him to repay the advances which had been made to him. Once out of debt, he found the call of the ice irresistible. He meditated a dash to the unknown centre of the Beaufort Sea in the Arctic regions, and had gone far to mature his plans when circumstances barred the way, and he resolved on one more Antarctic voyage.

This time the munificence of friends secured him freedom from financial worries. His plan was sound; the Enderby Quadrant which he was to explore was practically unknown; his old comrades rallied to him from the ends of the earth; but the ship was small though stout, and he was forty-seven years old, though a boy at heart. He sailed in the *Quest* in September, 1921, had a grievous buffeting on the voyage to Madeira, a long and trying delay for refitting in the heat of Rio de Janeiro, again a stormy voyage to South Georgia, and then the sudden seizure in the midst of apparent health, and the career of the most Elizabethan of modern explorers had an end as abrupt as the clash of "the blind Fury with the abhorred shears."

Shackleton lived like a mighty rushing wind, and the very strength of his nature made him enemies as well as friends. He resented injustice and slights, but they only spurred him on to show by new achievements how baseless they were. He endeared himself to his friends, and was adored by his ship-mates, who saw in "the Boss" a kindly but unquestionable authority. He loved applause and gloried in the limelight; but he was applauded for feats that no one else was able to accomplish. The labourer is worthy of his hire, and no one has a right to quarrel with a good workman if he likes to take some of his pay in the form of praise and publicity.

Shackleton's most characteristic quality was neither courage nor resolution, both of which he shared with other heroes of exploration. It was his instinctive judgment. Whenever he had to make a decision between two courses of action, no matter how suddenly the necessity arose nor how quickly it had to be met, he invariably did the right thing. Again and again the wrong decision would have meant certain death or irremediable disaster. This power of decision was not an effort of reason, but an apparently instinctive impulse which can perhaps be accounted for by a peculiar balance of perception. Indeed, it is to the balancing of contradictory qualities that much of Shackleton's success was due. His mind was not essentially scientific, though he valued science and made most generous provision for it in his expeditions. He was both impulsive and cautious, yet he was never irresolute. He revelled in poetry and seemed to breathe the air of romance, but at the same time he was a methodical organiser and a keen business man. His imagination was amazingly fertile, and it seems as if in planning an expedition he imaged to himself everything that could possibly happen in any set of circumstances and then set himself to work to provide for each contingency. Whatever may have been its secret, his personality was his greatest power, and it marked him out as a commanding figure He might well have been a Drake or a Ralegh; in no time and in no conditions could he have been commonplace. The greatness of his loss may be judged by the things he did and the way he did them.

HUGH ROBERT MILL.

SIR WILLIAM CHRISTIE, K.C.B., F.R.S.

WILLIAM HENRY MAHONEY CHRISTIE was the youngest son of Samuel Hunter Christie, professor of mathematics in the Royal Military Academy at Woolwich and secretary of the Royal Society from 1837 to 1854. He was born in 1845, the same year as George Darwin and two years later than David Gill. Educated at King's College School and Trinity College, Cambridge, he was fourth wrangler in 1868, and in the following year was elected to a fellowship of his college. On the recommendation of Airy, Christie was, in the autumn of 1870, appointed chief assistant at the Royal Observatory, Greenwich. At that time the activity of the Observatory was largely concentrated on its traditional duty of the regular observation of sun, moon, planets, and fundamental stars, the stars being regarded as points of reference for the planets, and especially the moon, and serving also for the determination of time. The observations were made with the transit circle erected by Airy in 1850. Christie made a careful study of (1) the most suitable value of the refraction constant at Greenwich, (2) the corrections to be applied for a well-established and persistent difference between the zenith distances of stars when observed by reflection from mercury and when observed directly, and (3) the value of the latitude at Greenwich—data required to deduce the declinations of stars free from systematic errors. In this involved and somewhat indeterminate problem his judgment was correct, as is shown by the smallness of the systematic corrections applicable to the Greenwich catalogues of 1880, 1890, and 1900 to bring them into accord with the mean of other observatories.

The extension of the field of work of the Observatory was pressed on Airy by Warren de la Rue, who advocated continuous observations of sun spots, and by Huggins, who advocated spectroscopic observations of sun and stars. In a letter to Airy in May, 1872, Huggins writes: "I understand Mr. Christie, who is zealous in the matter, to say that you would be agreeable to this course." Government sanction was obtained, and Mr. E. W. Maunder was appointed assistant for photographic and spectroscopic observations. Christie was in sympathy with both these extensions of the activity of the Observatory. The photo-heliographic work was carried through very successfully, and arrangements made with the Solar Physics Committee, and later with the Cape and Kodaikanal Observatories, resulted in a uniform and continuous series of photographs of the sun being taken day by day, which were afterwards measured and discussed at Greenwich with reference to the positions and areas of sun spots.

