pendent discovery in 1837. His experiments on the resistances of solutions enabled him to deliver an anticipation of Ohm's law for currents.

Cavendish's researches provide brilliant examples of the way in which theory and experiment progress hand in hand. For Cavendish did not owe discoveries to the development of new electrometers or other technical devices. His advances were based on the application of a brilliant theoretical mind to the devising of simple but subtle experiments. His distinction of "intensity" from "quantity" of electricity enabled him to derive exact quantitative results with apparatus no more sophisticated materially than that used by earlier qualitative researchers such as Franklin. The most striking example of this is in his use of his own body as a "galvanometer". In comparing the resistances of solutions he discharged a Leyden jar through his body through a length of solution in a tube, which he varied by altering the separation of the electrodes inserted at each end. When he felt that the shock was indistinguishable from that from the same Leyden jar through an invariant "control" solution, he varied the length of the test solution until the shock was just noticeably greater than that through the control. He repeated this variation until the shock was just less and took the mean of the two readings as the length of test solution which had the same resistance as the control. Maxwell pointed out that these results were obtained "more than forty years before the invention of the galvanometer, the only instrument by which anyone else has ever been able to compare electric resistances". Indeed, "Cavendish was his own galvanometer".

Cavendish's electrical researches have previously had two editions. This third impression is extremely valuable, as the older volumes are not easily obtained. Clerk Maxwell provided an extensive introduction and account of the researches, together with characteristically analytical notes. The index, part due to Cavendish himself and part to Maxwell, is highly detailed and a valuable guide. Almost a dozen facsimiles of Cavendish's hand-drawn figures are included. This new edition will, hopefully, inspire for Cavendish himself "more veneration in future ages than at the present moment".

J. M. NICHOLAS

BACKGROUND TO NEWTON

Theories of Light

From Descartes to Newton. By A. I. Sabra. (Oldbourne History of Science Library.) Pp. 363. (London: Oldbourne Book Co., Ltd., 1967.) 70*s*. net.

DURING the seventeenth century, a few crucial fields of scientific enquiry became fully matured; among these were mechanics, pneumatics and optics. In studying the work then done in those fields, the historian is not forced to apologize for the chances missed, and the apparent blunders committed, by the great men. He can scrutinize the work done, and judge it by the criteria of adequacy of modern physical science; and after making allowance for the state of knowledge and technique of the time, he can exhibit it as genuine science of a high order of excellence.

The perceptive historian will, however, observe that the style of that scientific work was not quite the same as our own; the greatest men were, in name and in commitment, "natural philosophers". And so their technical work was influenced by their deepest views on method and metaphysics. The influence was not a simple one; for no piece of concrete scientific research can be merely the application of the preassigned method, or the simple illustration of an ontological scheme. The inevitable tensions between principle and practice are further complicated by the social dimension of scientific work; what an author says to his audience will be strongly conditioned by his assessment of the terms of the dialogue and the point he wishes to establish.

In this study of one line of development of optics, Dr Sabra has done this sort of history supremely well. With a thorough mastery of the historical sources, he has analysed the arguments of the protagonists of the great debates on the properties of reflected and refracted light, and the phenomena of colours. In reconstructing Descartes's theories, and exhibiting the ambiguity of the crucial term "determination", he is able to explain the controversy with Fermat, and also to settle the vexed question of Descartes's originality. His study of Newton's early work in optics appears after a spate of recent research by others, and does not bear the same excitement as the earlier sections. But here, too, he illuminates the history by a well documented demonstration of a thesis: that Newton's interpretation of his "crucial" experiments was governed by his prior commitment to the corpuscularity of light, and to the nature of colours as unchanging qualities of these corpuscles. The work of Fermat and Huyghens and Hooke is also studied closely, as befits their role in the development of optics between Descartes and Newton.

Throughout the narrative we have a cluster of empirical questions (on reflection, refraction and colour), each giving rise to mathematical formulations and physical interpretations, but these latter being conditioned by methodological and philosophical principles. The statements of methodology are exhibited at length, analysed and related to what was actually done. Also, the empirical questions move in a natural sequence, following the points of significant advance: reflection and refraction dominating the earlier part, and colours the later.

This choice of topics indicates the boundaries imposed by the author on his study. For we have, in effect, the history of those particular problems in the matured science of physical optics, the investigation of which culminated in the published researches of Newton. The history is genuine, and will appear entirely natural to a modern scientifically trained reader. But this approach applies equally well to the nineteenth century, when the deepest advances in natural science were still conditioned by philosophical commitments. In the seventeenth century, when a field such as optics was just achieving full maturity, it was still in the process of identifying its soluble problems, and putting the others to one side. The concentration on "light" to the exclusion of "sight" was effected only after Kepler and Descartes; and the philosophical problem of the nature of colours had a far more complex and important history in the period before Newton than the author indicates. Moreover, the study of light as a physical agency, not merely causing but also organizing changes in matter, was of great importance in that century; and of this we hear nothing.

The lack of specification of topics such as these which have been excluded from this study may give the reader the impression that this work is "the" history of theories of light in the seventeenth century. The author explicitly disclaims any comprehensiveness for his study; but he is responsible for his judgments of historical significance. In his restriction to the successful, "real" scientific problems in optics, he has lost some of the special atmosphere of that heroic century of the creation of modern physical science.

J. R. RAVETZ

ONE MAN'S ETHNOGRAPHY

Kwakiutl Ethnography

By Franz Boas. Edited by Helen Codere. Pp. xxxvii + 439. (Chicago and London: University of Chicago Press, 1966.) $12.50; 90*s*.

THERE are anthropologists who have a preference for armchair anthropology: "theory at all costs" is the motto