Obituary

Sir Richard Glazebrook, K.C.B., K.C.V.O., F.R.S.

RICHARD TETLEY GLAZEBROOK, whose death took place at his home at Limpsfield, Surrey, on Sunday, December 15 last, was born at West Derby, Liverpool, on September 18, 1854. He came of two well-known Liverpool families, members of both of which have attained distinction, being the eldest son of Nicholas Smith Glazebrook, of West Derby, Liverpool, and of Sarah, daughter of Richard Tetley, of Liverpool. He was educated at Dulwich College and, later, at Liverpool College, whence, in 1872, he gained a scholarship at Trinity College, Cambridge. He took his degree as fifth wrangler in 1876, was made a fellow of his College in the following year, and for twenty-two years, until 1898, was engaged in active work in Cambridge. He became a College and University lecturer in mathematics and natural science, assistant tutor at Trinity, and in 1895 was made Senior Bursar. Immediately after taking his degree he studied in the Cavendish Laboratory, where he became a demonstrator under Lord Rayleigh in 1880, and in 1891 was made assistant director.

In considering Glazebrook's science work in Cambridge, it is necessary to bear in mind the position of science teaching there at the time. Clerk Maxwell had been appointed the first professor of experimental physics in March, 1871, and gave his earlier lectures in the lecture room of Liveing, the professor of chemistry. The new building for experimental physics, the Cavendish Laboratory, was not completed until 1874. The students attending Maxwell's lectures in the early days were mainly men who, like Glazebrook, had already taken a high place in the mathematical tripos. When Glazebrook began experimental work in 1876, he turned his attention at first to optical questions, and his first important paper, "An Experimental Determination of the Values of the Velocities of Normal Propagation of Plane Waves in different directions in a Biaxial Crystal, and a Comparison of the Results with Theory" was published in the *Phil. Trans.* in 1878. A second paper, on "Double Refraction and Dispersion in Iceland Spar" appeared, also in the *Phil. Trans.*, in 1880, and a third in 1882, in which year he was elected F.R.S. But under Maxwell his attention had also been given to electrical questions, which more and more occupied his time during the professorship of Lord Rayleigh (1880–84) and after.

When, in 1880, Glazebrook was made a demonstrator, the number of students was still small, but soon tended to increase, and it was necessary to give attention to the organisation of the 'demonstrations'. Then began that co-operation with Napier Shaw which had so great an effect for many years on science teaching both in colleges and schools. It is not necessary here to go into details; Glazebrook was from the first fully alive to the disadvantages as well as the advantages of any such plan, but some system of the kind soon was clearly essential in dealing with the greatly increased numbers of students requiring to gain experience in experimental work, and the scheme adopted in Cambridge found wide approval among teachers elsewhere.

During Lord Rayleigh's tenure of the Cavendish professorship, much time was given to a redetermination of the electrical units. The British Association Committee on Standards of Electrical Resistance, appointed in 1861, after doing much valuable work, had been dissolved in 1870. The unit of resistance adopted by that Committee, as represented by a number of practical standards constructed and issued by the Committee, came to be known as the B.A. unit. This purported to represent the absolute unit, but by 1880 it was realised that its value was appreciably in error, and the re-appointment of the Committee and a redetermination of the unit were generally called for. During the years 1880–84, three redeterminations of the B.A. unit, in terms of the absolute unit, were made under Lord Rayleigh in Cambridge, one of them by Glazebrook in 1882, as a result of which the value of the B.A. unit in terms of the absolute unit was found to be 0·9867. An important result of the work was that the B.A. Committee undertook to arrange for the systematic testing of resistance coils, and for this testing Glazebrook, who had been appointed secretary of the Committee, became responsible. During his later years at Cambridge, it occupied much of his time, and impressed upon him the need of a public institution which should undertake this and similar work of national importance. As secretary of the B.A. Committee, he had charge also of the B.A. condensers constructed by the Cambridge Scientific Instrument Co. to the design of Dr. Muirhead. He continued to act as secretary of the Committee until its dissolution in 1912.

During Lord Rayleigh's professorship, the numbers working in the Cavendish Laboratory steadily increased, and the increase continued under his successor, the present Master of Trinity. Additional demonstrators and assistant demonstrators had to be appointed, and the system of organisation of the laboratory teaching introduced by Glazebrook and Shaw was extended, with appropriate modifications, to the more advanced classes. A plan of co-operative research by the members of such classes gave valuable results, an illustration of which is furnished by the paper by Glazebrook and Skinner on "The Clark Cell as a Standard of E.M.F." published in 1892 in the *Phil. Trans.*

In 1898, after twenty-two years' work at Cambridge from the date of his graduation, Glazebrook accepted the post of principal of University College, Liverpool. His tenure of this position was, however, brief, for in July, 1899, he was asked, and agreed, to

