aeroplane flying overhead, is reported (in this volume) to have remarked, "Ah, a man in a kite!"

E. H. HUTTEN

INVENTION OF THE CALCULUS

The Mathematical Works of Isaac Newton

Vol. 1. Assembled with an Introduction by Dr. Derek T. Whiteside. (The Sources of Science, No. 3.) Pp. xxi + 160. (New York and London: Johnson Reprint Corporation, 1965.) n.p.

VOLUME 1 of *The Mathematical Works of Isaac Newton* is the first of two volumes which the Johnson Reprint Corporation have included in their series "The Sources of Science". It reproduces English translations of three Latin texts on which Newton's reputation as a creative mathematician in the calculus was originally founded. These are prefaced by a useful and scholarly introduction by Dr. Whiteside, who emphasizes that it is "the very depth, complexity, and disorganization" of Newton's mathematical papers which have prevented scholars from producing a satisfactory collected edition.

The first work chosen is the short tract entitled "De Analysi per Æquationes Numero Terminorum Infinitas", written in 1669 but not printed until 1729. The English rendering reprinted dates from 1745—John Stewart's "Sir Isaac Newton's Two Treatises of the Quadrature of Curves, and Analysis by Equations of an Infinite Number of Terms". Here is, as Newton says, "rather shortly explained, than accurately demonstrated" a general method for constructing series expansions of given functions, and then using them by simple integration to solve problems in the quadrature and rectification of curves. John Stewart added a "large Commentary, in which the Demonstrations are supplied where wanting, and the Doctrine illustrated, and the whole accommodated to the Capacities of Beginners for whom it is chiefly designed". The original tract had a restricted circulation but was not printed. Newton, later (1671), added it to an earlier tract on fluxions (October 1666), both subjects being amplified and revised. It was usually known by the title "Methodus Fluxionem et Serierum Infinitarum", and is the second of Newton's tracts to be reproduced, in its anonymous English version of 1737, entitled "A Treatise of the Method of Fluxions and Infinite Series, with its Application to the Geometry of Curve Lines". In spite of its obvious importance, Newton, even after several attempts, failed to find a printer. The third reproduction in this volume is an English translation of a treatise published by Newton in 1704 as a (Latin) appendix to his (English) *Opticks*. This is an article, apparently authorized by Newton, printed in the first scientific dictionary—John Harris's *Lexicon Technicum. Or, an Universal Dictionary of Arts and Sciences* (*1710*) and entitled: "Quadrature of Curves by Sir Isaac Newton".

The first and third tracts in this volume formed the basis for Newton's claim to priority in the dispute with Leibniz over the invention of the calculus.

The successful introduction of ideas of time and motion for the solution of problems in purely static, timeless, classical geometry was an act wholly alien to Greek thought, and only possible to a mathematical genius of another culture. Newton was, as he tells us, a great admirer of the Greeks, and chose to present the *Principia* in Euclidean form when he could have used an analytical approach. It is interesting, therefore, to note a certain disquiet which he expressed, rather obscurely, when he introduced his method of fluxions: "But since we do not consider the time here, any farther than as it is expounded and measured by an equable local motion; and besides whereas things only of the same kind can be compar'd together, and also their velocities of increase and decrease: therefore in what follows I shall have no regard to time formally consider'd, but shall suppose some one of the quantities propos'd, being of the same kind, to be increas'd by an equable Fluxion, to which the rest may be refer'd, as it were to time; and therefore by way of analogy it may not improperly receive the name of Time. Whenever therefore the word Time, occurs in what follows (which for the sake of perspicuity and distinction I have sometimes used), by that word I would not have it understood as if I meant Time in its formal acceptation, but only that other quantity, by the equable increase or fluxion whereof, Time is expounded and measured" (p. 49).

G. BURNISTON BROWN

STRUCTURE OF THE EARTH'S UPPER ATMOSPHERE

Auroral Phenomena

Experiments and Theory. Edited by Martin Walt. (First Lockheed Research Symposium on Space Science.) Pp. vi + 170. (Stanford, California: Stanford University Press; London: Oxford University Press, 1965.) 40*s*. net.

THE ten papers comprising *Auroral Phenomena: Experiments and Theory* encompass theoretical and experimental aspects of aurorae, with emphasis on the latter. The classical techniques of spectrometry and photometry are represented as well as the sophistication attendant on radar, balloon and satellite experiments.

A most useful contribution by A. Omholt summarizes the proceedings of the symposium, setting out the currently available information and suggesting areas of further work. The notion of the aurora as a small part of a cosmic phenomenon taking place between the Sun and the Earth receives considerable attention, along with a discussion on the effects of bombardment of the upper atmosphere by energetic particles on ionospheric disturbances and atmospheric processes. In any event, auroral activity presents an opportunity to investigate atmospheric structure. One important outcome has been the optical determination of temperature as a function of height in the polar atmosphere. Mention is also made of auroral classification according to the excitation mechanism and the type of particles impinging on the atmosphere, rather than one based on geometry and spectral characteristics of the activity. Although satellites offer intensely interesting studies of auroral morphology, ground observations are by no means obsolete for they still are suitable for examinations of auroral details, in particular rapid pulsations and movements. The television film technique described elsewhere in the volume by T. N. Davis is a truly worth-while step in these investigations as the film can be examined at leisure and particular auroral features inspected quantitatively. The technique is extremely sensitive and an important aspect arising from it is that auroral microstructure researches are possible. An obvious extension of the scheme is to aurora and airglow spectroscopy.

So far as optical measurements of aurorae are concerned, A. Vallance Jones directs attention to the suggestion that whereas synoptic observations of the distribution of auroral emissions can be made with satellite-borne photometers, rocket-borne instrumentation is especially valuable for looking at the height distribution of diffuse auroral forms.

The interactions of energetic charged particles with the atmosphere are discussed by A. Dalgarno. Along with a contribution by J. W. Chamberlain on the present status of auroral theory, this comprises the theoretical content of the volume.

Balloon measurements of X-rays in the auroral zone are described by K. A. Anderson with the classification of X-ray bursts according to their association with geo-