Obituary.

MR. OLIVER HEAVISIDE, F.R.S.

BY the death of Oliver Heaviside the scientific world loses one of its most original thinkers. He was born in London on May 13, 1850, and his uncle was Sir Charles Wheatstone, the practical founder of modern telegraphy. The Heaviside family were interested in music and telegraphy. His brother Charles, who lived at Torquay, was connected with the musical industry, and his brother, Arthur West Heaviside, was a superintending engineer to the Post Office and one of the pioneers of radio telegraphy.

After leaving school Heaviside obtained a post with the Great Northern Telegraph Co. at Newcastle-on-Tyne, which he held for several years. During this period he communicated papers to the *English Mechanic*, the *Telegraphic Journal* and the *Philosophical Magazine*. These papers are of more than average ability and show great promise. For example, in 1873 he showed that quadruplex telegraphy was a possibility. Unfortunately, in 1874, increasing deafness made him retire from business life and he went to live in Devon. He now devoted himself whole-heartedly to the study of electricity and its applications. He published many papers which gradually became more and more technical and more and more difficult to understand, as it became necessary, in order to avoid repetition, to assume that the reader knew some of the writer's previous work. Consequently he had difficulty in getting them published in the ordinary technical journals. At that period there were few referees competent to understand them. As a rule they suggested that the paper should be cut down. The result was that many necessary mathematical links were left out, and the expert has no easy task to follow the reasoning. Fortunately, several well-known scientific men—in particular Sir Oliver Lodge, Prof. Perry, and Dr. G. F. C. Searle—had noted the advent of a mathematical physicist of superior ability and helped him to get his papers published. He had, however, to run the gauntlet of a good deal of unintelligent criticism, and none of his discoveries received that immediate recognition which their merit deserved.

Heaviside communicated to the Society of Telegraph Engineers (now the Institution of Electrical Engineers) a paper solving the problem of the electrostatic and electromagnetic interference between overhead parallel wires, a problem which has come to the front at the present time. His methods of measuring mutual inductance published in 1887 are of great value in themselves, and, like most of Heaviside's work, have been most fruitful in suggesting extensions to others. He was the first to solve the problem of the high-frequency resistance and inductance of a concentric main. It would probably have remained neglected for many years had not Kelvin given some of his results in his presidential address to the Institution of Electrical Engineers in 1889.

From the practical point of view, Heaviside's most important work was laying the foundation of the modern theory of telephonic transmission; a theory which has proved a veritable gold mine for the practical telephonist. He pointed out that the difficulties which arose in telephony were due to the different attenuations and different velocities of the various component waves which carry the necessary currents. His theory of the distortionless circuit showed clearly the lines on which telephony could be developed. Working on these lines some ten years later, Prof. Michael Pupin in the United States developed his loading coils, and long-distance telephony was born.

In 1891 Heaviside was elected a fellow of the Royal Society. In 1892 his earlier "Electrical Papers" were published in two volumes. The value of his work began then to be realised by electricians. He did perhaps more than any man to show the value of a knowledge of physics and of mathematical theory in the electrical industry. Pupin has said that Heaviside did much "to introduce the living language of physics in place of the sign language of mathematical analysis." Heaviside's pioneering work will always take a leading place in the history of electrical theory.

The first volume of Heaviside's great work on "Electromagnetic Theory" was published in 1893 and the second volume in 1899. His original intention was to publish the third volume in 1904 and the concluding volume in 1910, but this he found impossible, and so published the third and concluding volume in 1912.

Heaviside was the first to give the theory of the steady rectilinear motion of an electron through the ether, a theory which has been developed by others—notably by Searle—with important results. By an electron he simply meant an electric charge. He pointed out many years ago that even if we knew the constitution of the electron we would be a long way from finality. There is no absolute scale of size in the universe. As it is boundless in one way towards the great, it is equally boundless towards the small. He was one of the first to predict the increase of mass of a moving charge when its speed becomes very great. To verify all Heaviside's reasoning and especially to examine the validity of some of his mathematical methods will provide work for many mathematicians and physicists. He strongly resented the contemptuous tone adopted by some mathematicians when referring to his work on divergent and semi-convergent series. He had found them useful in general theory and for computing purposes, and so he naturally considered his critics prejudiced. In June 1902 he wrote the article on the "Theory of the Electric Telegraph" in the "Encyclopædia Britannica." Many theorems given in this article are constantly quoted by the writers of text-books. In particular his description of what is now called the Heaviside layer, by means of which Hertzian waves are supposed to be bent round the earth, is familiar to every radio engineer.

In the later years of his life Heaviside was one whom every electrical engineer delighted to honour. In 1908 he was elected an honorary member of the Institution of Electrical Engineers. When in 1921 the Faraday Medal was founded, it was universally considered most appropriate that Heaviside should be the first Faraday medallist. The president, Mr. J. S. Highfield, went to Torquay and presented it to him in person. He was an honorary Ph.D. of Göttingen, an honorary member of the Literary and Philosophical Society of Manchester and of the American Academy of Arts and Sciences.

