith in the practical efficacy of science is not altogether misplaced, but it can become excessive. What is one to do if the guidance offered by orthodox science is inadequate, or unpalatable – for example, when a disease is said to be incurable? People may then be tempted to turn to other sources, supposedly equally 'scientific', in the hope of more 'helpful' advice.

Even in the most advanced societies, there exists a considerable body of *folk science*, of varying degrees of sophistication, outside the domain of orthodox science. From our present point of view, the most interesting characteristic of this sort of knowledge is that it often claims to be 'scientific', despite the fact that it has not been accredited as such by the scientific community. Such claims are addressed, of course, to the general belief in the superiority of science to religion, magic and other systems of knowledge. Thus, cancer sufferers are induced to dose themselves with 'laetrile', a substance 'discovered' by a man with a PhD who offers an elaborate biochemical explanation for its supposed action. On a larger canvas, T. D. Lysenko presented 'scientific' arguments to justify his agricultural methods, and thus became (with the support of Stalin) a folk hero amongst Soviet farmers, even though his claims were not confirmed by properly conducted experiments.

For this reason, the established institutions of science are very hostile to all forms of *pseudoscience*. This hostility is often well founded. People who esteem science highly but who are ignorant of its contents are easy victims of self-deception, if not outright fraud. Scientists would be socially irresponsible (§15.6) if they failed to take a public stand against practices that they regard as grossly misguided or deceitful.

Nevertheless, scientific opposition to pseudoscience is sometimes carried to unwarranted extremes. For example, the attempts by some astronomers to prevent the publication of Immanuel Velikovsky's harmless nonsense about the history of the Earth aroused the suspicion that science was trying to set itself up as the sole authority on all such matters. This intolerance of deviant opinion infringes the scientific norms of universalism and scepticism (§6.2), and cannot be justified epistemologically. Philosophers simply do not all agree that there is a formal criterion (§3.7) by which 'pseudo-science' can be unfailingly distinguished from the genuine article.

At its core, established science is a coherent system of fact and theory, without serious rival as a source of reliable information. Scientists mostly work within an accepted framework of regulative principles (§3.10), and strive earnestly to build up an empirically tested, non-contradictory body of knowledge (§3.8). But the scientific enterprise cannot be closed off from other cultural activities and influences. At any given moment it must take notice of propositions of widely varying credibility,



ranging from well-validated observations and theories to the wildest shores of fantasy. Securely held paradigms, like the permanence of the continents, fall into disgrace (§7.4), whilst absurd notions from folk science, like the fall of meteorites from the sky, are found to be justified. Sophisticated practical techniques, such as clinical medicine, rely as much on unexplained maxims and untested rules of thumb as on validated facts and theories.

This is not to say, as doctrinaire sociological relativists seem to suggest (§8.2), that one bit of claimed knowledge is as good as another. Folk science is very seldom as reliable as orthodox science where they both apply. Scientists have every right to express their opinion that some knowledge claims, such as those made for extrasensory perception, are so contrary to established understanding, and are supported by so little evidence, that they should be dismissed as *parascience*. But even at that distance from the centre, the margin of credibility is not altogether distinct. It is a fundamental metascientific principle that there can be no sharp line of demarcation between 'scientific' and 'non-scientific' beliefs in everyday life.

## *16.4 Academic scientism*

The word 'science' has been used in this book in the present-day fashion, as if it referred almost exclusively to subjects such as physics, chemistry, biology and geology, and their associated technologies such as engineering, medicine and agriculture. But this word was originally used to denote any orderly body of knowledge or recognized branch of learning. In most European languages the corresponding word – *la science*, *wissenschaft*, *scienza*, *nauka*, etc. – still has this general meaning. Thus, to say of sociology or economics that it is one of the *behavioural* or *social sciences* can quite properly be taken to mean that it is an academic discipline whose subject matter is some aspect of human behaviour or some aspect of society.

In the nineteenth century, however, the primary meaning of the English word was narrowed down to its present use. The notion of a science came to be associated with the methods, concepts and credibility characteristic of the 'physical' and 'natural' sciences, whose progress was then so striking. Scholars opening up the systematic study of behavioural and social phenomena were induced to define their work as 'scientific' only when it followed those methods as far as possible. To say, then, that sociology is a social *science* could be interpreted as a claim that it shares some of the characteristics – especially the ultimate credibility – of physics, chemistry, biology or geology, and is capable of being applied technologically in the spirit of engineering or medicine.

