1 Posing the problem

1.1 Lord Gifford's brief

"I wish the lecturers to treat their subject as a strictly natural science, the greatest of all possible sciences, indeed, in one sense, the only science, that of Infinite Being, without reference to or reliance upon any supposed special exceptional or so-called miraculous revelation. I wish it considered just as astronomy or chemistry is."

This is Lord Gifford's statement in the deed of foundation of his lectures in 1885. Much water has flowed under the bridge since then, and we can no longer take for granted either the character of "natural science" or of "revelation" in the sense in which these concepts were understood in Gifford's time. We therefore make no excuse (and believe it to be within the spirit of his foundation) that this book concentrates on the problem of what it is to be a "science," and what kind of continuity, if any, exists between the knowledge of "nature," of "persons," or of "society," and the possibility of knowledge of God.

We speak of "knowledge," but our difficulty today in addressing Lord Gifford's brief is that the theory of knowledge (epistemology) has come to mean almost exclusively the methodology of the natural sciences and, more recently and belatedly, the social sciences, to the exclusion of any possibility of knowing extraspatiotemporal reality, if such can be said to exist. Our culture leads us to believe in a natural space–time reality that is explored and increasingly discovered to us in natural science. For us unreflective empiricists, this is the paradigm of reality against which all other claims to objectivity have to be measured. We also believe in the existence of other persons with whom we join in groups and societies and who create a kind of man-made reality of social rules, roles, norms, and institutions. These are also space–time entities, available for study as are the objects of natural science. Among these entities are the objective facts of religion: the creeds, rituals, churches, hierarchies, sacred places. They form a humanly created reality like other social phenomena. In this case, however, their adherents generally claim more –

they claim that there is a reality outside space and time, that we can know this reality, albeit imperfectly, and that it is not discovered by our various scientific methods. Our culture typically does not have room for any taken-for-granted reality of this kind. If it is believed at all, it will either be an optional extra to the reality in which we all live, or it will have to be integrated with our other beliefs as a result of a much deeper critique of space–time reality and of natural knowledge.

Crudely stated, this is the epistemological problem posed by our naturalist and scientific culture. Note that our culture makes "reality" dependent on methodology; reality is intrinsically "verificationist" in that it assumes that what is in space–time is all there is, because that is what we appear to have direct access to, and it is reinforced in everyday interactions and in the success of science.

Our title, *The Construction of Reality*, is intended to challenge this positivist or "verificationist" view at its foundations. It draws attention to a different tradition, in which "reality" is held to be humanly "constructed" and not "given." This tradition seems to be the antithesis of our everyday conception on which science builds. Indeed it is, and we shall not adopt it in an extreme idealist form. To sharpen up the issues in a preliminary way, let us look in diagrammatic form at the positivist theory of knowledge, with application to natural and to social science, and compare this theory with the possibility of religious knowledge.

Figure 1.1 shows a "thinking head." To the left is the two-way interaction with an external spatiotemporal reality (s–t), which results in a model of that reality in the head. We shall develop a theory of how a mental model can be seen as consisting of a network of entities called schemas. The model of spatio–temporal reality is not "projected on to nothing," but is constrained by physical feedback, a process that runs from the child's acquisition of mental schemas to the scientist's testing and verification of theories. Of course, as we see in detail in Chapter 3, Figure 1.1 is oversimplified. The child's learning depends on the sensory and motor capabilities of the whole body and on his interactions with family and other people, as well as his sensing the physical environment. Learning also involves the social phenomena of language and its feedback cycles.

