Communication to the Association.

TOTAL ECLIPSE OF THE MOON, 1931 SEPTEMBER 26.—The eclipse was observed at Wellington, Nilgri Hills, South India, from an altitude of 6000 feet under perfect conditions. Mid-eclipse was at $1^h\ 18^m$ Indian standard time (September 27), $19^h\ 4^m.8$ G.M.T. on 26). The moon was nearly in the zenith, so the whole eclipse was observed well.

It was of the normal type of "red eclipse," and it is noteworthy that not only was the outer ring of the umbra of a totally different colour, viz., a blue grey, but the central copper red of the umbra was distinctly brighter than the outer portion. I have previously noticed this difference in colour, but not the difference in luminosity; the cause is no doubt a matter of selective refraction and absorption by the earth's atmosphere, and it would perhaps be interesting if those skilled in meteorology could give some explanation. Eleven occultations of faint stars were observed during totality, including one of about 6·5 magnitude, but the remainder of 10th or less.—A. COLEMAN.

Obituary Notice.

William Frederick Denning.

William Frederick Denning was born on the 25th November, 1848, at Redpost, near Radstock, in Somerset, the son of Isaac Poyntz Denning, an accountant in Bristol. As a boy he showed a deep interest in natural history and later in astronomy, and was one of the watchers of the great Leonid return of 1866; but it was the observation of a brilliant Taurid fireball on 9th November, 1869, and the correspondence with A. S. Herschel which that fireball initiated, that really directed his interest towards the observation of meteors. To this he devoted the greater part of his life's work, and his investigations range over nearly every aspect of the subject; but his most valuable contributions are his true paths and his radiants. His successive lists of true paths contain the heights velocities and radiants of about 1,350 meteors in all; many of them observed in the course of combined watching organised by Denning, and the remainder comprising fireballs casually observed, the accounts of which Denning assiduously followed up by letter and by newspaper correspondence. These paths, of which a good proportion are based on the work of some of the best of meteor observers, represent the most extensive investigation of the flight of individual meteors hitherto carried out.

Denning's work in radiants was decisive both in quality and in quantity. From the first he obtained radiants with an accuracy which at that time was not commonly attained; and it is one of the great merits of his work that the output of radiants accurate to within one or two degrees that came from

his observations really rendered obsolete the work of a looser character. And as to quantity, after his first few years of meteoric work (when he was learning the value of more extended watching) he commenced to produce a volume of observations that soon dwarfed the work of all other observers. In 1876 he obtained 51 radiants based on the observation of 766 meteors, and the following year yielded him 162 radiants from the observation of 1,929 meteors; an outstanding performance at any time, but then so extensive a piece of work as to mark a new departure in the observation of meteors. He continued work on the same scale up to 1888, by which time he had amassed by his own labours the greater part of our knowledge of the feeble and attenuated meteor systems: and though subsequently he never carried out work on quite so ample a scale, each year brought some considerable addition to his earlier investigations. He also undertook the reduction of the observations of other workers, such as Tupman, Heis, Konkoly and the Italian Meteoric Association, for the purposes of checking his own results and deductions; although he did not regard the radiants deduced from such reduction as of equal weight with those obtained directly from observation. One outcome, at any rate, of this laborious work was the compilation of his general catalogue of radiants, a project which he had for many years had in mind and which he successfully completed in 1899 when his catalogue was published in Volume 53 of the *Memoirs of the R.A.S.* Only Denning, with his experience in observing and in the reduction of the work of others, could have produced a catalogue at once comprehensive and lucid from the heterogeneous mass of materials then existing, and this catalogue has ever since been the standard reference list for meteor workers throughout the world.

