Book Reviews

NEWTON'S THINKING

The Mathematical Papers of Isaac Newton

Vol. 3: 1670–1673. Edited by D. T. Whiteside. Pp. xxxvii+576+4 plates. (Cambridge University Press: London, June 1969.) 210*s*; $32.50.

EACH new volume of Dr Whiteside's monumental edition of Newton's mathematical papers brings to light for the first time source material of outstanding value for the historian: a large part of this latest volume is taken up by the authentic text of Newton's great treatise of 1671 on the method of series expansion and fluxion calculus, as well as extracts of the manuscript version of the optical lectures he delivered as Lucasian professor during the period 1670–73 covered by this volume. These documents are accompanied by those masterly introductions to which the editor has accustomed us and by appendices supplying a considerable number of related texts which are thus made immediately available to the reader. No detail of Newton's calculations is left in the dark; the editor's translation of the Latin texts is more than an accurate rendering: it is actually a running commentary of the original. Moreover, elaborate footnotes analyse the most difficult passages and point to the few slips that could puzzle the reader, or perhaps escape his notice.

The main event in Newton's career which is reflected in the documents published in this volume is his appointment to the Lucasian professorship, of which he was the second occupant, after Isaac Barrow. Whiteside, whose cool-headed erudition is sweeping away a good deal of the Newtonian hagiography, observes that Barrow's resignation of the chair was most likely not so much an act of generosity towards his gifted student as a preparatory move toward securing for himself the mastership of Trinity College. Anyhow, Barrow's influence on the orientation of Newton's thinking, both in mathematics and optics, is quite conspicuous (as Whiteside points out) as soon as one compares their respective writings; thus the comparison of functional variation with a "flow", resulting in the "fluent" and "fluxion" terminology, is of Barrovian origin. Newton never managed to finish the treatise he started in 1671 and in which he wanted to give a systematic account of his methods and their various applications to algebraic and geometrical problems. In contrast to Leibniz, who had realized the importance of thought-saving symbolism, Newton was content to set up rules of procedure, which he could only explain and illustrate by examples. His lack of feeling for the advantages of symbolic notation is strikingly shown by the fact that there is in his papers no trace of the dot notation for fluxions before 1691: he just used the final letters of the alphabet (v, x, y, z) for the variables, and the middle letters l, m, n, p for their respective fluxions; a feature which only the examination of the original manuscripts could reveal, because the imperfect second-hand transcriptions and translations of the treatise, published in the 18th century, made use (for obvious reasons) of the dot notation, without deeming it necessary to warn the reader of the alteration. We learn that the main reason why Newton's treatise was not promptly published was the unwillingness of the London booksellers to risk the printing of unsaleable mathematical books written in Latin: Barrow's geometrical and optical lectures and Wallis's *Mechanica* had just been a dismal failure on the book market. In later years, Newton often referred to his 1671 treatise, not least in the course of his controversy with Leibniz. The manuscript bears traces of frequent use; in fact, the first leaf is now missing and is here reproduced from one of the early editions. It is a capital document for the study of Newton's mathematical conceptions and, notwithstanding the large literature based on the inferior printed versions, it will repay detailed examination.

The editor's self-imposed restriction to Newton's mathematical work has induced him to make a selection of the optical lectures, essentially limited to the parts dealing with geometrical optics. Fortunately, he has included the material relevant to the vexed question of Newton's views about the chromatic aberration. Here again, it looks as if the evidence thus collected seals the fate of one of the most tenacious Newtonian legends: if Newton despaired of improving the quality of refracting telescopes, it was not because he entertained a wrong view of the relationship between mean refraction and dispersion, but simply because unsuccessful trials had made him realize the practical obstacles to making an achromatic combination of lenses. His whole approach to the problem was thus a soundly practical one, and his pessimistic conclusion was based on first-hand knowledge of contemporary technical skill. This would indeed be more consonant with our general picture of Newton's thinking: a practical outlook is no less apparent in the analytical methods developed in the treatise on series and fluxions than in his optical and astronomical investigations. It is an essential component of his genius and perhaps the dominant motivation for all his creative work.

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WAVE PROPAGATION

Ionospheric Radio Waves

By Kenneth Davies. Pp. xvii+460. (Blaisdell: Massac usetts, Toronto and London, 1969.) $13.50.

OBSERVATIONS of the ionosphere, by probing with radio waves from the ground, have been in progress for about 40 years. There is now a world-wide network of ionosonde observing stations which is constantly adding to our knowledge of the formation and movement of the ionosphere and is of great value to communication engineers concerned with operating long distance radio links. These observations have been powerfully supplemented for about 15 years by instruments in satellites. Ionospheric physics is now a large and expanding scientific subject.

The ionospheric medium is a partially ionized magnetoplasma. The propagation of radio waves in this is fascinating because it is both anisotropic and inhomogeneous. The result is a series of complicated problems which are intriguing for the mathematically inclined physicist but sometimes puzzling for the practical communications engineer. It might perhaps be said that, in this field, our knowledge of wave propagation has made its farthest advance.

The author of this book has succeeded admirably in writing an introduction to this subject which will tell the communications engineer just about all that he wants to know and will at the same time whet the appetite of the reader who wants to go into more mathematical detail. Kenneth Davies is a member of the staff of the laboratories in Boulder, Colorado, where ionospheric data are processed and where much important research is done. They used to be called at various times the "Central Radio Propagation Laboratory" and the "National