We use the term *construction* for the building of schemas in the head whether or not they are projected out on the external world. We refer to coherent sets of such schemas as "cognitive systems," thus using the word *cognitive* in the sense adopted by social anthropologists, rather than in the narrow sense of the positivists' "knowledge." In our analysis of space–time reality, we do not speak of pure projection of our models on a mere blank; that is, we reject both the idealism of "pure projection" and the naïve realism that sees nature as merely impressing our minds via the senses. Thus, arrows point both ways between space–time and the schemas in the head. In a sense,

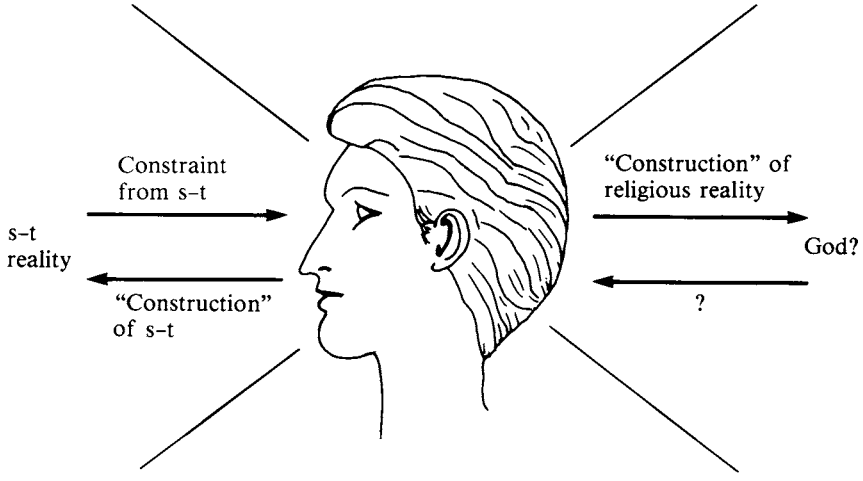

Figure 1.1. A thinking head

s–t and the head are inside each other. A model of s–t is in the head, and the head is part of s–t. The scientist may hope to develop laws to explain s–t, including in particular how these interactions enable the brain to build its schemas. This is explained in cognitive science, which recognizes a process of feedback correction and learning, as a result of which the models are not entirely arbitrary. We can, for example, develop Euclidean geometry and then raise the ontological question of whether the external s–t reality conforms to Euclidean geometry. We construct the natural world in our science, but s–t constrains these constructions by feedback.

Returning to Figure 1.1, the arrow on the right from head to God represents the construction of religious reality, for which there are no doubt sometimes "models in the head." The fact that people have religious beliefs can be included as part of what is to be explained about s–t reality, and some sociologists have adopted evolutionary or functional theories of this fact. But is there a return arrow for a feedback constraint on this construction? Freud, for example, would claim that our God schema is a modification of the father concept, with no external reality to which it answers. But most believers in theistic religion want to say there is a God reality that is not just constructed within the head but is out there, not contained within s–t. Certainly, there are myths and fables embodying people's constructs of God, so if there is a God reality, it has to impinge on the s–t world – it has to impinge on our physiology. The naturalist would simply offer a story of why it is useful to society to invent myths about God, without requiring a God "out there" that these myths are about.

