Review: [untitled]
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Source: *Philosophy of Science*, Vol. 26, No. 3 (Jul., 1959), pp. 270-272
Published by: The University of Chicago Press on behalf of the Philosophy of Science Association
Stable URL: http://www.jstor.org/stable/184954
Accessed: 15/10/2011 04:23

BOOK REVIEWS

MICHAEL POLANYI. *Personal knowledge: towards a post-critical philosophy.* Chicago: University of Chicago Press, 1958. xiv + 428 pp. $6.75.

This book is a discussion of the nature of human knowledge with particular attention paid to scientific knowledge. The author, an eminent physical-chemist at the University of Manchester, presents here an expanded version of his Gifford Lectures for 1951-52. It is the author's thesis that philosophers of science have, in general, misunderstood the chief import of the Copernican revolution in science, that this misunderstanding is largely responsible for many of the current difficulties in science proper, and that the cure is to make a more thorough-going analysis of the actual process exemplified in scientific knowledge.

The argument of the book begins by suggesting that the Copernican revolution has been customarily interpreted to mean that man ought to rely for his knowledge upon observation of objective data, from which he forms theories which refer him back to objective data. While not denying the importance of theory in this process the primary emphasis has been on the objectivity of the observation, on the notion that theory is responsible to and decided by observation. This view has produced a "critical" epoch in the philosophy of science, which has led through Occam, Hume and Mill to contemporary logical empiricism with its insistence that all meaning is a function of observables.

That there is some reaction against this emphasis on sense-experience as a source of knowledge to the detriment of theory as a source of knowledge is evident in the current literature. (For example, Milton K. Munitz, *Space, Time, and Creation*; also the article by J. Bronowski on "The Creative Process" in the *Scientific American* for September, 1958.) This book is in that stream of thought and presents a thorough-going statement—both philosophically and scientifically—of the view that theory is primary and observation secondary. While a dedicated logical empiricist is not likely to be converted from his views by reading this book, it is hardly likely that he will ever hold them with the same degree of conviction after being exposed to Polanyi's critique.

Although not wishing to do the author an injustice by over-doing the Copernican analysis—it occupies only a few pages of the book—the thesis of the book may be stated simply by continuing with that illustration. As in his whole analysis Polanyi does not think that his discussion of the Copernican illustration points out anything not known by historians and philosophers of science, but only that it emphasizes points they have tended to de-emphasize. We are reminded that there was no difference in observable data between the theory of Ptolemy and the theory of Copernicus. Accordingly when Copernicus—and scientists since his day—chose the Copernican theory rather than the Ptolemaic it was not on the grounds of observable differences that the choice was made, but primarily on grounds of differences in theory.

This raises the question of the extent to which scientists since Copernicus have, in fact, been influenced by differences in theory rather than by differences in sense-experience observables. Do scientists in fact decide, and does perhaps the progress of science actually depend, upon choices made between theories without a great deal of concern being exhibited for observable data?

In this connection Polyani discusses the historical development of the theory of relativity. He points out that it is commonly asserted that this theory was a result of the efforts to resolve the difficulties of the Michelson-Morley experiment. He asserts that, on the contrary, this experiment had nothing to do with the development of the theory. Polanyi had an American correspondent (Dr. N. Balazs) inquire of Einstein concerning this point. The correspondent reported the result of his inquiries as follows:

> The Michelson-Morley experiment had no role in the foundation of the theory. He got acquainted with it while reading Lorentz's paper about the theory of this

> experiment (he of course does not remember exactly when, though prior to his papers), but it had no further influence on Einstein's considerations and the theory of relativity was not founded to explain its outcome at all. (P. 10, fn. 2.)

One might think that, nevertheless, other scientists accepted the theory only because of the experimental problem. In this connection Polanyi discusses the fate of the work of D. C. Miller, who got a positive result from repeating the Michelson-Morley experiment. Polanyi quotes from C. G. Darwin's presidential address to Section A of the British Association in 1938. Darwin says of Miller,

> We cannot see any reason to think that this work would be inferior to Michelson's, as he had at his disposal not only all the experience of Michelson's work, but also the very great technical development of the intervening period, but in fact he failed to verify the exact vanishing of the aether drift, What happened? Nobody doubted relativity. (P. 13, fn. 1.)

Polanyi remarks, "The experience of D. C. Miller demonstrates quite plainly the hollowness of the assertion that science is simply based on experiments which anybody can repeat at will." (P. 13)

If the decision between the theories of Ptolemy and Copernicus was not made in terms of a difference in experimental observations, if the theory of relativity was not formulated nor accepted in terms of experimental data, what is the criterion that science uses to decide between theories? Some scientists, misled by the analysis of scientific method as a function primarily of observables, have sought to decide between theories solely in terms of experimental observations. This is the path, according to Polanyi, that leads to most of the errors of modern science. He believes that the criterion for deciding between theories is one in which observation plays only a minor role, that the main difference between theories involves what he calls rationality. "Modern physics has demonstrated the power of the human mind to discover and exhibit a rationality which governs nature, before ever approaching the field of experience in which previously discovered mathematical harmonies were to be revealed as empirical facts." (P. 15)