Arising mainly from his investigations of these minor streams Denning called attention to the long duration or repeated recurrence of radiation from certain centres; which had indeed been previously pointed out by R. P. Greg, but it was the accuracy and extent of Denning's work that really raised the problem of stationary radiation as an important issue. It had for long been known that the radiant of a long-enduring stream should be in motion from day to day, as had been first pointed out by Leverrier; nor was Denning unaware of the implications of the position which he adopted, since from the first he was subjected to criticism, and not least emphatically by friends such as A. S. Herschel in private correspondence. On the contrary, he regarded it as a very interesting conflict between observation and theory, and looked forward to its yielding some important new information. The controversy was carried on for many years, with a bitterness on the part of some critics in strange contrast with the restraint of Denning's own writing, but at all times adverse criticism left Denning's position substantially unshaken. The reason for this lay ultimately in the fact that such adverse criticism was essentially theoretical in nature, which in Denning's estimation merely showed the weakness in the theory; and accordingly the only valid attack on Denning's position could solely come from

observation itself. During the past twenty years, a real attempt has been made, first by C. P. Olivier and his co-workers in America, and more recently in England, to subject Denning's views to test by observation; and while the result is still in doubt, such testing by observation was what Denning himself most earnestly desired.

But while his name is most intimately connected with the stationary radiation of the minor streams, Denning also made equally valuable contributions to our knowledge of the major showers. He was the first observer to detect the motion of a radiant in accordance with the requirements of theory, a matter of fundamental importance: as early as 1877 his observations showed a distinct progression in the radiant of the Perseids, to which he expressly called attention, and this he followed up in 1884 with a formal announcement of the motion. In addition, he later detected the motion of the Lyrid and Geminid Showers. His were also the first accurate determinations of the position of the Lyrid Radiant and they rendered the supposed connection of that stream with Thatcher's Comet far more satisfactory: whilst in 1916 he discovered a new major shower, that connected with Pons-Winnecke's Comet.

But while undoubtedly his most important work, Meteoric Astronomy was by no means the only field in which he laboured with distinction. He carried out extensive observations of the planets, and was undoubtedly one of the foremost planetary observers of his day. His first instruments were small refractors, but he later obtained a 10-inch With-Browning reflector (with which most of his telescopic work was done), and a 12·6-inch reflector by Calver, both on altazimuth stands. It is unfortunate that circumstances compelled him to give up planetary observation after 1906, but he had already accumulated material covering well over a quarter of a century.

Unquestionably his greatest contribution to our knowledge of the planets lay in his investigations of the proper motions and rotation periods of markings on Jupiter; and his systematic work, which included the observation of many thousands of transits of spots over the central meridian of the planet's disc, helped very largely to establish the permanent nature of some of the best-defined surface currents. He was also greatly interested in the past history of special features, and in the search for possible periodicities in their appearance or motion. He observed the rapidly moving N. Temperate Spots in 1880 and 1891, and from a comparison with earlier drawings and notes by various observers suggested a recurrence at intervals of about 11 years. This has not been substantiated, but there was a similar outbreak in the same latitude in 1929-30.

Jupiter's famous Red Spot was, of course, an object of special interest to Denning, and he was able to show conclusively that the present spot and the " hollow " in the S. Equatorial belt in which it is commonly seen to be lying, are to be linked up with the hollow drawn by Schwabe in 1831 September 5. Denning carried his investigation further back still, and succeeded in connecting Hooke's Spot of 1664 with that observed by J. D. Cassini and recorded by various observers at intervals

down to 1713, but a long gap of over a century then follows, during which there are no records of its appearance. Denning, however, concluded that in view of their similarity of position and motion and the frequent faintness or invisibility of the Red Spot in recent times, it is by no means improbable that the earlier spot and the Red Spot may be the same object. In the course of these investigations Denning traced the remarkable changes of rotation period shown by the available observations, and tentatively suggested a periodicity of about 48 years.

Owing to its greater distance Saturn offers far fewer opportunities for systematic study than Jupiter, but in 1903 a number of spots appeared in the planet's N. hemisphere, and in a discussion of the recorded observations Denning showed the mean rotation period to be about $9^h\ 10^m\ 38^s$, or some 23^m longer than that which had previously been derived for the equatorial regions.