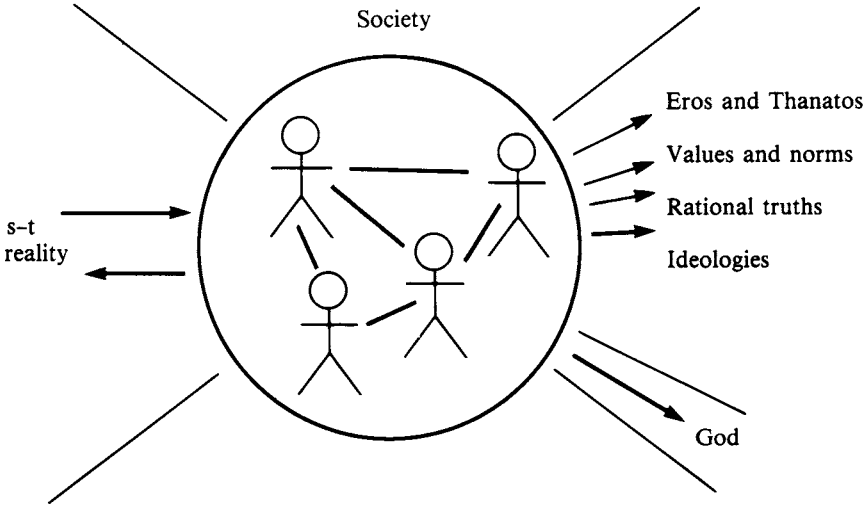

Figure 1.2. The collective social model

Reference to such "social schemas" reminds us that the representation in Figure 1.1 is too individualistic; we must consider not just the individual with models in the head and the external reality to which they may or may not answer, but also the fact that the individual is an interacting member of a society with its own "constructed" realities. Figure 1.2 represents the collective model as constituted by all these interactions, that is, by socially accepted concepts that include taken-for-granted scientific theories of the s–t world and also the values, norms, myths, and religions that make up the network of social life. From the naturalist point of view, the same question arises about the "objectivity" of values and norms that arose already about God; namely, is there an external reality against which they can be tested and corrected, or are they purely the internal constructs of societies?

Marx, Durkheim, and Weber all discussed a social reality within space–time, but constructed when groups transcend the capabilities of the isolated individual. Indeed, the notion of the isolated individual itself is a social legacy from the Enlightenment and ultimately from the Protestant notion of each individual soul's having unique value before God and direct access to him. Marx and Durkheim came in different ways to postulate social realities, such as the class struggle, or symbolic systems *sui generis,* which emerge from the behavior of large groups of people and their institutions and which could not have been predicted from individual or small-group behavior alone. Thus, Durkheim claimed there are "social facts" as well as "natural facts" and "individual facts." Durkheim also claimed that "society

is God." In a social theory parallel to Freud's individual theory of father projection, he concluded that individuals project their idea of society beyond space–time to construct God and religious symbolisms:

> [Religion] is a system of ideas by means of which individuals represent to themselves the society of which they are members, and the obscure but intimate relations which they have with it. Such is its primordial role; and though metaphorical and symbolic, this representation is not unfaithful. (Durkheim 1915, p. 225, translation in Lukes 1973, p. 461)

We might try to capture the ontological question suggested by Figures 1.1 and 1.2 by asking, "Is God more like gravitation or like embarrassment?" Gravitation is a reality that constrains our schemas of the physical world by the well-understood processes of testing and experimental feedback. Theories of gravitation give us at least part of the truth about it. Embarrassment, on the other hand, may be seen as a social artifact, arising when the person finds she has broken the social rules and is isolated from her group; this depends on the society's having a set of rules that are easily broken. One could conceive of a society in which there is no such thing as embarrassment, because of the support people give to those who display their imperfect mastery of the social rules. In any case, the conditions for embarrassment depend on social conventions. Gravitation exists independently of human activity and is known by human beings in terms of its testable interaction with them. Embarrassment is based on how we perceive certain kinds of human situations and would not exist independently of this perception.

There is a sense in which the religious believer would hold that God is more like gravitation than embarrassment. The same sense will be true for the holder of any ideology with respect to the reality of the concepts that underlie the ideology, such as the class struggle for Marxists, or the soul for Eccles. We have distinguished Reality "out there" (capital *R*) from the stories or models people have about what they take reality to be (which we call their constructed "reality," with a lower-case *r*). To claim that God is like gravitation is to say there is some kind of constraint and feedback on our knowledge of him, which in this case is from beyond space–time. On the other hand, "naturalism" is the thesis that there is only space–time Reality and that this Reality is sufficiently understandable in terms of scientific methods.

