Obituary

Prof. Willem de Sitter

ASTRONOMY has suffered a heavy loss by the death of Willem de Sitter, director of Leyden Observatory. In the development of astronomical research in the present century, Holland has taken a conspicuous part; and, since the death of J. C. Kapteyn, de Sitter has been the leading astronomer of his nation. He is most widely known as the propounder of the 'de Sitter universe', a recondite development of the theory of relativity which is the basis of our present idea of an expanding universe. But that reveals only one side of his versatility. The great research, which occupied him for thirty years, was in classical celestial mechanics; and in 1931 the Royal Astronomical Society awarded him its gold medal "for his theoretical investigations on the orbits of the satellites of Jupiter, and for his contributions to the Theory of Relativity". It is a strange chance that, of his most conspicuous contributions, one should relate to the Jovian system—first-fruits of the invention of the telescope—and the other to the remotest systems that the telescope has yet revealed. But, setting aside his personal research, astronomers more usually think of him as the energetic head of a flourishing observatory, who by his sound practical judgment, his wide experience, and his single-minded character, has had a far-reaching influence on the general advance of astronomy.

Willem de Sitter was born at Sneek in Friesland on May 6, 1872. He was educated at the Gymnasium at Arnhem, where his father was a judge, and at the University of Groningen. Though primarily a mathematician, he was captured by Prof. Kapteyn's enthusiasm and began to work in the Astronomical Laboratory at Groningen. It was, however, Sir David Gill who finally converted him into an astronomer. Visiting Groningen in 1896, Gill made his acquaintance, and eventually invited him to the Cape to assist in the discussion of the heliometer observations of Jupiter's satellites. De Sitter found the Jovian system a subject after his own heart; it gave scope both to his mathematical training in celestial mechanics and to his later interests in the practical side of astronomy. He worked at it more or less continuously until 1929, when at last he felt satisfied to publish his definitive values of the orbital elements and masses of the four satellites.

After two years at the Cape Observatory, de Sitter returned to Groningen and became an assistant in the Astronomical Laboratory. In 1908 he succeeded H. G. van de Sande Bakhuyzen as professor of astronomy in Leyden. On the death of E. F. van de Sande Bakhuyzen in 1918, he was appointed director of the Leyden Observatory. This was an important and arduous post, for the Dutch Government had decided on a great enlargement and reorganisation. Leyden is one of the oldest observatories; its third centenary was celebrated last year; but for many years it had ceased to be an important institution. De Sitter applied himself to the reorganisation with energy and far-sightedness, and sacrificed his personal work to the responsibilities of his office. Surrounding himself with a well-chosen staff, he rapidly made the Observatory one of the most important in Europe. This success was fittingly recognised when he was made president of the International Astronomical Union for the period 1925–28.

One interesting innovation was the alliance which de Sitter formed in 1923 with the Union Observatory at Johannesburg, providing for regular visits of members of the Leyden Observatory to gather observational material in the favourable climate of South Africa. Leyden will shortly have its own instrument installed at the Union Observatory, namely an equatorial with twin photographic telescopes of 16-inch aperture having Cooke triplet objectives. The instrument is now ready for testing, and de Sitter was planning just before his death a visit to England to inspect it.

In 1916–17, de Sitter published a series of three papers in the *Monthly Notices of the Royal Astronomical Society* "On Einstein's Theory of Gravitation and its Astronomical Consequences". These were the first papers in English on the new theory. Einstein's original paper was almost inaccessible here, owing to the interruption of international communication; probably the only copy in England was one which de Sitter kindly sent to the present writer about this time. There were already a number of developments to be added. De Sitter's papers included an admirable up-to-date exposition of the mathematical theory; and they have greatly influenced the form in which the general theory of relativity has come to be understood in England. In the second paper, he investigated the effect of the new law of gravitation on the motion of the moon, and found that it would cause an advance of the perigee and node amounting to nearly 2″ per century; this is at present just outside the limits of practical detection. The analysis in the paper is very arduous, and shows how fully de Sitter had entered into the methods of the new theory. A simpler way of handling the problem has since been discovered, but it confirms de Sitter's conclusion.

