

THE ROLE OF PHILOSOPHY IN SCIENCE¹

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Posted over the door of the first science laboratory I ever entered was a sign which read: "No dogs or metaphysicians allowed." This attitude of contempt, even of hostility, of the scientist toward philosophy has rarely been reciprocated by the philosopher, who, on the contrary, has always made science one of the chief objects of his concern and a major source of his data. Several sorts of things have happened in recent years to soften if not to eliminate this derogatory attitude of scientists toward the profession I represent here today. One of these is the series of revolutionary upheavals that have recently occurred in the supposedly settled sciences. My old physics teacher said to me a few years ago: "I have taught physics for years; I have even written textbooks used to teach it; but I am beginning to feel that I know nothing about it. I find that I have to become a philosopher and start all over again." What has happened in physics is now happening in the younger sciences. The scientists themselves have come to realize that these readjustments forced upon them are the consequence of *philosophical* questionings and re-interpretations.

Another cause of this growing appreciation of the relevance of philosophy to the scientific project is the discovery by the scientist that his research may have social consequences that need ethical and general philosophical examination. The dramatic instance of such an admission is the document issued by the atomic scientists after our use of their product in Japan. A third major reason for this shift in attitude on the part of the scientist is the fact that philosophers are preparing themselves more adequately for those aspects of their total task which are concerned with science. Several major universities in the United States now require of any candidate for a Ph.D. in philosophy a Master's degree or equivalent in some other subject, usually a science. Some of us now believe that in a short time no philosopher will be thought qualified to teach the philosophy of science unless he has a double doctorate or equivalent, one in a science and one in philosophy. Few of us who now teach the subject come even close to this ideal and we are correspondingly humble in what we have to say about science. It is in such an appropriate spirit of humility that I discuss with you scientists of Knoxville the functions that philosophy *does* perform, or *should* perform, as its part of the greater human project of knowing and controlling the world to the benefit of us all.

¹This paper is a written version of a talk given before the Knoxville Science Club, December 3, 1954.

THE PIONEERING FUNCTION

Even a casual study of the history of western culture shows that philosophical speculation has always preceded, in pioneering fashion, the detailed and systematic reduction of the data of any area of experience. Classic Greek philosophy contains several major examples of daring speculative hypotheses which provided the rough framework within which science proper later operated. One has only to mention the atomic theory of Democritus, the mathematical probings of the Pythagoreans, the evolutionary explanations of Empedocles, and the political thinking of Plato, the Sophists, and Aristotle, to be reminded of the debt modern science owes these early thinkers.

What many people overlook is the fact that philosophy has never ceased mothering new sciences. Even within the memory of many of you present, psychology finally became established as a science; and today logic, value theory, and semantics are showing signs of being budding sciences. What further sciences may thus be pioneered and produced by philosophy I do not know, but I am confident that there will be many others.

THE SYNOPTIC FUNCTION

Man's intellectual activity exhibits roughly two distinct aspects or phases: the analytic and the synthetic. There is an application of the second of these which has always been a part of the philosophic project. We call it the *synoptic* function. Literally the term "synoptic" means to "to see together"; and that is what philosophy tries to do in this one of its several functions. It exercises this synoptic function in several areas, attempting to "see together," or to bridge gaps between, areas of knowledge which for some reason have become separated in our thinking.

One such gap which we try to bridge is between commonsense knowledge and science in general. Science, as a body of knowledge, seems so abstruse or even esoteric that the common man is inclined to worship dumbly and blindly without understanding. Philosophy attempts to retrace, to reconstruct, the path which science has followed from the commonsense mainland to the island it now appears to be. This task involves both a sort of historical reconstruction and a discovery of that which is still common to science and the commonsense it seemingly resembles so little.

