will the conscious human turn his unique power of understanding upon himself, both as an individual and as part of a social mechanism?

Faith and method joined to imagination and curiosity still lead us on. Science is the greatest inciter of hope that we know—rational hope that the triumphant methods that have given us deeper understanding and increased efficiency as biological and social mechanisms will one day give us a still deeper insight into who and what we are and what we may become when rational control is extended. As in art and religion so in science—new meanings evolve as the mind continues its unshackling process. The eternal is not brought down from aloft only: it is also sought out and raised up among men. Science is one way of acquiring a knowledge of meanings or of adapting or inventing meanings that give deep human satisfaction —for a time.

OBITUARY

ARTHUR EDWIN KENNELLY

WITH the death on June 18 of Dr. Arthur E. Kennelly, professor emeritus of electrical engineering at Harvard University and the Massachusetts Institute of Technology, electrical engineering lost one of the pioneers who began his professional work when the only practical application of electricity was its use in simple telegraph circuits, but who lived to see the art reach its present highly developed form. His unusual ability, his industry, his gifted personality and his many important contributions to the development of electrical engineering gave him international recognition as a scientist and a teacher. His career was contemporaneous with those other great contributors to electrical engineering such as Heaviside, Edison, Steinmetz, Elihu Thomson, Sprague, Houston, Brush, with all of whom he was more or less closely associated in his professional work.

Dr. Kennelly was born at Colaba, near Bombay, India, on December 17, 1861, his parents being David Joseph Kennelly and Katherine Heycock Kennelly. He was educated in private schools in Great Britain, France and Belgium, and especially at the University College School, London. He was definitely attracted to a telegraph engineering career by attending a public lecture in 1874 at Albert Hall, London, by Mr. Latimer Clark on "Submarine Telegraphy." In 1875, at the age of 14, he was appointed assistant secretary to the Society of Telegraph Engineers (later the I. E. E.), London. In 1876 he entered the submarine cable service of the Eastern Telegraph Company and for several years was engaged in the laying and repairing of submarine cables between England and India, rising to the position of senior electrical engineer in 1886. In 1887 he became associated with Thomas A. Edison in his electrical laboratory at Orange, N. J., remaining his principal electrical assistant until 1894. In 1893 he was made consulting electrician to the Edison General Electric Company and the General Electric Company of New York. From 1894 to 1901 he was a member of the firm of "Houston and Kennelly," consulting engineers. In 1902 he was engineer in charge of laying a submarine telegraph cable for the Mexican Government from Vera Cruz to Campeche. The same year he was appointed professor of electrical engineering at Harvard University, which position he held until 1930, when he retired as professor emeritus. He was also professor of communication engineering and director of electrical engineering research at the Massachusetts Institute of Technology from 1913 to 1923, becoming professor emeritus in 1930.

In 1903 he married Julia Grice, of Philadelphia, who died early in 1935. A son, Reginald Grice, a chemist, of Springfield, Massachusetts, survives.

During 1918 Dr. Kennelly was a civilian liaison officer for the Signal Corps for the U. S. Army in France. He was chosen as the first exchange professor in engineering and applied science at French universities from seven cooperating American universities. Also, he was the first Iwadare lecturer to Japanese universities (1931).

Dr. Kennelly has been honored by many professional and scientific societies and has been the recipient of several medals and similar honors. Space permits the mentioning of only a few.

He served two terms (1898 to 1900) as president of the American Institute of Electrical Engineers, in 1911 was president of the Illuminating Engineering Society, and in 1916 was president of the Institute of Radio Engineers. He held either active or honorary membership in the American Institute of Electrical Engineers, the British Institute of Electrical Engineers, Société Française des Electriciens, Royal Astronomical Society, American Association for the Advancement of Science, the German Elektrotechnische Verein, the National Academy of Science, the Japanese Institute of Electrical Engineers, the American Academy of Arts and Sciences, of which he was vice-president, and many others. In 1935 he was honorary president of Union Radio Scientifique Internationale and in 1938–1940 he was vice-president of the Edison Pioneers.