To say that God is like embarrassment, on the other hand, is to say that religion is a purely social construct. If God is understood as an unconscious projection of the father figure, or as society itself in its role as the source of corporate authority, constraint, and desire, then the problem of his empirical existence is solved, though at the price of the falsity of most of what most believers of all faiths have believed about him. Such psychological and social accounts of the origin and function of religion are widely taken to have fatally undermined any pretensions of religion to be an independent

source of knowledge. We may in fact conjecture that Marx, Durkheim, and Freud on religion are now much more potent sources of science–religion conflict than Galileo, Newton, and Darwin ever were.

Before challenging this naturalist interpretation of Figures 1.1 and 1.2, we examine in more detail what is represented on their left-hand sides. It is crucial to any conclusions about "Reality" and "realities" that we understand the claim to have knowledge of the spatiotemporal and to describe it more adequately than is done in crude empiricism and naïve realism. This examination has two parts. We first look at the way philosophy of science itself has moved away from crude empiricism and brought into question the realist interpretation even of natural science. Second, we shall introduce schema theory as a general science of the cognitive, basing it on studies of everyday perception, action, and learning. We find these studies also support the view that knowledge is essentially constructive.

1.2 Empiricism undermined

We have described constructive feedback procedures as the basis of our knowledge of s–t reality. This basis provides a demarcation of scientific knowledge that is common to the scientific positivists, to Popper's use of falsifiability, and to Peirce's and Habermas's views of natural scientific method as a convergent limiting process. Science is what survives experimentation and test; the results of experiments may feed back to change the theory; and sometimes, as with Kuhn's (1962) paradigm change, to suggest revolutionary changes in natural cosmology. During the past four centuries, however, we have learned that scientific theories do not provide final, true, and objective knowledge of the world. The Aristotelian worldview was displaced by the Newtonian, which has in turn been displaced by the modern physics of relativity and quantum mechanics. Yet, it may seem paradoxical that with our increasing understanding of the mutability of scientific theory goes an increased confidence in the predictions we make on the basis of scientific theory. We can explain the motion of the planet Mercury better and better in terms of successive theories that are radically different from one another: earth-centered epicycles (Ptolemy), sun-centered epicycles (Copernicus), an ellipse with one focus at the sun (Kepler), a body moving according to the inverse square law (Newton), or in terms of relativity theory (Einstein).

In 1906 Duhem first clearly pointed out that a multiplicity of theoretical models may all fit a given set of data relatively well yet presuppose different ontologies (Duhem 1954). Each theory may use a different vocabulary of concepts to represent what it takes to be the fundamental entities and properties that exist in nature. The data underdetermine the theoretical ontology, and there seems no reason in principle to suppose that a final theory corresponding with what "there really is" in the world will ever be realized. How, then, can we reconcile this view of "no final theory" with the progressive

success of our knowledge about the world since the sixteenth and seventeenth centuries?

There is certainly instrumental progress in science in that the pragmatic possibilities of predicting and controlling empirical events have vastly increased. When a new theory replaces the ontology of an old theory, it may also change the set of phenomena we choose to consider important. But for those phenomena addressed by both theories, the observation language of the new theory must be able to represent the observations made within the old theory, and the new theory must explain the phenomena so represented. In particular, a successful new theory should help us understand where the old theory succeeded even while replacing the ontology of the old explanation. A given theory lets us develop an observation language (based in part on the scientific instruments made possible by that theory), which enables us confidently to specify the nature of experiments and the results to be obtained under specific conditions. This procedure not only enables us to express the success of the theory but also to represent the discrepancies that provide the "error signals" for what Peirce characterized as the self-corrective feedback procedure of experimental science.

We adopt the *pragmatic criterion* (see Hesse, 1980, Introduction) of predictive success by means of such a feedback procedure. The pragmatic criterion is therefore the criterion of "truth" or "acceptability" that operates specifically in natural science. Though pragmatic success may be said in some sense to be a criterion for anything deserving the name *knowledge*, we shall see that it does not operate in so direct a way, if at all, for social and religious cognitive systems. The pragmatic criterion as just defined may therefore be regarded as the demarcating criterion for what we mean by natural science – the criterion according to which we *construct* the scientifically "objective" natural world.

