residence, 12 Grove Road, Lakenham, Norwich, and was buried with Roman Catholic rites.

He was an able land surveyor, and after being engaged for many years in surveys in the North of England, became managing clerk to Messrs. Wright and Woodrow, the principal land agents in Norwich. He married, in 1864, Miss Harriet Agnes Pettit, daughter of an organist and composer in Norwich. His wife predeceased him, and there was no family. He retired from business some twenty years ago, but continued to live in the same residence till his death.

He contributed several papers to the *Monthly Notices* on eclipses and occultations. His last two papers, published in 1885, give particulars of the thirteen total solar eclipses which have been visible in the British Isles between 878 and 1724, two excellent maps showing the lines of totality. The last sentence of one of these papers may perhaps be quoted :

"It appears from the limiting lines of these eclipses that London has been twice totally eclipsed, Dublin twice, and Edinburgh five times ; and, assuming the calculations to be correct, the Moon's shadow would have fallen upon every spot of the British Isles except a small space at Dingle, on the west coast of Ireland."

The calculations were made some ten years before publication of the paper ; but even then the author was in the seventies. The tables used were generally Hansen's. Among the papers found at his death was a map of the British Isles showing the course of the 1927 eclipse, which suggests that he contemplated continuing this work, but was no doubt prevented by advancing age. He was elected a Fellow of the Society on 1865 February 10.

ALBERT MARTH was born at Colberg, in Pomerania, on 1828 May 5, and was left an orphan at an early age. The desire of his mother had been that he should enter the Church, but after some time devoted to the study of Hebrew and theology, his early enthusiasm for mathematical science asserted itself, and he resolved to apply himself exclusively to astronomy, which he studied at the University of Berlin, subsequently going to Königsberg, where he became a pupil, and then an assistant of Dr. C. A. F. Peters, professor of astronomy at that university. A schoolfellow of his once said, "Marth may study what he likes, but he is and always will be an astronomer." This early prediction was amply fulfilled in after years, for throughout his life Marth devoted himself solely to that science ; indeed, among the numerous memoirs and papers he published, which evince his wide knowledge of general astronomy, we do not find one dealing with any other subject. It cannot be doubted, however, that the influence of a master of such consummate ability as Peters largely contributed to develop in Marth that accurate conception of astronomical problems which he in many ways so conspicuously displayed.

Marth's earlier contributions to astronomy were all published

in the *Astronomische Nachrichten.* In 1852 he published an ephemeris of Westphal's Comet from observations made at Königsberg, and in the following year he made some observations of *Hebe* with the meridian circle of that observatory. In 1853 he became an assistant to Mr. Hind, who was then astronomer at Mr. Bishop's observatory in the Regent's Park, and whilst in that position in 1854 March 1 he discovered the minor planet *Amphitrite* (29), anticipating by one day Pogson's independent discovery of the same planet. He remained at Mr. Bishop's observatory under two years, contributing in that time to the *Astronomische Nachrichten* the elements and ephemerides of the minor planets *Euterpe*, *Amphitrite*, *Massilia*, and *Urania*, besides the elements of Comet I. 1854. In 1855 he succeeded Rümker as astronomer at the Durham Observatory, where he remained till 1862. During this period he published in the *Astronomische Nachrichten* of 1856 August 26 the first part of his "Researches on Satellites." He proposed to investigate the motions of the satellites of *Saturn*, *Uranus*, and *Neptune*, and to elucidate their theories. In this memoir he confined himself to the preliminary mathematical investigations which are necessary, and incorporated new formulæ involved by the principle he adopted. Observations of *Saturn's* satellites had been made by Bessel in the case of *Titan* by measuring the positions with reference to the ring, and of *Iapetus* and *Rhea* by reference to *Titan*. Marth pointed out that such positions of *Titan* rest on the assumption, which is not beyond doubt, that the centre of the figure of the ring coincides with the centre of the planet, and that the investigation of the orbits of the two other satellites is only possible after the motions of *Titan* have been duly determined. He points out that for a series of observations of a satellite to be made a contribution of full value towards an investigation of its motions, it is essential to adopt such a method in observing that the results of reduction may give positions of the satellite referred to the centre of the planet. In the first part of the paper he deduces the formula by which the apparent positions of the satellites referred to the planet, either by means of angular distance and position angle, or by differences of right ascension and declination, may be calculated from given elements and given places of the planet, and by which likewise the equations of condition may be found which exist between variations of the positions and corresponding variations of the elements. He then shows how to determine the approximate elliptic elements of the orbits which are to be used in the calculations, and he lastly takes into account the disturbances introduced by the action of the Sun and other bodies. This important paper, which was noticed in the Council's report for 1857 February, formed the introduction to the numerous ephemerides of satellites which he computed annually from the year 1870 to the time of his death, nearly all of which were published in the *Monthly Notices.* No further communication on the theoretical question appeared until 1887, when he sent to the *Monthly*

Notices a paper, "On the Formulæ for Computing the Apparent Positions of a Satellite and for Correcting the Assumed Element of its Orbit." He continued his researches on satellites in several smaller communications which appeared from time to time in the *Monthly Notices*, and in which he constantly urged the importance of increased observations being secured to enable him to perfect his ephemerides.