It is in the third of these papers that the 'de Sitter universe' appears as a suggested alternative to the 'Einstein universe'. It is perhaps necessary to explain how these ideas arose. It has become the regular procedure in mathematical physics to express the laws of Nature by differential equations. But in classical physics at least the differential equation is not the whole of the law; boundary conditions are also prescribed. Thus it is not sufficient to say that Newton's law of gravitation is $\nabla^2\varphi = -4\pi G\rho$; there is the further condition that that solution of the differential equation must be taken which makes φ zero at infinity. Tested by the principle of relativity, the Newtonian equation failed; Einstein had to substitute another differential equation, and so reached his famous theory. But what is sauce for the goose is sauce for the gander, and the boundary values at

infinity should also be tested by the same principle. Unfortunately, they did not satisfy the test. In particular, the familiar solution giving the gravitational field of the sun (which affords the chief observational tests of the theory) gives values at infinity which are open to this criticism. Einstein was the first to recognise this inconsistency, and proposed a remedy. De Sitter pointed out that there was an alternative which in some ways appeared less artificial. He entered into a full discussion of the astronomical phenomena which might be used to discriminate between them. Both theories lead to a closed spherical space, and de Sitter's paper contains estimates of upper or lower limits to the size of the universe on either hypothesis. It is a reminder of our progress in the last seventeen years that none of these estimates is large enough to include some of the nebulæ the distances of which have recently been measured.

De Sitter pointed out that the most definite test would be provided by the velocities of the spiral nebulæ. In his cosmology, but not in Einstein's, the velocities should increase with increasing distance. He does not seem to have noticed that the velocities should all be recessive, though this is almost immediately evident from his formulæ. It is true that he predicted a systematic displacement of spectral lines to the red, due not to genuine motion but to a 'slowing down of time' at great distances from us. This is now recognised to be only a second order effect, and is submerged in genuine increase of receding velocity with distance. We need not here trace in detail how the present version of the expanding universe differs from de Sitter's original account; the differences are such as naturally arise in the course of development of a highly original idea. Confronted for the first time with the topsy-turvy conceptions to which his pioneer work had led, de Sitter was amazingly far-sighted on some points and amusingly blind on others. He appreciated as much as anyone the joke that some of the most surprising properties of his universe arose from the fact that he had forgotten to put any matter into it.

The de Sitter universe attracted the attention of geometers as well as physicists, and became a favourite theme of study. De Sitter took little part in this himself. By the time the radial velocities of spiral nebulæ had been determined in sufficient numbers, he was heavily occupied in reorganising Leyden Observatory. For at least ten years he was "the man who discovered a universe and forgot about it". But in 1930, having at last completed his work on the Jovian system, he returned to the subject. Learning later of Lemaître's development of the theory, he accepted it with enthusiasm and published a number of papers on the problems raised. An interesting summary of his later views is given in the last chapter of his book "Kosmos", which contains the Lowell lectures delivered by him at Boston in 1931.

Astrophysics, as ordinarily defined, was outside de Sitter's range; but he took care to secure in his observatory a strong astrophysical department directed by Prof. Hertzsprung. His activities included most other branches of astronomy—dynamical, statistical, instrumental. He did much work on the fundamental constants of the solar system. His work on Jupiter's satellites led him to contribute to the examination of the secular retardation and irregularities of the earth's rotation, using the early observations of these satellites to check the earth's performance as a time-keeper.

Both for his ability and his character, de Sitter was highly esteemed by his colleagues. He was a frequent and welcome visitor to England. He attended and took part in several meetings of the British Association, including the two meetings held at the Cape. He was far from robust, having suffered a long and severe pulmonary illness about 1921 which left him with a damaged lung; but he did not spare himself in activity. He looked older than his years. Outside astronomy he was much interested in art and literature; but his greatest joy was in his home life with his children and grandchildren. He had two sons and two daughters, all married.

On November 9 of this year he became seriously ill with pneumonia, at the same time with two other members of his family—a son and grand-daughter who had just returned from the Dutch Indies. The child died on November 16, but it was hoped that de Sitter would recover. On November 18, complications set in and he grew rapidly weaker. He died on November 19. A. S. E.

The Rev. A. H. Cooke

Alfred Hands Cooke was born at Enfield in 1854. He was a colleger at Eton and proceeded as a scholar to King's College, Cambridge. Here he crowned a classical career of unusual brilliance by being Senior Classic in 1878. The following year he was elected a fellow of King's, where he remained as dean and tutor until 1900.

Cooke's scientific work was almost exclusively confined to the study of the Mollusca, and in this branch of zoology he soon attained a position of widely recognised authority. He was University curator of zoology from 1881 until 1890 and in 1895 published his best-known book—the entirely charming volume on Mollusca in the Cambridge Natural History. But he did much other work of a more technical nature and the value of his many papers on conchology was acknowledged by the degree of Sc.D. conferred on him by the University in 1914. He was president of the Malacological Society in 1913–15 and of the Conchological Society in 1919–20. His large collection of shells, many of them taken by himself in foreign travel, he had recently presented to the British Museum. This collection includes a very long series of the whelk, *Purpura lapillus*, from all parts of the world. It shows the extreme variations of the species and contains a sinistral variant, a Hungarian specimen and one of the four or five recorded examples.

For twenty years after leaving Cambridge, Cooke was headmaster of Aldenham, where he produced a steady stream of fine classical scholars of his own training, and continually encouraged and extended