Among the several awards accorded him were the Edward Longstreth Medal and the Howard Potts Medal of the Franklin Institute, for electrical research; the medal from the Société Industrielle de l'Est; the

Cross of Chevalier de la Légion d'Honneur from the French Republic; the annual medal of the Institute of Radio Engineers; the Edison Medal of the American Institute of Electrical Engineers; the Mascart Triennial Medal of the Société Française des Electriciens. He was a member of Tau Beta Pi.

In 1895 he received the honorary degree of doctor of science from the University of Pittsburgh; in 1906 the honorary degree of master of arts from Harvard University, and in 1922 was made doctor of the Faculty of Science, University of Toulouse, France. In 1936 he received the honorary degree of doctor of engineering from the Technische Hochschule of Darmstadt, Germany, on the occasion of the centenary celebration of that Hochschule. In 1939 he was elected a member of the Royal Swedish Academy of Sciences.

One of his chief contributions to applied science is a paper on "Impedance" presented in 1893 before the American Institute of Electrical Engineers. This was the first publication of the extension of Ohm's law to the complex plane and is the basis of the application of complex quantities to alternating-current circuit analysis. Another of his outstanding contributions is the application of hyperbolic functions to the solution of electrical-engineering problems. In 1891 Heaviside had given in terms of hyperbolic functions the fundamental steady-state equations for potential and current along a line, but in alternating-current cases he showed only lengthy scalar methods for their solution. In 1894 Dr. Kennelly gave the first solution in terms of complex hyperbolic functions and at the same time introduced the polar notation for complex quantities, which has come into extensive use. He has since expanded the use of complex hyperbolic angles to alternating-current lines, such, for example, as expressing the equivalent Π or T of a smooth line in terms of a complex angle θ and two other quantities. His publications, including tables of complex hyperbolic functions and charts, have long been in extensive use for the solution of line problems, by both students and practising engineers. Early in his career he developed an electrical method of localizing faults in submarine cables by varying the current strength, and he also originated the center of gravity method for loads on electric circuits. In illumination, he developed a diagram, known by his name, for determining the mean spherical candlepower of a lamp from its zonal distribution curve without the use of a planimeter.

In March, 1902, Dr. Kennelly advanced the theory that the conducting properties of the ionized rarefied upper atmosphere might reflect back electromagnetic waves, and later in the same year Heaviside also offered the same theory. This theory has been verified experimentally, and the reflecting upper atmosphere has become known as the Kennelly-Heaviside layer. In 1912, he worked out jointly with Dr. G. W. Pierce the motional impedance circle for a telephone receiver. This discovery is highly important, as it gives a method for evaluating the performance of a telephone receiver and the method is applicable to other vibrating apparatus having an electromechanical system.

Dr. Kennelly has published some twenty-eight books of which he is the sole author of ten. Among these are "Wireless Telegraphy and Telephony," "The Application of Hyperbolic Functions to Electrical Engineering Problems," "Chart Atlas of Complex Hyperbolic and Circular Functions," "Electrical Vibration Instruments," "Electric Lines and Nets." In addition he was the author of over three hundred and fifty technical publications.

Realizing the many advantages of the international metric system, as past president of the American Metric Society and after 1915 as officer of the Metric Association, he worked arduously to effect the adoption of the system in the United States; as a result it has already been adopted in many industries and laboratories, and has come to be used in athletic events.

He was always deeply interested in electrical units and standards. He was secretary of the Standards Committee of the American Institute of Electrical Engineers at its inception, and later became the chairman; likewise, at its inception in 1908, he was secretary of the U. S. National Committee of the International Electrotechnical Commission (I.E.C.), at one time was president and in 1938 was made honorary president. The I.E.C. always was one of his deepest interests and most continuous activities. In 1932 he was United States delegate and "chef de délégation" from the United States to the Paris Congress. On several occasions he was a delegate to international conferences on electrical units and standards and he assisted materially in the devising of the Meter-Kilogram-Second (MKS) system of electrical units which has recently been adopted internationally. At one time he was also chairman of the Sectional Committee of Definitions of the American Standards Association. For a number of years he was a member of the National Research Council, to whose work he made many valuable contributions.

He was deeply devoted to electrical engineering and its allied subjects and worked indefatigably for their advancement. To him this was not only a vocation, but in a large measure it was his recreation as well. His extensive contributions were made possible only by long hours of work and by planning and using his time with a high degree of efficiency.

