

a modern university. It was not until 1926 that Childs' work was crowned by the grant of university independence to the college at Reading. But the opening of Wantage Hall, which symbolized his most significant contribution to the idea of a modern university, was probably the event in his career from which he derived the greatest pleasure, and it is the event which comes first to the memory of some, at least, of his associates on the morrow of his death.

F. M. STENTON.

### Prof. A. E. Kennelly

WE regret to report the death on June 18 of Prof. Arthur Edwin Kennelly, emeritus professor of electrical engineering both at Harvard University and at the Massachusetts Institute of Technology. He had laboured for many years enthusiastically and successfully to further the interests of humanity by lightening manual and mental drudgery and promoting international co-operation for the interests of all. His work led him to associate with experimental and theoretical physicists, with mathematicians, inventors and engineers.

Kennelly was born at Bombay in India in June 1861 of British parentage. He was educated at private schools in Scotland, France and Belgium, and for four years at University College School, London. His first post was that of assistant secretary of the Society of Telegraph Engineers of London (now the Institution of Electrical Engineers). In 1876 he was a telegraph operator in England with the Eastern Telegraph Co. and in 1878 he was an electrician in Malta. In 1881 he was chief electrician in a cable engineering ship. In 1887 he went to the United States and became the principal electrical assistant to Thomas A. Edison, which position he held until 1894. In 1893 he was in addition consulting electrician to the Edison General Electric Co. (now the General Electric Co. of New York).

In 1902 Kennelly was appointed professor of electrical engineering at Harvard University and occupied that chair until his retirement as emeritus professor in 1930. During the years 1913-24 he was professor of electrical engineering at the Massachusetts Institute of Technology, being appointed emeritus professor of that Institute also.

From 1894 until 1902 he was in partnership with E. J. Houston, the firm acting as consulting engineers. He was president of several societies, including the American Institute of Electrical Engineers, and the Illuminating Engineering Society during the early years of that organization. He was also president of the Metric Association.

In the international field, Kennelly's services have been of the highest distinction. He was a United States delegate to the Electrical Congresses of 1900, of 1904, where he carried out the onerous duties of general secretary, and in 1932. He was also delegate to the International Radio Conferences in Paris in 1921 and in Washington in 1927, where allocations of radio transmission frequencies were made to the nations of the world. He was a member of the International Committee of Weights and Measures

and attended the meeting at Sévres in 1933. During the year 1921-22 he represented seven co-operating American universities as first 'exchange' professor in engineering and applied science at several French universities. In 1931 he gave a series of lectures in Japan under the Iwaware Foundation. He has published many books and is the author of more than 350 papers, many of which were presented before scientific organizations at home and abroad. He was unflinching in his attendance at committee meetings and was the chairman of the committee on electrical definitions which has done very useful work.

In 1900, Kennelly was very interested in the progress made by Lodge, Fleming and Marconi in wireless transmission. When many mathematicians were proving that the transmission of wireless waves round the curvature of the earth was a physical impossibility, Marconi transmitted waves from Poldhu in Cornwall to Newfoundland. Kennelly, on March 15, 1902, was led to believe that the wireless waves were reflected by some kind of cloud producing a 'mirror' effect which bent the waves round the earth's surface. Kennelly and Heaviside both thought of a reflecting layer of ionized gas which could reflect the rays. This layer has since been called the Kennelly-Heaviside layer.

In 1924 Appleton demonstrated the real existence of a 'mirror' layer. The regular variation in reception, as the wave-length was changed, proved its existence, and later experiments proved that there was more than one reflecting layer in the atmosphere.

One of the most useful mathematical methods popularized by Kennelly was the use of Argand's method of using complex numbers to aid computers, thus saving much arithmetical labour. In April 1893 in a paper published by the A.I.E.E. under the title "Impedance", he applied complex quantities to technology and to the extension of Ohm's law to alternating current theory. He calls the inductance multiplied by  $2\pi$  times the frequency, the "inductance speed". The impedance is therefore the geometrical or vector sum of the resistance and the inductance speed. We thus find what is often called the Ohm's law for alternating currents, which simplifies the everyday theory of the practical electrician. The impedance of inductive coils in series is readily determined, and when two or more inductive coils are in parallel the component currents are easily found. This can be done both graphically and algebraically. In the latter case, the solutions are expressed in terms of hyperbolic functions, which in the absence of tables are sometimes very laborious to compute. He therefore edited charts and tables of hyperbolic functions to several decimal places, for which there has been a great demand by practical electricians all over the world, as by the use of the tables and charts there is a great saving in the time taken by computers, and the accuracy required nowadays is much greater than that required thirty years ago. They are much used in long-distance telegraphy and telephony.

