can thus do the vertical form of their dance even in the dark; for they can remember the direction of the food source in relation to the position of the hive and of the sun.

Prof. von Frisch, by his first work on bee behaviour, published in 1922-23, showed the foraging organisation of the hive to be far more complex than had hitherto been conceived. By this latest work (1946-49) he poses tremendous problems for the neurophysiologist and psychologist and shows that the foraging and orientation behaviour of bees is such as to require a reconsideration of some of the most fundamental concepts used in our explanations of the behaviour of insects and other animals. The day of Loeb and the tropism theory now seems far away indeed. In spite of the fact that the honey bee has been closely associated with man for many centuries, it is now clear that we still have a very long way to travel before arriving at anything like a full understanding of its behaviour and social organisation.

¹ Von Frisch, K., *Osterr. Zool. Z.*, 1, 1 (1946).

² Von Frisch, K., *Experientia*, 2, 397 (1946).

³ Von Frisch, K., *Bull. Animal Behaviour*, 1, No. 5, 1 (1947) (translation of ref. 1).

⁴ Von Frisch, K., *Naturwiss.*, 35, 12 and 38 (1948).

⁵ Von Frisch, K., *Experientia*, 5, 142 (1949).

⁶ Baumgartner, H., *Z. vergl. Physiol.*, 7, 56 (1928).

⁷ Boehm, G., *Acta Ophthalmologica*, 18, 109 (1940).

OBITUARIES

Dr. Norman R. Campbell

NORMAN ROBERT CAMPBELL was born in 1880 and was the third son of William Middleton Campbell, of Colgrain, Dumbartonshire. He was educated at Eton and Trinity College, Cambridge. He was a student of Sir J. J. Thomson, became a fellow of Trinity College in 1904, and worked mainly on the 'spontaneous' (as it was then often described) ionization of gases in closed vessels. It is not easy, on reviewing the papers by the various workers in this field, to attribute with certainty the credit for establishing the part played by penetrating radiation in producing ionization, but it is clear that he had correctly diagnosed the cause of the phenomena; and it was in the course of this work that, with A. Wood, he established the radioactivity of potassium. In this period also, in studying discontinuous phenomena, he arrived at 'Campbell's theorem' on the effect of random disturbances on a 'receiving' system.

Campbell was appointed to the Cavendish research fellowship at Leeds, when Sir William Bragg was Cavendish professor of physics there, and he became an honorary fellow of that University in 1913. While at Leeds, he continued to work on the ionization of gases by charged particles, and on secondary radiation, then known as 'delta' rays. Soon after the outbreak of the First World War, he joined the staff of the National Physical Laboratory, and was associated with the late Sir Clifford Paterson in investigating the mechanism of the spark discharge produced by plugs for internal combustion engines, which work was described in a number of confidential reports to the Advisory Committee for Aeronautics.

In 1919 Campbell joined the staff of the research laboratories of The General Electric Co., Ltd., which Paterson had undertaken to organise. As an original member of this staff he took a prominent part in establishing those features necessary to assure free-

dom to the research worker in an industrial organisation; and for many years he was consulted by his colleagues on a wide variety of matters, in which his strikingly original approach was at all times an example and a stimulus.

One characteristic of his scientific work (his willingness to modify conclusions) is illustrated by a series of papers on "The Clean-up of Gases in the Electric Discharge" (published in the *Philosophical Magazine* in the early twenties), though they form only a small fraction of his work between 1919 and 1948. He worked on photo-electric photometry and colour matching, the standardization and theory of photo-electric cells, statistical problems, the adjustment of observations, and (returning, in collaboration with Francis and James, to the theory of random phenomena, the foundations of which he had laid thirty years earlier) the production of 'noise' in thermionic valves and circuits.

In addition to the eighty-eight papers recording this work, Campbell published nine books, of which his "Modern Electrical Theory", "Physics, the Elements" and "Measurement and Calculation" are the most typical of his clarity, his scientific philosophy, and his ability to provoke reconsideration of fundamentals. The acknowledgment, in the preface to his "Physics", to "my masters, Henri Poincaré and Bertrand Russell; but I fear that the latter (at any rate) will think his pupil anything but a credit to him", was entirely characteristic of both the friend and the controversialist. So also was the fact that Campbell undertook the labour of re-writing this large book when the complete original manuscript was lost in the post.

Campbell was a man of the highest principles, and once convinced he was right was uncompromising in his attitude in ethical and scientific discussion. This was apt to lead to controversy—tempered always by readiness to reopen discussions if additional information were provided by his adversary. His chief hobbies were walking and climbing, and he had climbed every Scottish peak over 2,000 ft. He was a delightful companion on these occasions; and he was an excellent host, as those who were fortunate enough to be his guests will well remember.

In 1912 he married Edith Sowerbutts, and they were close companions for nearly forty years; having no children of their own, they adopted a boy and a girl. The last fifteen years of Campbell's life were marred by ill-health, which restricted his physical activities, and he retired in 1944 to their holiday cottage near Lulworth. This was completely destroyed by a bomb later that year, and Mrs. Campbell was severely injured. Ill-health and the loss of their home and nearly all their worldly goods found Campbell still philosophical, logical and unperturbed. The loss of his boy on active service and Mrs. Campbell's death in 1948 he met with great courage, though he was much too deeply attached to them to be unaffected by the loss of their companionship.