The spectroscopic observations for velocity in the line of sight were not successful. It was not until the introduction of photography by Vogel that any reliance could be placed on line of sight determina-

tions of velocity, and not until the Mills spectrograph at the Lick Observatory was got into operation in 1895 by Campbell that thoroughly trustworthy results were obtained. But the earlier observers in the field, as in the parallel case of parallax determinations, deserve credit for attacking an important problem, though they did not succeed in overcoming the great difficulties which it presented.

On the retirement of Airy, in 1881, Christie was appointed Astronomer Royal. His tenure of office is notable for the large additions he made to the equipment of the Observatory and to the introduction of stellar photography. The first extension of the buildings was an additional computing room, and with it a pier and dome, which served later for the astrographic equatorial. In 1885 he represented to the Admiralty the desirability of increasing the optical means of the Observatory, and received its assent to the purchase of an object-glass of 28-in. aperture and 28-ft. focal length. In co-operation with Stokes an object-glass was proposed which might be used for visual or photographic observations. This telescope, constructed by Sir Howard Grubb, was completed in 1893 and installed on the equatorial mounting which until then had carried the Merz 12¾-in. telescope. The drum-shaped dome covering the Merz refractor was worn out, and was replaced by an Oriental-looking dome designed by Christie to contain the longer telescope. This telescope was for many years in charge of Mr. Lewis, and has been utilised for a valuable series of observations of double stars.

The provision of the photographic refractor of 13 in. with a 10-in. guiding telescope, to enable Greenwich to take part in the photographic mapping of the heavens, was sanctioned in 1888. The instrument, constructed by Sir Howard Grubb, was mounted in the 18-ft. dome over the computing rooms in 1890. The Greenwich section of the astrographic chart and catalogue and the observations of Eros for solar parallax were made with this telescope. Christie took a share in the deliberations and arrangements for this international undertaking. He designed a micrometer for use at Greenwich which facilitated the comparison of neighbouring plates. He was also the discoverer of a very useful empirical formula connecting the magnitude of stars with the diameter of their photographic images.

The largest addition to the Observatory was commenced in 1890, but not completed until 1898. It is a cruciform building, with office rooms on the ground floor, libraries and workshop in the basement, rooms for preserving records and photographs on the upper floor. The central octagon is used as a store room, and is surmounted by a 36-ft. dome originally built to cover Lassell's 2-ft. mirror presented to the Observatory by the Misses Lassell. Before the building was completed Sir Henry Thompson generously offered to provide a 26-in. photographic refractor and a 30-in. reflector, both on the same equatorial mounting. The equatorial and the refractor were constructed by Sir Howard Grubb and the mirror by Dr. Common. The refractor was used in observations of Eros, observations of Neptune's satellites, and for various other purposes, while the reflector was used in photography of nebulæ, observations of small planets, comets, faint satellites, etc., and was instrumental in the discovery of the eighth satellite of Jupiter.

About the same time Christie designed a new altazimuth. The instrument is essentially a transit circle which can be mounted in any azimuth. It replaced Airy's altazimuth, which did not give sufficient accuracy. The new instrument usefully supplements the observations of the moon made with the transit circle.

These various extensions to the Observatory buildings cramped the space for meteorological observations, and the iron in the domes affected the magnets, which were housed in a wooden building a few yards to the north of the new observatory. A plot of ground in Greenwich Park was lent to the Admiralty by the Office of Works, where a magnetic pavilion was erected for taking absolute magnetic observations.

Christie took a good deal of interest in the observation of total eclipses. He went to Japan in 1896, to India in 1898, to Portugal in 1900, and Tunis in 1905. With the equipment arranged by him in 1896 an excellent series of large-scale photographs of the corona were taken at the eclipses of 1898, 1900, 1901, 1905, and 1914.

Christie retired from his office on his sixty-fifth birthday, October 10, 1910, with the good wishes of his staff. He maintained his interest in the Observatory, and came regularly to the annual visitation. He was also frequently at the meetings of the Royal Astronomical Society and the Royal Society, serving on the council of the Royal Society six years and on that of the Royal Astronomical Society forty-one years, being president in the years 1888–1890. Several foreign academies also accorded him honours. He received the distinction of C.B. on the occasion of Queen Victoria's Diamond Jubilee and was promoted K.C.B. in 1904.

He married in 1881 Violette Mary, daughter of Sir Alfred Hickman, of Wolverhampton. Mrs. Christie died in 1888, leaving two sons, one of whom died in childhood. His elder son, Mr. Harold Christie, lived at the Observatory until his father retired, when they went to live first at Woldingham and afterwards at Downe. Sir William was of a courteous and hospitable disposition, and would always invite some members of his staff to meet a foreign astronomer who might be visiting the Observatory. He thoroughly enjoyed astronomical conferences and eclipse expeditions for the opportunities they afforded of meeting astronomical colleagues. He acquired in these expeditions a love of sea voyages, and after his retirement made several trips abroad in the winter. In the early part of 1921 he went to Jamaica, and paid a visit to Mr. and Mrs. Pickering at the observatory of Mandeville. This year he started for Mogador a few days after meeting many of his friends at the Royal Astronomical Society Club. He was then apparently in fair health, but died on January 22, before the ship reached Gibraltar. F. W. DYSON.