The controversies surrounding this semantic confusion are obvious manifestations of *academic scientism* (§3.9). But underneath the rhetoric there lies the very important question of the influence of 'science' (in the narrower sense) within academia. In other words, we are led into an investigation of the extent to which other academic disciplines are – or ought to be – regarded as equivalent to, or comparable to, the established natural sciences. The object of such an investigation should not be to prove, say, that sociology is so 'like' physics that it could be just as 'true', but to discover what such disciplines have in common, and what they may learn from one another.

The precise extent of 'science' in the conventional sense is not quite clear. The natural sciences and their associated technologies (§9.6) do not constitute a compact set within academia. Disciplines such as geography, psychology and archaeology straddle the administrative boundaries between the Faculties of Science, Social Science and Humanities. Engineering, medicine and agriculture draw upon economics, social psychology and sociology as well as upon the physical, biological and earth sciences. Many practical techniques that originated in physics and chemistry, such as radiocarbon dating of manuscripts and works of art, have found invaluable application in the traditional humanities. Some branches of scholarship, by their very nature, have physical, biological and social aspects, whilst the technical resources of science can be exploited throughout the scholarly world, just as in everyday life.

But there has long been a tendency towards 'scientification', in many disciplines, that goes beyond mere eclecticism. For example, *quantitative* empirical data (§2.7) and quasi-mathematical theoretical *models* (§2.12) are often preferred over other forms of 'fact' and other schemes of explanation. The importance of *experiment* (§§2.8, 3.7) is also strongly emphasized, and the possibilities of successful *prediction* (§3.6) are considered. In other words, the methodologies and validation procedures that have proved so powerful in the physical sciences are being applied to behavioural and social phenomena, in the belief that they will produce a sounder body of knowledge than any alternative intellectual approach.

This belief is evidently founded upon a general philosophy of science that regards these as essential features of the 'scientific method'. But as the history of biology demonstrates, a vast amount of good science can be discovered with little reference to numerical measurements. The quantitative approach is not a necessary condition for epistemological progress in the scientific spirit, and tends to exclude qualitative information that is highly relevant to the understanding and explanation (§2.10) of complex phenomena. Again, direct experimentation may be feasible in the study of the behaviour of individuals and small groups, but is out of the question when the object of study is a whole social system. But natural scientists do not see this as a total ban of the logic of justification. For example, a conjecture in meteorology can be refuted by subsequent observations of uncontrived events, whilst the whole science of geology relies upon consistent theoretical inference (§ 3.5) from data obtained by systematic exploration of nature, with very little possibility of genuine



prediction (§3.6). There is no absolute philosophical mandate for the proposition that science is essentially predictive, or that knowledge that cannot be tested experimentally must be excluded from the scientific archives.

Any opinion on the rôle of 'scientific method' in disciplines such as social psychology or economics thus depends on what is thought to be the nature of this method in its more conventional setting, and on the epistemological status of the results it obtains. Is scientific knowledge to be strictly limited to what can be discovered and validated by some formal procedure, such as the hypothetico-deductive method (§3.7) or does it include knowledge that could only have been obtained from other sources, such as introspective insight, or codified personal experience? Does science describe reality (§3.9) or is it only one of a number of possible ways of looking at the world?

Philosophy offers a variety of answers to these questions. Some philosophers, for example, maintain a strictly *positivist* epistemology (§3.3), which takes a very austere view as to what may be counted as scientific knowledge, but elevates this knowledge to a highly privileged status excluding almost all other sources. Supporters of scientific *realism* (§3.9) hold similarly that there is a uniquely credible scientific world view, which can be discovered by appropriate methods. General philosophies of this kind tend to make a sharp distinction between 'scientific' and 'non-scientific' procedures, and favour the introduction of the former in place of the latter in all branches of learning.

But these modes of *philosophical scientism* are now somewhat out of fashion, and science is usually assigned a more modest rôle in general philosophy. In particular, philosophers influenced by the *sociology of knowledge* (§8.1) would argue that all knowledge and belief must be thought of as a social product, whose character derives from the interpersonal situation where it is generated. Scientific knowledge should therefore be seen primarily as the collective output of a community with a peculiar internal social structure (§8.4) and subject to specific external forces. This critique does not necessarily lead to total relativist scepticism concerning the special status of scientific knowledge (§8.3), but it strongly suggests that the intellectual and personal relationships between the individual scholars in a particular discipline may be an indication of the extent to which it is 'like' an established science. Do they, for example, share enough by way of accepted facts and concepts to resolve some of their differences of opinion by rational argument, and thus extend the area of consensus (§8.5)? It was the lack of such efforts towards consensus between the warring schools of psychoanalysis that made the 'scientificity' of their enterprise seem so doubtful to outside observers.