Another synoptic task of philosophy is the discovery of unity among the special sciences. Representatives of each science usually recognize the need for someone to do this job but reject it as theirs; so it is taken over, properly enough, by the philosophy of science. It consists in a searching out of common elements of method, common assumptions and concepts, and common goals. This attempt at synthesis is particularly important today with regard to the social and the natural sciences. If there ever was

a time when scientists needed a fellow feeling, a common understanding, it is now when there are powerful forces of anti-intellectualism ranging up and down the land. It is a part of the task of philosophy to further this feeling of a fraternity of scientists across the apparent gap between those who study physical nature and those whose subject matter is the doings of man himself.

A third type of synoptic activity of philosophy, often ignored or rejected by scientists of the past but today again becoming respectable even among them, is that of integrating scientific findings, including data about man's basic needs and yearnings, into a broad cosmic picture, even a metaphysics. The old philosophical argument in support of such a synthesis is still good: everyone operates in terms of a metaphysics, usually a borrowed one or a sloppy, unsystematic one of his own; hence it is the part of wisdom to work one out carefully and in full light of the best scientific knowledge available.

THE CRITICAL FUNCTION

The revolutionary upheavals that have recently shaken even the foundations of the science of physics, among others, have resulted from critical re-examinations of the basic concepts and assumptions of that science. Such critical activity is typical of philosophy. No idea is so old, so revered or so widely accepted as to escape reflective examination. Such re-study, in the light of other logical possibilities and from novel perspectives, often reveals unwarranted assumptions at the very base of a science, assumptions perhaps shared by a whole culture. An example of one such assumption now being subjected to careful scrutiny is the mechanistic materialism that has underlain so much of our science, even our psychology and sociology. It is this same critical approach that has called our attention to the apparent incompatibility of scientific determinism and the moral demand for individual responsibility.

THE INTERPRETATIVE FUNCTION

Somebody in a culture should be concerned about the social conditions requisite to a successful scientific program and the social consequence of that program. Again it is the philosopher who performs this function which I shall call that of interpretation. I have already mentioned the growing concern of scientists with the social consequences of their discoveries. It is philosophy in the form of value theory that stands ready to guide the discussion of such consequences. These same scientists, jarred out of their monkish complacency by increasing restrictions both private and governmental, on direction of research, on communication of results, and even with regard to their freedom of movement about the world, have come to appreciate the

efforts philosophers have long been making toward an understanding of social, economic and political conditions conducive to scientific endeavor.

At least in these ways I have described I am confident that philosophy has been and will continue to be a functioning partner in the grand enterprise of learning better the nature of the world to the betterment of the human condition. And, I trust that if I have not convinced you as yet of the right of my interpretation that I have, nevertheless, stimulated you to further exploration of the subject.

AN OCCURRENCE OF A PLEUROPTERYGIAN SHARK IN THE CHATTANOOGA SHALE OF TENNESSEE

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Recent investigations by the University of Tennessee of the Chattanooga shale under contract for the U. S. Atomic Energy Commission have included the Dale Hollow Reservoir area, Clay County, Tennessee. The upper few feet of the Chattanooga shale in this area generally contains abundant nodules of phosphate in distorted gray-black shale. Many of these nodules enclose conodonts and *Lingula* species. Other kinds of fossils are unknown.

The present report concerns a fish preserved in a phosphate nodule from the top of the Chattanooga at the junction of Lick Run and East Fork Creek, Dale Hollow Reservoir, Clay County, Tennessee. This exposure is intermittently submerged by the lake, and the lower part of the Chattanooga shale is now permanently covered.

The fossil is embedded in a nodule of ovoid shape, approximately five inches long and two inches thick. A brain case, visceral skeleton, and pectoral fin are present. The displayed attributes of these structures indicate the fish to be a pleuropterygian shark, and probably of the genus *Cladoselache*. This generic assignment of the specimen is principally based on the presence of secondary rays interspaced between the tips of the primary radial elements of the pectoral fin. No teeth are preserved, and the incompleteness of other important characters precludes definitive specific identification. It is of interest to note that, as in the cladoselachian materials found near Cleveland,

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