Book Reviews

METAMETHODOLOGY

The Methodological Heritage of Newton

Edited by Robert F. Butts and John W. Davis. Pp. 170. (Blackwell: Oxford, April 1970.) 35*s*.

THE collection of essays in this volume is the fruit of a colloquium held on Newton's methodological thought at the University of Western Ontario. Although they deal with various aspects of the Newtonian legacy, I agree with the editors that the individual contributions form collectively a surprising degree of unity. In his own time Newton's views on methodological, epistemological and scientific issues were the subject of endless discussion and criticism. In the wake of this, the eighteenth century gave rise to varying traditions which emphasized different components of the intellectual heritage. These essays ably explore both the complexities of Newton's own thought and its ramifications in the subsequent Newtonian schools.

The central contention of the contributors, stated or otherwise, is this: methodological problems are never divorced from the metaphysical and ideological dimensions of any given thinker's point of view. Thus, in order to be clear about methodological components in a scientific system, one must be clear about the general metaphysics or theology (*pace* seventeenth-century thought) that will obtain given that a complete scientific system has been epistemologically established. Failure to appreciate this, the contributors contend, has led to an imperfect historical understanding of methodological procedures, and has given rise to a dominant philosophy of science which, ideologically, is positively harmful for the advancement of science in general.

The chief critics of this philosophical school are Feyerabend and Buchdahl. The former, against the background of his rejection of the "myth of the given", illuminates adherence to a methodological system by comparing it with belief in the Protestant rule of faith. In this way new substance is given to the contention that beneath the formal face of science lie ideological commitments which result in "party lines". Buchdahl, by tracing Kant's critique of Newtonian science, throws light on such notions as the comprehensibility, intelligibility and "probative strength" of scientific ideas and hypotheses. He also presents an interesting discussion of the fact that Newton's law of gravity was accepted, while there was widespread concern about the intelligibility of Newtonian gravitation both existentially and *qua* an attractive "power".

The essays by Laudan and Butts, on Whewell and Reid respectively, show, in an informative way, two different attempts at giving a rationale for Newton's methodological position. In so doing both writers indicate the rich diversity of the response to the legacy of Newton. F. E. L. Priestley and John Davis once again emphasize the importance of theology in connexion with seventeenth-century thought in general, and specifically with methodology in the extended sense. Both analyse an important, but too often neglected, aspect of human thought, namely, that two opposing schools—Newton *versus* Leibniz or Berkeley—can adhere to the same unconscious presuppositions, but bitterly oppose each other doctrinally. N. R. Hanson brings to bear some complex but useful conceptual machinery on Newton's conception of hypotheses. Hanson is able to show in an interesting and new way that Newton certainly could have said "hypotheses fingo". Let us now hope that the spectre of Newton's never hazarding an hypothesis is truly laid to rest.

This volume is to be recommended both to the specialist and the general reader. It would have been helpful if the editors had included a name and topic index.

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INSPIRED MATHEMATICIAN

Hilbert

By Constance Reid. With an Appreciation of Hilbert's Mathematical Work by Hermann Weyl. Pp. xi+290. (Allen and Unwin: London; Springer-Verlag: Berlin and New York, June 1970). 75*s*.

GÖTTINGEN in the late nineteenth and early twentieth centuries was the centre of the mathematical world; much was due to Klein's commanding personality, organizing ability, and wide knowledge; much also to Hilbert's superlative research powers and his inspiration of a crowd of brilliant young disciples. Dr Reid's biography is a fascinating account of the man and of his work. In particular, she has succeeded remarkably well in conveying the main lines of Hilbert's researches without bringing in too much technical detail; for those who want a more professional assessment, Weyl's 1944 obituary notice is included as a 40-page addendum. The book also contains a large number of photographs of Hilbert, of Königsberg and Göttingen, and of the members of the Göttingen school.

Hilbert's work has been roughly divided into five main sections: (i) invariants; (ii) algebraic number fields; (iii) foundations of (a) geometry, (b) mathematics in general; (iv) integral equations and calculus of variations; and (v) mathematical physics. In all of these he made fundamental discoveries. Of his work on invariants, Weyl, in his *Classical Groups*, remarks that Hilbert "solves the main problems and thus almost kills the whole subject". This could be said of much of his work, yet mark the "almost"; what seemed to be final was so often to Hilbert only the opening of a door to unexplored fields to which he could direct the attention of the mathematical world. His perception of the possible future was remarkably acute. His synthetic foundation for projective geometry in the *Grundlagen der Geometrie* (1899) set a standard for axiomatic formalism, yet the whole programme is implicit in his remark, made in 1891, that "It must be possible to replace in all geometric statements the words point, line, plane by table, chair, mug". Certainly the Courant–Hilbert *Methoden der mathematischen Physik* (1924) showed striking prescience; by some occult prevision, the authors provided not so much the methods in current use as the methods which would be needed by the new physics just about to burst on an astonished world, the physics of Born, Dirac, Heisenberg, Jordan. This prophetic vision is also in evidence in the famous paper on "Mathematical Problems", presented by Hilbert to the Second International Congress at Paris in 1900. Here lines of inquiry were suggested, and on the much of the twentieth century mathematics developed, though not always to Hilbert's entire satisfaction. At Paris, and again at Bologna in 1928, he had asked for proofs of consistency and completeness in the formal axiomatic systems on which he wished to base the whole of mathematics. In 1930, Gödel showed that Hilbert was asking for the impossible. The old man, now nearly 70, was staggered, but not shattered; almost immediately he began an attempt to rescue what he could of his "theory of proof".

This stimulating volume will surely send some readers back to Hilbert's epoch-making memoirs. Fortunately, his collected works, first published by Springer in 1932–1935, are now available in a cheap reprint (1965) by the Chelsea Co. of New York.

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