Such construction is constrained by the pragmatic criterion, and we do not take it to imply a radically nonrealist view of science. In this interpretation, we differ from some recent sociologists of science who, in the swing away from empiricism, have rejected even this minimal attempt to demarcate natural science from other cognitive systems. In a new form of social idealism, they have suggested that in complex developments of theory, feedback from the world is altogether excluded, so that science becomes a socially generated imaginative schema like other social myths (see, for example, the "strong programme" of Bloor 1976; and also Barnes 1974, 1977; Collins & Pinch 1982; Collins 1985). It seems, however, that this extreme conclusion has resulted in part from exclusive concern with either "fringe" sciences like parapsychology, or with theories that have taken off far from their original empirical bases and that depend on highly elaborate and artificial instrumentation, such as current research in fundamental physics. However that may be, it is rare to find a sociologist who does not recognize some natural constraints on scientific knowledge. As Barry Barnes puts it, even in a nonliterate

hunting culture, the hunters know they must throw the spear to the front of the running lion. Natural knowledge that is continuous with animal-type predictive skills and habits still forms the basis of science, at least up to the point at which science becomes indistinguishable from pure mathematics or pure science fiction.

What the sociologists of science are recognizing, however, is that this formulation of the pragmatic criterion is a minimal characterization of science, and that only on this narrow basis can science be demarcated from other types of cognitive systems. The pragmatic criterion exhausts the content of the feedback arrow from space–time Reality to the "model-in-the-head," and yet it is strong enough to prevent the model's being purely an intersubjective representation of social realities. But there is a strong arrow in the "constructive" direction, too, and only recently have we come to understand how many characteristics of science previously thought to be "objective" ("read off" the real world) are, after all, products of construction, albeit constrained by the pragmatic criterion. Here are a few of these characteristics.

1. Science is in a literal sense constructive of new facts. It has no fixed body of facts passively awaiting explanation, for successful theories allow the construction of new instruments – electron microscopes and deep space probes – and the exploration of phenomena that were beyond description – the behavior of transistors, recombinant DNA, and elementary particles, for example. This is a key point in the progressive nature of science – not only are there more elegant or accurate analyses of phenomena already known, but there is also extension of the range of phenomena that exist to be described and explained.

2. The facts themselves are *theory laden*. There is no representation of facts without the observation language, and no observation language is just "given" as theory-free. Hence, there is a pressure toward relativism. How can we ascribe perennial truth value to statements of fact, given that these statements presuppose theories that come and go? The answer is that we cannot ascribe perennial truth value; but we do generally have an observation language rich enough to express observations not assimilable to current theory. Moreover, we also have the ability to recognize experiences that are not well described in the observation language. We can thus talk of feedback even though our language may not be able to formulate the range of such feedback. Observation language and even perception are theory laden, yet they are rich enough to contain feedback that contradicts the theory. We have, as it were, a spiraling set of nested feedback systems, as advances in theory respond to feedback and in turn enrich the observation language to make new corrections possible. Ptolemy used observations to correct the description of the epicycles for planetary motion, but it took a higher level of feedback to question the concept of epicycles themselves. It took an even

higher level to perform what Galileo (1953, p. 328) called the "violence upon the senses" involved in recognizing that what looked and felt like the movement of the sun round a stable earth is to be described as the motion of the earth. At each stage, concepts about space and time previously taken for granted as almost tautologies come to be seen as representing choices within a larger framework in which feedback correction is possible.

3. There is a different sense in which theory is richer than data and is therefore empirically underdetermined by data. Logically speaking, theories are not deducible from data, and many theories may fit the same data reasonably well. Duhem argued that any particular hypothesis is always embedded in a more general theory, all of which has to be tested as a whole against experience. Any given hypothesis may always be saved from falsification by modifying surrounding hypotheses or by modifying the interpretation they put on the data. Thus, no theory can claim unique and permanent validity, since over the long term it may not only be falsified by new experience but also one or more of its rivals may come to look better or be in greater conformity with prevailing fashion. How, then, does scientific theory, when accepted, give such an appearance of stability and consensus that it was taken by Descartes and his successors as the very paradigm of progressive knowledge?