For fifty years Heaviside lived practically a hermit's life at Torquay. He was a good correspondent, but very difficult to approach personally. In his later years Dr. and Mrs. Searle of Cambridge were practically his only friends. The Government gave him a civil list pension, and about twenty years ago Mr. Asquith increased it. The Institution of Electrical Engineers took a filial interest in him, and it is gratifying to remember that during the last few years of his life the Institution kept in constant touch with him. In the preface to his "Electrical Papers" he says that the question "Will it pay?" never interested him. He was, he said, mainly actuated by philanthropic motives. Looking back—as he has probably saved the Government of every large civilised country in the world millions of pounds in the costs of their telephone schemes—he was truly a philanthropist. He died at Torquay on Tuesday, February 3, and was buried on Friday, February 6, in the same grave as his father and mother, only relatives and Mr. R. H. Tree, representing the Institution of Electrical Engineers, being present. Thus ended the life of one who has left a record of work which has proved of great value to the world.

A. RUSSELL.

PROF. N. KULCHITSKY.

THE death of Prof. Nicholas Kulchitsky on January 30, at the age of sixty-nine, has removed one of the foremost of Russian histologists. For many years he occupied the chair of histology at the University of Charkov, where he accomplished most of his researches. His methods of fixing and staining tissues are now in universal use—those for smooth muscle are particularly well known. He devoted much attention and made numerous important observations on the distribution of connective tissue in the intestinal tract and other organs. His text-books of histology are standard works and at present are commonly used by Russian medical students. That his work was well known outside his own country is shown by the fact that he was an honorary member of the Anatomical Society of Great Britain and Ireland.

Prof. Kulchitsky was a man of wide interests and sympathies. He responded whole-heartedly to the request of his government for his expert assistance in the work of the Ministry of Education, and for a number of years he held the post of administrator of education in the Charkov district and later in the Petrograd district. During the period just before the first revolution he held the post of Minister of Education. During the period of upheaval he suffered severely from the hardships attending revolution and counter-revolution: in order to maintain his family and himself he was reduced to hard manual labour. That he was able to live through these hardships, at his advanced age, is evidence of his characteristic power for hard work and perseverance. At length he was fortunate enough to embark on a British refugee ship together with remnants of Wrangel's forces, and this brought him to London, where he found shelter and opportunities for continuing his scientific endeavours.

During the brief time of less than three years, as lecturer in the Department of Histology at University College, London, Kulchitsky was largely concerned with the teaching of students, but he also completed several important and significant researches. Not the least of these is that in which he showed that voluntary muscles are supplied by both medullated and sympathetic nerve fibres, the former being attached to the large muscle fibres, whilst the latter supply small muscle fibres. These facts led to the physiological and clinical investigations of the late Prof. Hunter, who showed that the smaller fibres are responsible for the maintenance of tone in voluntary muscles. The work has found important applications in the operation of dividing the sympathetic nerves supplying the muscles affected in cases of spastic paraplegia.

Prof. Kulchitsky and Prof. J. I. Hunter were associated in their work, and it is indeed a sad coincidence that the untimely death of young Prof. Hunter should so soon have been followed by the unfortunate accident, a fall down an elevator shaft at University College, which led to the death of Prof. Kulchitsky.

The loss of Prof. Kulchitsky is deeply mourned by all his associates and friends at University College and by the scientific world in general. G. V. A.

DR. DAVID B. SPOONER.

THE Archæological Department of the Indian Government has suffered a heavy loss by the death at Agra on January 30 of Dr. David B. Spooner, who had been Deputy Director-General of Archæology in India since 1919 and had acted on one occasion as head of the Survey during Sir John Marshall's absence on leave. Dr. Spooner's connexion with the Department commenced at the opening of the present century, and there can be no doubt that by his own efforts and achievements he did much towards giving practical effect to the policy of conservation and research inaugurated by Lord Curzon in 1902. Up to that date, official efforts to preserve the monuments of past ages and to investigate the hidden remains of antiquity were "spasmodic, desultory, unscientific and planned on a penurious scale." With the appointment of a Director-General of Archæology and a staff of able assistants, among whom Dr. Spooner was deservedly considered one of the most capable, there began that enormous development of historical and archæological study which has been one of the most striking features of the twentieth century in India.

Dr. Spooner did excellent work as Superintendent of the difficult Frontier Circle; but his name is more likely to be remembered in connexion with his excavations at Pataliputra, now known as Patna, the ancient capital of the Maurya dynasty of Magadha, and with the somewhat startling theory which he advanced as to the origin of the family of Chandragupta and his successors. The fact that the palace of the Mauryas, discovered near the modern village of Kumrahar, was almost certainly designed in imitation of the Persian palace at Persepolis, together with other traces of Iranian influence upon the practice of the Mauryan court, led Dr. Spooner to assert that Chandragupta and his successors were of Persian origin. This theory, which he published in the Journal of the Royal Asiatic Society, has been accepted by no one except, possibly, certain Parsi scholars, who were naturally gratified at the idea of a "Zoroastrian period" of Indian history. But while no one disputes the fact that Persian institu-