Commentary on Boyle

ROBERT BOYLE ON NATURAL PHILOSOPHY. An Essay with Selections from his Writings. By Marie Boas Hall. 406 pp. Indiana University Press, Bloomington, 1965. $6.75

by R. Bruce Lindsay

The seventeenth century was noted in Western Europe for enthusiastic interest in scientific experimentation. This was particularly evident in England in the work of Robert Boyle and Robert Hooke, whose names have been immortalized in the famous laws known to every student of elementary physics. Though much written about, their own writings are now rarely read save by professional historians of science. A standard edition of Boyle's works was brought out by Thomas Birch in six volumes in London in 1772, but these are not readily accessible to the average scientist. The present volume by Mrs Hall, a well known authority on the work of Boyle and seventeenth century science in general, is therefore all the more welcome for its ample but carefully chosen selections from Boyle's writings and the excellent commentary she has provided.

The reader of this book cannot fail to be impressed with the tremendous range of Boyle's scientific interests. There is scarcely a branch of what we now call physical science to which he did not give attention, and in many of these he endeavored to do significant experiments to test his ideas. Unfortunately, his methods of working and writing were not very systematic, and this makes the modern assessment of the value of his results rather difficult. To help the reader in this respect, the author has prefaced the selections from Boyle's writings with a substantial summary of the principal contributions. In addition to a brief account of the life of the natural philosopher, this includes sections on the new learning, the mechanical philosophy, chemistry and pneumatics. By the new learning is meant, of course, the breaking away from the elaborate system building of Medieval scholastic science and the development of the Baconian point of view that experiment is the only sure basis of all knowledge of nature. So thoroughly did Boyle adhere to the notion of the primacy of experiment as the basis of all physical science that to many he gives the impression of having neglected the mainstream of seventeenth-century physics, namely the mathematical development of mechanics based on the theorizing of Galileo and Huygens and culminating in the sophisticated treatment of Newton in his *Principia*. It is true that Boyle rarely employed mathematics in the presentation of his ideas. It would be wrong to conclude, however, that he paid no attention to mechanics. On the contrary, as the author clearly points out in the section on mechanical philosophy, Boyle was thoroughly convinced that the only sure route to the understanding of all natural phenomena lay through mechanics and in particular the atomic or corpuscular hypothesis. He wrote very extensively in defense of the latter.

In chemistry Boyle labored valiantly to destroy the theory still widely held in his time that all substances are composed of mixtures of the three "elements," salt, sulphur and mercury. Though he did not himself succeed in giving the term element its modern meaning, he did insist that the chemical behavior of matter could ultimately be understood only in terms of the atomic and mechanical point of view, and this was probably his greatest contribution to chemistry.

Since Boyle's famous book *New Experiments Physico-Mechanical, Touch-*

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ing the Spring of the Air and its Effects (1660) is the one best known to most physicists, the latter will naturally be interested mainly in what the author has to say about the work on fluids. There is an attractive though all too brief section on pneumatics, in which certain modern attempts to deprive Boyle of the credit for having established the law that bears his name are successfully rebutted.

Though Boyle never prepared a thorough treatise on what is now called philosophy of science, it is clear from notes that remain that he thought a good deal about this subject. In particular he paid much attention to the role of hypotheses in science and had clear ideas about the distinction between good and bad ones.

The actual excerpts from Boyle's writings occupy somewhat over two thirds of the book and are carefully chosen to illuminate every aspect of his scientific work and thought. The reader of this material who is not previously acquainted with seventeenth century scientific literature will be impressed by the prolixity of Boyle's style and the often elaborate and tedious detail in which he indulges. Nevertheless, his evident sincerity and real desire to inform the reader precisely what he had done or was thinking about are usually persuasive and often engaging.

All who are interested in seventeenth-century physics will wish to look into this volume.

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R. Bruce Lindsay, who is Hazard Professor of Physics at Brown University, writes frequently on the history of science.

Ad hoc philosophy of science

BOSTON STUDIES IN THE PHILOSOPHY OF SCIENCE. Volume 2: In Honor of Philipp Frank. Robert S. Cohen, Mark W. Wartofsky, eds. 475 pp. Humanities Press, New York, 1965. $9.75

by Peter Caws

Volumes like this provide convincing evidence, if any is required, that the philosophy of science is enjoying a period of unprecedented intellectual and academic prosperity—intellectual because of the quality of the papers collected here, academic because of the auspices under which they appear. The thirteen contributions were originally presented, between 1962 and 1964, to the Boston Colloquium for the Philosophy of Science, a group that has been meeting for a number of years under the aegis of Boston University and the National Science Foundation. The Boston Colloquium is one of the better known enterprises of this sort, and it is easy to see why. As in the previous volume in the series (published in the Synthese Library by Reidel of Dordrecht in 1963) the material covered makes a good ad hoc cross section of current work in the philosophy of science. In addition the editors have had the genial idea of dedicating the book to Philipp Frank, who was one of the great figures in the recent history of the discipline and who has died since the publication of the book (PHYSICS TODAY, September 1966, p. 119). A series of tributes to him, by friends and colleagues, together with a bibliography, precedes the main papers. An excellent photograph of Frank appears as frontispiece.

The papers are not all equally relevant to the concerns of contemporary philosophers of science. Some of them are occasional, for example Sir George Thomson's reflections on the scientific method—well worth reading nevertheless, since it is a rare privilege to hear a Nobel physicist's view of the philosophical enterprise from the perspective of the working scientist. Some are downright peripheral, such as Norman Rudich's erudite but ponderous essay on "The Dialectics of Poesis," which, if presented as given here, must have caused a good deal of fidgeting in seats and consulting of watches among the members of the Colloquium. But a few are central, and between them give an excellent idea of what the discipline is all about. In this respect the contributions of Ernan McMullin, Wilfrid Sellars, Norwood Russell Hanson, J. J. C. Smart and Abner Shimony deserve special attention.

Of all these the one paper that gives the clearest view of the preoccupations of *professional* philosophers of science is Smart's, not so much because of what it says (lucid and informative as that is) as because of what follows it. Most of the essays are followed by critical comments; Smart's brief contribution gets three comments, each longer than the paper, by Sellars, Hilary Putnam and Paul Feyerabend, a hundred pages in all of philosophical polemics in the best tradition. The point at issue is the nature of explanation—that is, the nature of the relation between theory and observation. Smart discusses the views of Feyerabend and Sellars against the background of the (by now) standard view, for which he chooses Ernest Nagel as the spokesman. (Nagel gets no chance to participate in the debate, although Putnam strikes a glancing blow for him before setting upon Feyerabend.) The standard view maintains that elements of the theoretical structure correspond to and imply, but are not convertible into or exchangeable with, elements of observation. Feyerabend on the other hand holds that there is no sharp distinction between the observational and the theoretical, that the latter is a kind of extension or ramification of the former and that it would be quite proper (and not merely figurative) to *describe* the observed work of common sense in theoretical terms. Sellars agrees with Nagel that the elements of ordinary everyday observation are to be distinguished from elements of theory, and therefore disagrees with Feyerabend, since it follows that theoretical language is unsuitable for most descriptive purposes; but he does not think that ordinary observational terms correspond to theoretical terms either—*scientific* observations, which form a very select and specialized subclass of observations in general, must be described in theoretical language. There is no point in reproducing here the arguments between these positions, but they make absorbing and at times exciting reading.

McMullin's paper exemplifies a rather different concern; it is an exercise in what might be called the "history of ideas" in a scientific context, which traces the link between the ancient concept of *matter* and the modern concept of *mass*. Sellars' independent contribution—that is, apart