In the face of such diversity of views about the true nature of science, it would be rash to express a firm opinion on its place within academia. Techniques and intellectual strategies developed in the natural sciences can certainly be employed profitably in the behavioural and social sciences. The 'scientific' attitudes of empiricism (§3.2), theoretical self-consistency (§3.8) and objectivity (§8.6) are always to be welcomed in any academic discipline. But every methodology of research has to justify itself by its results in action, and the modes of thought that have evolved in the study of physical and biological phenomena do not exhaust all our intellectual resources. The social sciences have had to develop their own characteristic strategies to deal with problems of enormous difficulty which have no analogues in the natural sciences. The philosophy of science has to be extended to deal with the *reflexivity* of social thought, which engulfs every social scientist in the action he or she is observing. Self-awareness is the primary human characteristic, and is not to be glossed over, or ignored, on the grounds that it is somehow reducible to more elementary behavioural components. Indeed the critique of positivism (§3.3) applies with even greater force in the interpretation of human behaviour than in physics or chemistry. Some of the epistemological problems that are obvious in attempts to construct 'scientific' theories of social phenomena may also be observed, in more insidious form, in the natural sciences. Instead of trying to make sociology look like physics, it may be wiser to accept that physics may not be so very different from sociology after all.

## *16.5 Science and values*

From Plato, through Hobbes and Marx, one of the great dreams of European thought has been to construct a science of human behaviour that would solve all the problems of social life. In its grandest form, *political scientism* is akin to technocracy (§16.1). Politics itself is to be transformed into 'social engineering' to be blueprinted and operated by philosopher kings, scientific revolutionaries, or, more modestly, the diligent pupils of this or that professor of social science.

This conception of science as a complete cultural formula is untenable. The elusive art of government has undoubtedly gained immensely from the theoretical critiques and practical applications of the social sciences. But these critiques and applications are of limited scope, and are not founded securely on well-established theories comparable to the laws of physics and chemistry that have proved so effective in real engineering. As we have just seen, it is questionable in principle whether even the most mature and refined science of human behaviour could ever be precise and predictive to that degree. Moreover, any elaborate scheme of 'social engineering' would almost certainly fail in practice through lack of knowledge, or control, of numerous 'variables' and 'parameters' that could prove decisive in the unfolding of future events. Like every real technology, it would have to have a great deal of discretionary flexibility built into the design from the beginning.

Above all, any programme for the scientific management of human affairs is severely limited by uncertainties, contradictions and conflicts over the *values* at stake



in the choice of objectives. These values derive from religious, ethical and aesthetic modes of thought and action that lie outside the domain of science as traditionally defined. In effect, political scientism violates the basic tenet of the academic ethos (§6.3) that science should be disconnected from political and religious causes.

Ever since the seventeenth century, scientists have proclaimed and celebrated the *neutrality* of scientific knowledge as a virtue associated with its objectivity and unimpeachable authority in its own sphere. The traditional philosophies of science have always followed the regulative principles of scientific work (§3.10) in insisting that the external world to be explored by science must surely have unique properties that are independent of the individual human mind. To undertake this exploration in a partisan religious or political spirit would be to blinker one's vision and risk failure in the search for truth. To draw organized science into the cauldron of politics (§ 14.6) – for example to enlist the Royal Society for or against the government of the day – would thus be a betrayal of the whole research enterprise.

Originally, neutrality of science had to be defined mainly in relation to *religion*. The delineation of this boundary was dramatized in the trial of Galileo by the Inquisition and in the public debates that followed the publication of Darwin's theory of evolution. Whatever the actual historical course of these particular events, they have proved potent myths in the establishment of the ideology of academic science. In each case, it later turned out that the region of knowledge that was to be taken over by science was not vital to religion. What could be clearly demonstrated, from publicly available empirical evidence, concerning the nature of the world in space, time and comprehensible pattern, could evidently be distinguished from the inspirational and ethical principles that people also need to order their personal lives. Religious and scientistic fundamentalists continue to dispute this boundary from either side, but most theologians and most scientists agree that there can be peaceful coexistence between science and religion, provided that they are not forced into direct confrontation.