Denning's published work on Mars was not very extensive, but he made a number of drawings and notes. His conclusions (*M.N.R.A.S.*, **63**, 499) regarding the nature of the so-called "canals" are no doubt shared by most present-day observers, viz., that while there is an objective basis to the network of linear markings first noted by Schiaparelli in 1877, these features appear as "soft diffuse streams of dusky material with frequent condensations," and generally not as sharply defined lines, and that natural rather than artificial production is suggested by the appearance of the surface lineaments.

Denning also made frequent telescopic observations of the other major planets, especially Venus and Mercury. Although he sometimes saw vague markings on these planets, his care and conscientiousness as an observer did not allow him to try to deduce rotation periods. He published a very valuable summary of what had been recorded by previous and contemporary observers in *The Observatory* for 1906 and 1907.

There are two points to which it seems fitting reference should be made in these notes on Denning's planetary work. One is that he accomplished the whole of his excellent results without the advantages of a clock drive or even an equatorial mounting. This should be an encouragement to those who are unable to acquire these things. The other is the reliability of his observations. He possessed in a high degree those qualities which are essential for success in this field—a good eye, sound judgment, skill in draughtsmanship, coupled with the moral qualities of enthusiasm and perseverance; but nothing can contribute more to the imperishability of his achievements than the truthfulness and accuracy which characterize them.

He was a born observer, and of all astronomical phenomena nothing which was within the range of his observations escaped him, whether in his more arduous researches, or, for example, in such matters as eclipses, or the early visibility of the new moon. One of the very few observers in this country to have carried out systematic comet-sweeping, he was rewarded by the discovery of five comets, which he estimated cost him on the average 119 hours of work each. The discovery of Nova

Cygni III 1920 also stands to his credit, together with one of the earliest of the independent discoveries of Nova Aquilæ 1918.

For theory he cared not so much, although deeply involved in the controversy on stationary radiation; to be out under the night sky was his real satisfaction. In his younger days he was somewhat of an athlete, delighting in running and in playing hockey and a keen and skilful cricketer. But from early manhood he was dogged by ill health, and one by one such activities had to be relinquished; and for the latter half of his life he lived alone, suffering frequently from illness and visited only by his most intimate friends. His was a modest and retiring disposition, but he prized highly the recognitions and distinctions which his work brought him, which included the award of the Valz Prize of the Académie des Sciences in 1895 and of the Gold Medal of the R.A.S. in 1898. In addition he was in 1904 granted a Civil List pension for his services to astronomy, and in 1927 the M.Sc. (*Honoris Causa*) of the University of Bristol. Although after the utter collapse of his health in 1906 he suffered acutely, his love for his work continued unabated. He did much useful observing even during those unhappy years, and to the very end he was watching the sky and noting occasional meteors, calculating the paths of fireballs and writing accounts for the newspapers and letters to his friends. He died on the 9th June 1931 in his 83rd year, and we in the B.A.A. have special reason to be grateful for his life's work, for he was a very great observer and a worthy successor of those great amateurs of past days whose lives and work have enriched our science.—J. P. M. P. (*Planetary part by* T. E. R. P.).

Diary for 1931 December.

The predictions are given in Greenwich Mean Time, and are for the meridian and latitude of Greenwich.

Greenwich Mean Time. Day	h	m	Phenomena.
1	10		Jupiter in conjunction with the Moon. Jupiter 3° South (geocentric).
2	16	50·5	Moon Last Quarter.
3			Mercury at greatest elongation, 21° East.
9	10	16·0	New Moon.
10	20		Mercury in conjunction with the Moon. Mercury 4° North (geocentric).
13	16	27	Occultation of ϕ Capricorni, (Mag. 5·3), Disapp. P.A. 71°.
13	18	15	Occultation of B.D. −20° 6178, (Mag. 6·7), Disapp. P.A. 85°.
15	18	34	Occultation of W.Z.C. 1524, (Mag. 6·7), Disapp. P.A. 110°.