At any given time, several factors explain this apparent stability. First, the underlying pragmatic criterion ensures that where prediction and experimental control in local domains have been successful in the past, any theory must incorporate at least these predictions. Second, the logically possible multiplicity of theories relative to given data is reduced by the operation of criteria of simplicity, economy, and elegance. These criteria may even temporarily be preferred to the criteria of empirical fit; for example, Copernicus's heliocentric theory had at first little to recommend it as a more accurate representation of data than Ptolemy's theory, but it was mathematically simpler and more elegant and implied fewer unexplained coincidences in the relation between planetary motions. Third, "local" modifications of hypotheses may not succeed in saving large-scale theories because their implications may extend far beyond the phenomena that prompted the change. For example, creationists try to reject Darwin's theory because their way of life is grounded in a reading of the Bible inconsistent with an evolutionary account. They therefore try to amend auxiliary hypotheses to make creationism consistent with the data. But current evolutionary theory is embedded in a whole web of observations related to other sciences – to modern physics (carbon–14 dating of fossils) and molecular biology (the mechanisms of the gene), as well as to agricultural applications of genetics. The creationists cannot explain these phenomena, but the reality of their religious beliefs may be such that it is easier for them to sever the links in the causal network that binds such observations to evolutionary theory than either to accept evolution or construct an alternative theory. It is logically possible to sever these

links, but this violates other currently accepted methodological criteria of simplicity and the unity of science.

4. The upshot of these arguments is to question any strong version of scientific realism. By a "strong version" is meant the view that takes acceptable scientific theory to be the true or approximately true description of unobservable as well as observable entities, and regards its pragmatic success as sufficient to guarantee this, in spite of underdetermination and the theory-ladenness of observation. This strong realism often goes along with a naturalist epistemology according to which acceptable scientific theory is not only the best but also the only type of knowledge we can get.

There is certainly a sense in which we accept our current science as representing the "real" every time we rely on the inventions of modern technology. But this sense of "reality" commits us to no more than acceptance of theory as a local instrument for successful prediction, yielding approximate truth in local domains. It does not imply universality or perennial truth for theories that extrapolate far from the data, much less the exclusive knowledge claims for science that often accompany such a full-blooded realism.

To undermine positivism and realism in these ways is to raise an opposite objection, namely, that we are in danger of making scientific theory merely relative to historical circumstances. (For recent discussions of relativism, see Hollis and Lukes 1982.) Scientific relativists, like the sociologists of science mentioned earlier, regard theories as internally connected propositional systems, or "language games," which are worldviews to be given as much or as little significance as any other mythical cosmology. "Truth" is defined as coherence with the theoretical systems, and "knowledge" becomes socially institutionalized belief. Ironically, the "queen of the cognitive systems," theoretical science, comes to be seen as just one of the mythologies, though no doubt better worked out as a logical system and more useful for empirical prediction and control.

Such a statement of relativism can be taken two ways. It may be a *reductio ad absurdum* of the critique of scientific realism and empiricism, requiring rehabilitation of the queen of cognitive systems to her methodological palace. Or, it may be taken as an invitation to raise the status of the other "mythologies" by a more careful investigation of their methodological and cognitive credentials. We attempt this second response here. We seek to avoid a relativism in which "anything goes" by examining the various kinds of criteria of acceptability that apply to different kinds of constructed models and myths.

Scientific theories, then, have some characteristics of ideological or social myths; they also have many of their social functions. We have only to think of crucial episodes in the debates between science and religion to see that this is so. The Copernican system may or may not have originally been intended as a realistic description of the cosmos, but it was certainly perceived