Nowadays, the challenge to the neutrality of science comes mainly from politics. The collectivization of science (§11.1) has brought research under State control, so that decisions on science policy are inevitably influenced by political considerations (§14.5). At the technological end of the R & D spectrum, political and commercial forces flow into the gaps left by scientific ignorance and uncertainty, so that the scientific expert (§15.5) finds it almost impossible to maintain a neutral stance. In the basic natural sciences, it may look easy enough to draw a line between what *is* and what *ought* to be, between what *will* happen, and what is *desired* as the outcome of a certain action. But as the scientists who conceived and built the first nuclear weapons came to realize, there is no obvious frontier post between scientific *means* and political *ends* (§12.3). Perhaps the political neutrality of science was always a myth, as many Marxist metascientists have argued (§8.1): it is certainly unrealistic nowadays to suppose the pursuit of scientific knowledge can be disconnected from its political consequences and causes.

But the connections between the natural sciences and politics are explicitly technological. They are made through the instrumental mode, and have little to say on the religious, commercial, aesthetic or purely hedonistic goals that people seek by their means. A scientistic programme of 'social engineering' would have to employ the social and behavioural sciences to bring these values into the blueprint. But these sciences are certainly not as neutral and objective as this programme would demand. Every social psychologist, sociologist or economist, however disconnected his research from the corruptions of applicability, comes to realize that there is no such thing as a value-free proposition in relation to human affairs. The social sciences offer guidance on the likely outcome of social action as if through the eyes of an impartial observer; but this guidance, being expressed in the language and symbolism of a particular culture, already contains the values of that culture. In other words, the argument becomes circular. Science cannot be extended throughout the whole cultural domain to provide an independent objective source of both the means for action and the values attached to the results of such action.

## 16.6 The value of science

The fact that science cannot be the source for *all* human values does not mean that it cannot be considered a foundation for *some* values, or indeed, of value in itself. Many *rationalists* and *humanists*, having rejected the traditional religions, justify their ethical codes by reference to various fundamental scientific concepts, such as the apparent unity and coherence of the physical universe, or the inevitability of progress through biological evolution. Others are inspired by the notion of scientific technology as a means by which nature can be controlled and transformed. Others, again, revolt against this notion, and regard science as a major source of negative forces and values. The beliefs, hopes and fears generated by science are not, of course, part of science as such, and are not to be justified or dispelled by scientific analysis alone. These are themes that are often explored with imaginative insight through the genre of *science fiction*, where the social and cultural influence of science is often presented far more vividly and cogently than in the academic metascientific literature.

In all of this, one must not lose sight of the value attached to the pursuit of scientific knowledge as an end in itself. The unravelling of some great scientific mystery – for example, the decoding of the molecular mechanism of genetics – obviously gives enormous satisfaction to very large numbers of people, far beyond those who are directly involved. Quite apart from all utilitarian considerations, science is held in high esteem by the general public. The idea of science as a transcendental enterprise



to explore the Universe, unveil the secrets of nature, and satisfy our boundless human curiosity (etc., etc: the rhetoric is also unbounded) is not a mere invention of the academic ideology (§6.4). For reasons that are none the less compelling because their ultimate sources are aesthetic and spiritual, people are willing to support basic science 'for its own sake', and take pride in scientific achievements whose significance they cannot properly understand. It may be our duty, in the field of science studies, to demystify scientific work, unmask the self-serving interests of scientists, devalue the products of social technology, and denounce the pretensions of science as a guide to social action. Nevertheless, when all the rhetoric has been debunked, there is a residuum of truth in the notion that science is a fascinating endeavour, capable of engaging men and women at their best, and enlarging and enriching the human spirit with its discoveries.

## Further reading for chapter 16

The topics mentioned in this chapter are so large and diverse that it is inappropriate to recommend a limited set of sources. The following works happen to be relevant, and are amongst the many that a serious student would need to consult.

D. Layton, 'Education in Industrialized Societies', in *A History of Technology*, ed. T. I. Williams, Vol. VI, Part I, pp. 138–71. Oxford: Clarendon Press, 1978

J. R. Ravetz, *Scientific Knowledge and its Social Problems*. Oxford: Clarendon Press, 1971 (pp. 364–402 on 'Folk Science')

R. Westrum, 'Science and Social Intelligence about Anomalies: The Case of Meteorites', in *Sociology of Science Knowledge*, ed. H. M. Collins, pp. 185–217. Bath: Bath University Press, 1982

L. R. Graham, *Between Science and Values*. New York: Columbia University Press, 1981

T. Roszak, *Where the Wasteland Ends*. London: Faber & Faber, 1973 (an attack on scientism from a humanistic point of view)

J. Passmore, *Science and its Critics*. London: Duckworth, 1978 (a defence of science as a component of culture)