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become the first director of the National Physical Laboratory. He had in 1897, as secretary of the Electrical Standards Committee of the British Association, given evidence before the Treasury Committee, of which Lord Rayleigh acted as chairman, which in July, 1898, recommended the establishment of the Laboratory, to be under the control of the Royal Society. His formal appointment was dated January 1, 1900, but already in the summer of 1899 he was actively helping in the preliminary work and negotiations involved before the necessary new buildings could be provided. The proposal of the Treasury Committee was that the institution should be established by extending the Kew Observatory, and the original intention was to build in the Old Deer Park, Richmond, but difficulties arose, and in 1901 Bushy House, Teddington, was offered as an alternative, and accepted. Kew Observatory remained part of the new institution as the Observatory Department. Once this decision was reached, rapid progress was made with the alterations and additions necessary to adapt Bushy House for the purpose, and on March 19, 1902, the Laboratory was formally opened by the Prince and Princess of Wales, their Majesties the present King and Queen. From that time onwards the success of the new institution was rapid. Glazebrook quickly gained the entire confidence of the influential body of men who consented to act as the governing body—the General Board and Executive Committee—of the Laboratory. He showed, too, his judgment of men in the early recruits he found for the staff: T. E. Stanton, F. E. Smith, H. C. H. Carpenter, W. Rosenhain, H. H. Jeffcott are early names on a list which might be greatly extended.

The funds provided by Government were meagre, but with every year the friends of the Laboratory grew and were ready to give practical form to the enthusiasm which was fostered by the success of the new institution. The first new building was that for electrotechnics and photometry, and others rapidly followed, for metrology, for chemistry and metallurgy, while the engineering building had more than once to be extended to accommodate the increasing work. The Director's first care was the provision of suitable units and standards of measurement, determined with ever-increasing accuracy as need arose and knowledge grew, including the fundamental standards of length, mass and time; the electrical units and standards including those of capacity and inductance; temperature standards, over a continually extending range of temperature, as demanded by modern science and practice; standards for pressure measurement; photometric standards and special standards for specific purposes. Much of this work, for example, the accurate measurement of high temperatures, involved extensive research, and among other typical researches undertaken in the early days may be mentioned the investigations into wind pressure on structures and into the strength of materials when subjected to varying and repeated stresses.

It was in 1908 that the building of the tank for experiments on ship models was commenced, the funds for which were provided through the generosity of Sir Alfred Yarrow. In May, 1909, the Advisory Committee for Aeronautics was appointed by Lord Haldane, with Lord Rayleigh as president and Glazebrook as chairman, to advise upon flight problems, and to control research to be undertaken at the N.P.L. by means of models, and at Farnborough on the full scale. Thus began Glazebrook's long connexion with aeronautical research. As is well known, rapid progress was made with the experimental work, and the success achieved was of great importance to Great Britain during the Great War.

In a somewhat similar manner the question of research in wireless telegraphy arose at the beginning of 1913. The Postmaster-General appointed a committee, with Lord Parker as chairman, of which Glazebrook was a member, to report as to existing systems of wireless telegraphy, and as to what provision the State should make for research on the subject; and in 1914 the committee obtained approval of a scheme involving the provision of buildings and equipment at the N.P.L. The carrying into effect of this scheme was stopped by the Great War.

By 1913 also the testing work previously done at Kew had been transferred to Teddington, and Kew Observatory had become the research station of the Meteorological Office. An administration building had been provided at Teddington to meet the need of increased accommodation. Additions to the buildings had, of course, also been necessary for the aeronautical researches.

In 1914, therefore, under Glazebrook's energetic administration, the success of the Laboratory was fully established and its great value as a national institution made clear. Its scope had become even wider than was originally contemplated by its promoters and there was ample evidence that its usefulness had by no means reached its limit.

Its further development was, however, greatly affected by the War. The proposed wireless researches were, no doubt unfortunately, not begun, and the staff who remained, after a number had gone on active service, had to devote much attention to routine work connected with munitions supply. The aeronautical work, of course, became at once of extreme importance, and for that increased provision had to be made; and a number of other special problems were referred to the Laboratory for investigation. When the Ministry of Munitions was formed, Glazebrook became a member of its staff, and was able in many ways to render personal service. Valuable work was done by the Metrology Department of the Laboratory as a result of the experience already gained in accurate measurement, and for this work temporary staff had to be provided in somewhat large numbers. Towards the end of the War, it became clear that the Royal Society could no longer continue to be financially responsible for the N.P.L.; but Glazebrook was able to secure that the scientific control of the work by the Society under the pre-existing scheme should continue. In September, 1919, he retired from the directorship, on reaching the age limit.