During Marth's sojourn at Durham three further important papers were communicated to the *Ast. Nach.*; the first in 1856, "Ueber die Berechnung der Coordinaten in Ellipsen von starker Excentricität"; the second in 1860, "On the Polar Distances of the Greenwich Transit Circle," which was a lengthy and stringent criticism of the Greenwich methods and reductions; the third in 1862, "Vorschlag eines neuen Verfahrens die von der Biegung eines Instruments und von den Unregelmässigkeiten seiner Zapfen erzeugten astronomischen Beobachtungsfehler zu bestimmen." This was a proposal of a new method for determining the flexure and pivot errors which was specially applicable in the case of an instrument with a prism in the centre. These proposals formed the subject of a controversy between Marth and M. Loewy which appeared in the *Monthly Notices* in 1882.

In 1862 he left Durham to join Mr. Lassell as his assistant at Malta, where the 4-foot telescope was erected. With this instrument he discovered and formed a catalogue of the positions of 600 nebulæ. Many of these nebulæ were found independently by D'Arrest and Stephan, whose observations proved the remarkable degree of accuracy with which Marth had determined positions with so unwieldy an instrument. He quitted Malta sometime in 1865, and resided in London for a few years, till 1868, when he was appointed astronomer to Mr. Newall, at Gateshead, to assist in the construction and erection of the 25-inch refractor at that observatory. This position was occupied for a few years, when Marth settled again in London, which he finally quitted in 1883 on his appointment to Colonel Cooper's Observatory at Markree, a position that he retained for the remainder of his life. In 1882 he was sent out to Montagu Road, Cape of Good Hope, in charge of an expedition to observe the transit of *Venus* at that station. He was successful in his observations, which he considered fairly good, notwithstanding much atmospheric disturbance at the time.

Marth was a most active and accurate computer, and he well earned the gratitude of astronomers for the tables and ephemerides he regularly prepared for so many years for observations of the satellites, and for physical observations of *Mars*, *Jupiter*, and the Moon. It cannot be doubted that the assistance thus afforded to observers has been the means of considerably advancing knowledge. In the papers already cited, and in many others, Marth showed his capacity for dealing with questions of theoretical astronomy under new and original aspects. In this connection we may cite his papers "On the Computation of the Equation of the Centre in

Elliptical Orbits of Moderate Eccentricities," "On a Simple Solution of Kepler's Problem," and on "Two Auxiliary Tables for the Solution of Kepler's Problem." We may also mention the interesting paper he published in the *Monthly Notices* for 1885 March, entitled "Data for a Graphical Representation of the Solar System," the principle of which we may venture to quote. "The Sun's centre being the common focus of all the orbits, a plane passing through the Sun's centre perpendicular to the ecliptic will intersect all the orbits. Let this plane rotate, and let, for each orbit, the tracing be represented which the point of intersection produces on the plane in the course of a full rotation, and which for the present purpose may perhaps be called the 'ecliptical intersect' of the orbit. The form or shape of the tracing or intersect depends on the elements i, e, ω of the orbit: i, the inclination to the ecliptic; e, the eccentricity; and ω, the angular distance or departure of the perihelion from the ascending node Ω. A circular orbit in the plane of the ecliptic would accordingly be represented by a point or dash, a circular orbit inclined to the ecliptic by a circular arc, an eccentric orbit in which ω is $=\pm 90°$ by an arc of another curve. In order to lay down the 'ecliptical intersect' of any actual orbit, the coordinates of a sufficient number of points must be known, through which the curve may be easily drawn by hand. The coordinates required are the curtate distances from the Sun and the distances from the plane of the ecliptic, or $r \cos b$ and $r \sin b$, if r denotes the radius vector and b the latitude, to which must be added the corresponding ecliptical longitudes l and also the true anomalies v."

Marth was never married, and gave up all family life in order to pursue his scientific studies. His aspiration had been to be able to make observations with a perfect instrument in the best climate, but his ideal was never realised, and this disappointment to his sensitive nature, coupled with indifferent health, seems to have rendered his life not too happy. He had a wide and accurate knowledge of astronomical history and a remarkable memory. An old-standing complaint, brought about by his sedentary habits, assumed an acute form while on a visit to Heidelberg, and he quietly passed away on 1897 August 6.

The honorary degree of M.A. was conferred upon him by the University of Durham. He was first elected a Fellow of the Society on 1854 May 12 and resigned in 1857; subsequently he was elected again a Fellow on 1878 January 11. E. B. K.

William Roxburgh was the youngest son of the late Dr. William Roxburgh, sometime Superintendent of the Botanic Gardens, Calcutta, and author of the *Flora Indica*. He was born at Calcutta on 1812 May 15. He was educated at the New Academy, Edinburgh, and afterwards entered the University of that city, where he took the degree of M.D. in 1835. In the following year he settled in London, and pursued his medical