It is well known that Einstein held to some such view as this. The author quotes many other instances. He tells us that

> Hermann Weyl lets the cat out of the bag by saying: 'the required simplicity is not necessarily the obvious one but we must let nature train us to recognize the true inner simplicity.' In other words, simplicity in science can be made equivalent to rationality only if 'simplicity' is used in a special sense known solely by scientists. We understand the meaning of the term 'rational' or 'reasobanle' or 'such that we ought to assent to it', which the term simple was supposed to replace. The term simplicity functions then merely as a disguise for another meaning than its own. It is used for smuggling an essential quality into our appreciation of a scientific theory, which a mistaken conception of objectivity forbids us openly to acknowledge. (P. 16)

Because we formulate theories and choose between them in terms of a personal commitment to rationality, there is in all knowledge a personal element—hence the title of the book—and an emotional commitment—since our commitment to rationality is largely a matter of faith or hope on our part. But this commitment does not make knowledge subjective. The success of this commitment in science has shown that there is something in the universe corresponding to our intuitive sense of rational. The criterion therefore has an objective analogue. This commitment, "which shapes all factual knowledge, bridges in doing so the disjunction between subjectivity and objectivity. It implies the claim that man can transcend his own subjectivity by striving passionately to fulfil his personal obligations to universal standards." (P. 17)

The central portions of the book are devoted to a massive detailing and refining of this thesis. Not only the physical sciences, but logic, biology, psychology, and the social sciences are examined. A wide range of knowledge is brought to bear to illuminate the main argument. There are doubtless particular points upon which a critic might disagree with the author. But it cannot be denied that this is an important contemporary expression of a tradition in science that has its roots in such philosophers as Plato and Spinoza and that has received more recent support in the metaphysics of such moderns as Charles S. Peirce and A. N. Whitehead. Polanyi is not as good a philosopher as Peirce and Whitehead, for example, but he is a better scientist and has the advantage of a more thorough knowledge of contemporary science.

Rationality, as Polanyi considers it, is not as much a logical property as it is a psychological property. Logically, of course, alternative theories such as the Ptolemaic and Copernican are equally impeccable. Accordingly, if a scientist chooses between them on a criterion of rationality this criterion must not be able to distinguish between them on logical grounds, but on some kind of intuitive grounds. There must be a psychological sensitivity to what is "rational" as distinct from a logical sensitivity to what is formally consistent. And, if this is true, presumably the best scientists have the greatest amount of it. Perhaps it, rather than laboratory technique or mathematical manipulation ought to be what we should seek to develop in young scientists.

Testimony to the existence of such a sense has been offered by some of our best philosophers of science. What did Charles Peirce mean when he said, "The chicken you say pecks by instinct. But if you are going to think every poor chicken endowed with an innate tendency toward positive truth, why should you think to man alone this gift is denied?" (*Collected Papers*, 5.591)? Does Bertrand Russell's advocacy of a kind of synthetic a priori in *Human Knowledge* suggest a similar situation? Was Hans Reichenbach only speaking metaphorically when he said, "There seems to exist something like an instinct for the hidden intentions of nature, and whoever possesses this instinct, takes the spade to the right place where gold is hidden, and thus arrives at deep scientific insights. It must be said that Einstein possesses this instinct to the highest degree." (*From Copernicus to Einstein*, p. 94)?

One can criticize such statements as referring to something that is non-rational. But any philosopher or scientist who has tried to describe or teach the scientific method cannot help but feel that any explanation solely in terms of experimentation and observation leaves out a vital element which can be described only vaguely as "creativity" or "sensitivity" or "simplicity". If such elements are non-rational, they nevertheless need to be made explicit—or, perhaps, as Polanyi proposes, the concept of rationality needs to be enlarged so as to include them.

Philosophers of science can object to this as some kind of mysticism, but can they afford to ignore it? What would seem to be needed is a thorough re-examination of what actually goes on within the context of scientific inquiry. Polanyi's book is an important contribution to this effort. *Edward C. Moore, University of Idaho.*

HAROLD H. JOACHIM. *Descartes's Rules for the direction of the mind.* Edited by E. E. Harris. London: George Allen and Unwin Ltd., 1957. 124 pp. 10s. 6d.

This little book is a posthumous reconstruction of the Joachim lectures on Descartes' early work: *Regulae ad Directionem Ingenii*, 1628-9. Professor Joachim's original lecture notes were lost but Mr. Harris has re-written them from student notes taken in the lecture room by himself and by his fellow student, John Austin.

Descartes's *Regulae* describes the rationalist theory of systematic knowledge. Such knowledge constitutes a universal science or *vera mathesis*, which underlies (and is exactly the same in) whatever diverse fields in which genuine knowledge or science is possible. It is of course totally independent of any empirical considerations, being determined by the nature of the intellect alone. The several branches of mathematics are cited as examples of fields where the universal science has already been uncovered—in this case, Algebra and Geometry, the universal science dealing with numbers and spatial figures respectively.