Lindberg, David C., *The Beginning of Western Science* (Chicago: The University of Chicago Press, 1992).

ONE
Science and Its Origins

WHAT IS SCIENCE?

The nature of science has been the subject of vigorous debate for centuries—a debate conducted by scientists, philosophers, historians, and other interested parties. Although no general consensus has emerged, several conceptions of science have attracted powerful support. (1) One view holds science to be the pattern of behavior by which humans have gained control over their environment. Science is thus associated with craft traditions and technology, and prehistoric people are regarded as having contributed to the growth of science when they learned how to work metals or engage in successful agriculture. (2) An alternative opinion *distinguishes* between science and technology, viewing science as a body of theoretical knowledge, technology as the application of theoretical knowledge to the solution of practical problems. On this view, the technology of automobile design and construction is to be distinguished from theoretical mechanics, aerodynamics, and the other theoretical disciplines that guide it; and only the theoretical disciplines are to count as "sciences."

Those who adopt this second approach, viewing science as theoretical knowledge, do not generally wish to concede that all theories (regardless of their character or content) are scientific; and for such people the task of definition has just begun. If they wish to exclude certain kinds of theories, they must propose criteria by which to judge one theory scientific and another unscientific. (3) It has become quite popular, therefore, to define science by the form of its statements—universal, law-like statements, preferably expressed in the language of mathematics. Thus Boyle's law (formulated by Robert Boyle in the seventeenth century) states that the pressure in a gas is inversely proportional to its volume if everything else remains constant. (4) If this seems too restrictive a criterion, science can be defined

instead by its methodology. Science is thus associated with a particular set of procedures, usually experimental, for exploring nature's secrets and confirming or disconfirming theories about her behavior. A claim is therefore scientific if and only if it has an experimental foundation. (5) Such a definition, in turn, yields easily to attempts to define science by its epistemological status (that is, the kind of warrant its claims are held to possess) or even the tenacity with which its practitioners hold its doctrines. Thus Bertrand Russell has argued that "it is not *what* the man of science believes that distinguishes him, but *how* and *why* he believes it. His beliefs are tentative, not dogmatic; they are based on evidence, not on authority or intuition."[1] Science on this view is a privileged way of knowing and of justifying one's knowledge.

(6) In many contexts science is defined not by its methodology or epistemological status, but by its content. Science is thus a particular set of beliefs about nature—more or less the current teachings of physics, chemistry, biology, geology, and the like. By this test, belief in alchemy, astrology, and parapsychology is unscientific. (7) The terms "science" and "scientific" are often applied to any procedure or belief characterized by rigor, precision, or objectivity. Sherlock Holmes, according to this usage, adopted a scientific approach to the investigation of crime. (8) And finally, "science" and "scientific" are often simply employed as general terms of approval—epithets that we attach to whatever we wish to applaud.

What this brief and incomplete survey demonstrates is something that should perhaps have been obvious from the beginning—namely, that many words (including most of the interesting ones) have multiple meanings, varying with the particular context of usage. These meanings are sometimes mutually compatible and complementary, sometimes not. Moreover, it seems futile to attempt to eliminate diversity of usage. After all, language is not a set of rules grounded in the nature of the universe, but a set of conventions adopted by a group of people; and every meaning of the term "science" discussed above is a convention accepted by a sizable community, which is unlikely to relinquish its favored usage without a fight. Or to put the point in a slightly different way, lexicography must be pursued as a descriptive, rather than a prescriptive, art. We must acknowledge, therefore, that the term "science" has diverse meanings, each of them legitimate.

Even if we could find a definition of modern science that would satisfy everybody, the historian would still face a difficult problem. If the historian of science were to investigate past practices and beliefs only insofar as those practices and beliefs resemble modern science, the result would be

a distorted picture. Distortion would be inevitable because science has changed in content, form, method, and function; and therefore the historian would not be responding to the past as it existed, but looking at the past through a grid that does not exactly fit. If we wish to do justice to the historical enterprise, we must take the past for what it was. And that means that we must resist the temptation to scour the past for examples or precursors of modern science. We must respect the way earlier generations approached nature, acknowledging that although it may differ from the modern way, it is nonetheless of interest because it is part of our intellectual ancestry. This is the only suitable way of understanding how we became what we are. The historian, then, requires a very broad definition of "science"—one that will permit investigation of the vast range of practices and beliefs that lie behind, and help us to understand, the modern scientific enterprise. We need to be broad and inclusive, rather than narrow and exclusive; and we should expect that the farther back we go, the broader we will need to be.[2]

This admonition is particularly important for anybody embarking on a study of the ancient and medieval worlds. If we were to restrict our attention to anticipations of modern science, we would be focusing on a very narrow range of activity, no doubt distorting it in the process, and overlooking many of the very beliefs and practices of ancient and medieval culture that should be the object of our study—those that will help us to understand the development, much later, of modern science.

I will do my best to heed my own advice in the pages that follow, adopting a definition of science as broad as that of the historical actors whose intellectual efforts we are attempting to understand. This does not mean, of course, that all distinctions are forbidden. I will distinguish between the craft and theoretical sides of science—a distinction that many ancient and medieval scholars would themselves have insisted upon—and I will focus my attention on the latter.[3] The exclusion of technology and the crafts from this narrative is not meant as a commentary on their relative importance, but rather as an acknowledgment of the magnitude of the problems confronting the history of technology and its status as a distinct historical specialty having its own skilled practitioners. My concern will be with the beginnings of scientific *thought,* and that will prove quite a sufficient challenge.

A final word about terminology. Up to now I have consistently employed the term "science." The time has come, however, to introduce the alternative expressions "natural philosophy" and "philosophy of nature," which will also appear frequently in this book. Why are these new expres-