Glazebrook returned at first to Cambridge, where, of course, he still had many friends. He planned the

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production of a "Dictionary of Applied Physics", which, with the co-operation of many expert contributors, was issued in 1922, and has been widely used. But he soon found that the many calls upon his time rendered necessary a return to the neighbourhood of London. For a time he lived actually in London: later he built himself a house at Limpsfield, where he could enjoy the country and his garden, without being involved in too much travelling. He still continued to act as chairman of the Aeronautical Research Committee, as it was now called, which, with a number of sub-committees, already found necessary during the War for special sections of the work in dealing with design and production, had become a most valuable organisation for promoting advance in the science of aeronautics and in aircraft design. The reconstituted committee had the duty of initiating and supervising research and experimental work, and also of advising on the scientific and technical problems connected with the design and construction of aircraft. It was given responsibility for the investigation of air navigation problems and of accidents, and with the aid of the Air Ministry expert staff, assisted greatly in the attainment of safety in flying. In this connexion the reports made by the Committee on the disaster to *R.* 101, and on the accident which gave rise to a prolonged investigation into the causes of 'flutter', may be instanced as illustrating the importance of the work for which Glazebrook was specially responsible. He secured very close co-operation with the American Advisory Committee, and, through its president, Joseph Ames, principal of the Johns Hopkins University, maintained the friendliest relations with those engaged in aeronautical research in the States. From 1920 until 1923 he was Zaharoff professor of aviation and director of the Department of Aeronautics in the Imperial College of Science and Technology. For the prolonged and highly valuable services he thus rendered to aviation in Great Britain he was, in 1933, awarded the Gold Medal of the Royal Aeronautical Society.

Brief mention only can here be made of other public services rendered by Glazebrook during the time when he was director of the N.P.L. and after. He was for many years an active supporter of the Engineering Standards Association, now the British Standards Institution. In 1911 he became a member of the Royal Commission for the Exhibition of 1851, and Mr. Evelyn Shaw has written of the valuable services he rendered as chairman of the Science Scholarship and Industrial Bursary Committees, and of the personal interest he took in the subsequent achievements of the scholars. He was a member also of the Commissions for the Brussels and Turin Exhibitions. He became a member, in 1924, of the Statutory Commission for the University of Cambridge. In 1927 he was appointed a member of the Royal Commission on National Museums and Galleries which presented its report in the years 1929–30: he was made a member also of the Libraries Sub-Committee, and took especial interest in the proposals for improved facilities at the Science Museum. He was at various times president of the Physical Society, of the Optical Society and of the Institution of Electrical Engineers, and member or honorary member of the Institutions of Civil and Mechanical Engineers, and other technical institutions. He maintained, after his retirement, the closest connexion with the work of the N.P.L., and served on its main research committee and technical committees, as well as on the Executive Committee and the General Board. His friendship with the present director, formed when they served together on the Advisory Committee for Aeronautics from 1909 onwards, has proved of enduring value to the Laboratory.

Glazebrook was made K.C.B. in 1920, shortly after his retirement from the Laboratory, and K.C.V.O. in 1934. He was the recipient of honorary degrees from the Universities of Oxford, Edinburgh, Victoria and Heidelberg. He was Hughes medallist of the Royal Society in 1909, Royal medallist in 1931, and from 1926 until 1929 acted as foreign secretary and vice-president. In 1934 he was a member of the National Committee for Physics of the Royal Society, and a delegate to the International Union of Physics; and he took a foremost part in the organisation of the International Physics Congress held in London and Cambridge during October of that year. It is interesting to note that he was then again very active in promoting international agreement on the subject of electrical units, a matter which had continued to occupy his mind since the time when he worked under Clerk Maxwell and Lord Rayleigh at Cambridge. Only a few days before his death he wrote a letter on the meaning of certain constants in physics, which appeared in NATURE of December 21.

Glazebrook married in 1883 Frances Gertrude, daughter of the late J. W. Atkinson, of Leeds, who survives him, with their son and three daughters. Their golden wedding was celebrated in June, 1933. Any survey of his life and work would be incomplete which did not call to mind the care and devotion which watched over him throughout all those years.

WE regret to announce the following deaths:

Dr. H. Bolton, formerly curator and director of the Bristol Museum and Art Gallery, president of the Museums Association in 1923–24, on January 18, aged seventy-two years.

Prof. W. E. Byerly, emeritus professor of mathematics in Harvard University, on December 20, aged eighty-six years.

Captain S. R. Douglas, F.R.S., deputy director of the National Institute for Medical Research, and director of the Department of Experimental Pathology, an authority on virus diseases, on January 20, aged sixty-four years.

Prof. T. L. Hankinson, professor of zoology in the Michigan State Normal College, known for his work on animal ecology and on ichthyology, on December 3, aged fifty-nine years.

Dr. Josef Petřik, professor of physiology in the Masaryk University of Brno since 1931, on January 11, aged forty-one years.

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