Kennelly was very popular with his old students, who used to go from all parts of the world to study under him. I remember that before the Great War

I sent one of my students who was a graduate of London to do research under Kennelly. He often wrote saying how kind the professor was to him, having him to his house every week and going for a picnic into the country on holidays. Unfortunately, war broke out and he returned to join the army and paid the great sacrifice. I communicated the sad news to Prof. Kennelly and received a long letter back telling how popular the student was at Harvard, and how he took a leading part in all their sports and how they would ever remember him. They placed a memorial at Harvard.

By all who knew him, Kennelly will be sadly missed, but it is pleasant to remember that to him it was given to have a long and useful life spent in the service of his fellow men.

A. RUSSELL.

WE regret to announce the following deaths:

Prof. J. Grinnell, professor of zoology and director of the Museum of Vertebrate Zoology in the University of California, on May 29, aged sixty-two years.

Mr. F. W. Jones, O.B.E., known for his work on the chemistry of explosives, on June 24, aged seventy-two years.

Dr. Witmer Stone, emeritus director of the Academy of Natural Sciences of Philadelphia, on May 23, aged seventy-two years.

Prof. A. E. Wells, professor of metallurgy in Harvard University during 1926-31, on May 24, aged fifty-five years.

Prof. J. E. Woodman, emeritus professor of geology, in New York University, on May 19, aged sixty-five years.

## NEWS AND VIEWS

### Prof. V. Gordon Childe

PROF. V. GORDON CHILDE, whose election as an honorary member of the Prehistoric Society of Switzerland in recognition of his services to prehistoric archaeology is announced, has been professor of prehistoric archaeology in the University of Edinburgh since 1927. This chair, which he is the first to hold, was founded in memory of the late Lord Abercromby, himself distinguished as a pioneer in study of the Bronze Age in Europe. Prof. Childe, who is an Australian by birth, has travelled extensively in Greece, the Balkans, central Europe, and the East. His early visits to eastern European sites strongly influenced the line of his development in archaeological thought, leading him to appreciate, more fully, perhaps, than had been done by archaeologists previously, the importance of the Danube Valley and adjacent regions as a key position in the study of European prehistory. During his tenure of the chair in Edinburgh, Prof. Childe has not only been active in promoting general interest in archaeological studies in Scotland, but he has also taken a leading part in the organization of field research on Scottish sites. Of his own work in the field, the excavation of the stone age village settlement of Skara Brae in the Orkneys ranks as the most remarkable revelation of a complete prehistoric cultural unit which has yet been made in Northern Europe. His contributions to the literature of prehistoric archaeology are all remarkable for their grasp of detail, combined with an unusual breadth of view in tracing the general trends of development, as well as for insight into the interplay of the underlying forces, especially such as belong to the field of prehistoric economics.

### Newton's Correspondence

THE Royal Society has formed a committee for the purpose of collecting and publishing the whole of the correspondence of Sir Isaac Newton. It is

hoped that a substantial part of the work will be completed and that some of the volumes will be issued by the time of the celebration of the tercentenary of Newton's birth in 1942. The members of the committee are as follows: Sir Charles Sherrington (chairman), Prof. E. N. da C. Andrade, Prof. G. N. Clark, Sir William Dampier, Sir Arthur Eddington, Sir Thomas Heath, Dr. H. Spencer Jones, the Librarian of Trinity College (Mr. Adams) and Prof. H. C. Plummer. The Council invited Prof. Plummer to be the editor of the correspondence and he has accepted this great responsibility. It is hoped to obtain the co-operation of all librarians in the various libraries of America and of Europe, and notifications of any original letters appertaining to Newton in their collections should be sent to the Assistant Secretary of the Royal Society, Burlington House, London, W.1.

### Malaya and India: Early Cultural Relations

CONFIRMATION of a conclusion, which ran counter to generally accepted opinion, as to the archaeological possibilities of Malaya in the study of early cultural development in south-eastern Asia, has been afforded by the results of a fourteen months' archaeological investigation undertaken by the Greater India Research Committee during 1937-38. Excavations were carried out in Kedah, Perak and Johore under the field direction of Dr. H. G. Quaritch Wales, by whom the results have been described recently (*Illustrated London News*, June 24), and with the financial assistance of the Governments of the States interested. The most extensive and important of the excavations were in Kedah, some thirty sites, ranging in date from the fourth to the thirteenth century of our era, being thoroughly examined. The earliest remains are scattered and do not suggest any very large settlement before the sixth century. The oldest site found was on an isolated hill on the Sala River, some twenty miles north of Kedah Peak. Here was