Mr. W. Mayhowe Heller

MANY senior members of the British Association, especially those interested in the proceedings and reports of Section L (Educational Science), will learn with regret that one of the first secretaries of the Section, Mr. W. M. Heller, died in Dublin on May 13, at eighty-one years of age. The Section was founded in 1901, with Sir John Gorst, who at

the time was vice-president of Committee of Council of Education, as its first president, and Profs. H. E. Armstrong, John Perry and L. C. Miall and Dr. J. H. Gladstone as vice-presidents. In the previous year Mr. Heller had been appointed senior inspector and head organiser of science instruction by the Commissioners of National Education, Dublin. He held this post until 1923, when he became senior inspector to the Secondary and Technical Branch of the Department of Education of the Free State of Ireland—a post from which he retired in 1933.

In his work up to 1921, Mr. Heller was concerned mainly with primary schools, and he conducted classes for teachers in all parts of Ireland and arranged for the equipment of thousands of schools so that simple instruction in experimental science could be carried out in them. The course of practical work was based upon the Report of a British Association Committee in 1889; and teachers attending training courses had to perform all the experiments themselves. The successful introduction of this kind of instruction into the national schools was followed by the adoption of schemes of practical work in physics and chemistry in the Intermediate or Secondary Schools and by the Department of Agriculture and Technical Instruction.

Mr. Heller was a student of Prof. H. E. Armstrong's at the Central Technical College, now an integral part of the Imperial College of Science and Technology as the City and Guilds College, London. In 1889–92 he was science master at St. Dunstan's College, Catford, where he equipped and organised the science and engineering laboratories in close association with Prof. Armstrong and the headmaster, Mr. C. M. Stuart, the courses of work having the heuristic teaching of scientific method as their basis. Between 1892 and 1900, when he went to Ireland, he was in succession the head of the science side of King's College School, London, inspector and organiser of science under the London School Board, and principal of the Municipal Technical Day School at Birmingham—the first of its kind in Great Britain.

It is a fine tribute to the high regard in which Mr. Heller was held in Ireland, both as pioneer in the

field of scientific instruction and in other cultural associations, that he made Dublin his home for nearly fifty years. His ability as a teacher, kindness as an inspector and complete integrity, secured for him a wide circle of friends all over Eire. As an example of his adaptability to changing circumstances, he was proud to attend classes in Irish when the country became the Irish Free State of Eire.

These cordial relationships were greatly strengthened through his wife, Madame Cosslett-Heller, who for forty years was held in the highest esteem in musical circles as the most notable teacher of singing in Dublin and the founder of the renowned Irish Ladies' Choir. She was married to Mr. Heller in 1895, when he was an inspector and organiser of science under the London School Board; and before they went to Dublin in 1901 she had taken up the study of music at the Guildhall School and also at Paris and Frankfurt. She was a member of the British Association with her husband until her death in 1944 after fifty years of loving comradeship.

When Mr. Heller was president of Section L at the York Meeting in 1932, he had a distressing fall in the reception room of the Association and sustained a hip fracture which partially crippled him for the rest of his life. He had prepared his presidential address on the subject of "The Advancement of Science in Schools: its Magnitude, Direction and Sense"; but on account of his accident he was in hospital on the evening when the address was to have been delivered, and it was read to the Section by his wife, with Dr. Pickard-Cambridge in the chair.

For thirty-one years before this pathetic occasion, Mr. Heller had been an officer of the Section as secretary, recorder and in other capacities, working with enthusiasm to establish and extend active interest in the scientific method of acquiring knowledge through direct observation and experiment and thoughtful inquiry. As a wise and helpful guide, counsellor and friend, his memory is cherished with high regard by all with whom he came in contact, and as a pioneer in the teaching of elementary physics and chemistry his work in Eire remains an abiding monument to a life of loyal service in the field of educational science. R. A. GREGORY

NEWS and VIEWS

National Physical Laboratory:

Sir Charles Darwin, K.B.E., F.R.S.

SIR CHARLES DARWIN, director of the National Physical Laboratory, has announced his intention to retire from public service. He had earlier expressed a desire to be relieved of his duties at the end of last March, and his offer to remain, pending the arrival of his successor, was most gratefully accepted. Sir Charles, grandson of the author of "The Origin of Species", has had a distinguished scientific career at Cambridge, at Manchester under Rutherford until 1914, and at Edinburgh as Tait professor of natural philosophy until 1936, when he became master of Christ's College, Cambridge. In 1938 he was appointed director of the National Physical Laboratory, so he has guided its activities during a period which has been probably the most eventful in its history. Under his leadership, the National Physical Laboratory undertook during the War some

of the scientific work on bomb disposal, Mulberry and Pluto, etc., and to establish a link with the scientific work in the United States Sir Charles went to America in 1940 as director of the Central Scientific Office at Washington. On his return in 1942 he was appointed scientific adviser to the Army Council, returning to full-time work at the Laboratory in 1943.

Since the War, the Laboratory has continued to expand, and Sir Charles's broad interests, particularly in the mathematical and physical fields, are reflected in the additions of a Mathematics Division and an Electronics Section to its wide range of departments. He took a leading part, within the Department of Scientific and Industrial Research, in initiating the inquiry which led to the setting up of the new Mechanical Engineering Research and Hydraulics Research Organisations of that Department. Sir Charles is a well-known and popular figure in scientific circles and at conferences concerned with modern