The many who knew Dr. Kennelly were impressed by his versatility and resourcefulness and his breadth of interests. For example, in 1929 he presented a paper, "Meteorological Units Adopted by Various Countries." Also he has shown (1929) that an approximate law of fatigue underlies all the world's

racing animals (and human beings) such that all the series of events plot as substantially parallel straight lines on logarithm paper. The writer has heard him give a lecture on Macaulay, the historian, that would do credit to an arts professor. He was also a natural linguist and could converse fluently in French, German and Italian.

He was an excellent teacher as well as investigator and scientist. He not only had a clear conception of the intricate relations that often exist in electrical circuits, but he was able to present them in direct and simplified form that is characteristic of the good teacher. He was held in the highest esteem by students and colleagues alike, and at all times was most congenial and courteous. The hospitality of Dr. and Mrs. Kennelly to students and the younger members of the instructing staff was long a tradition at Harvard.

Nothing was more delightful than an informal conversation with him, for he had a wealth of the most interesting experiences from which to draw, and the quiet humor that was always innate in him would inevitably come to the surface. He was a most interesting and resourceful speaker and his services as such were always in great demand, both in the United States and abroad.

When he retired as professor emeritus in 1930 his eyesight had begun to fail, and although operations served to prolong it, during the last year or two of his life he could barely distinguish even large objects. However, in spite of this and of rapidly failing health, he pluckily refused to give up the work to which his life had been devoted. Assisted by a chauffeur, he went regularly to his office each morning, and with the assistance of a secretary attended the considerable correspondence and other matters that came to him. Current technical literature, frequently in foreign languages, was read to him. At times a graduate student in electrical engineering assisted him in interpreting and making drawings, which he was unable to do himself because of his eyesight. It was under such difficulties that he wrote several recent papers dealing largely with electrical units and systems, particularly the MKS system. He continued thus to carry on until stricken down in his last illness. With the passing of Dr. Kennelly the world has lost a great scientist, teacher, scholar and gentleman.

CHESTER L. DAWES

SCIENTIFIC EVENTS

PUBLIC HEALTH IN GERMANY IN 1938

THE Berlin correspondent of the *Journal* of the American Medical Association states that the report of the Public Health Service contains information regarding public welfare. Of those intending to marry, 47 per cent. made use of public consultations (36 per cent. in 1937). Of these, 38 per cent. received a marital loan, that is to say an addition to the expenses incidental to getting established. Maternity advice was sought by 6 per cent. of pregnant women. Infant welfare stations were available to the public in the ratio of one for seventy-seven infants born and were actually consulted on the average by sixty mothers per station. Consultation for pre-school children was offered in the proportion of 718 per hundred thousand inhabitants. More than 3,000,000 children of school age received attention, that is, about 4,545 per hundred thousand inhabitants. The schools of almost all districts, with few exceptions, were furnished dental supervision.

The care of tuberculous patients was extended during 1938. About 1,500,000 patients, against 1,250,000 in 1937, received attention. The number of roentgen treatments rose from about 1,250,000 to about 1,750,000. Hospitalization in public institutions increased from 45,000 to 49,000. Average x-ray examinations were 100 to thirteen patients. Somewhat greater facilities were provided for the treatment of venereal diseases, but the number of individual cases decreased (192,000 in 1938 against 200,000 in 1937). Consultation stations for cripples were increased and, on the average, 242 persons were advised per hundred thousand inhabitants. The increase in stations for alcoholic persons is more than counterbalanced by the decrease of the individual's consulting. However, other agencies not identical with these cooperated in the care for alcoholic patients, and their reports are not included in these figures. About 107,000 persons with psychic troubles were advised against 91,000 in 1937. The care for the infirm and aged is likewise organized according to regions. It is pointed out that these facts should not be regarded as completely evaluating the achievements of public health welfare in Germany, because there are other agencies besides the official health stations connected with public health bureaus.

THE HALL OF MAN AT THE WORLD'S FAIR

THE American Museum of Health, which has offices at 30 Rockefeller Plaza, New York City, and a series of exhibits at the World's Fair, will have, according to *Museum News,* the cooperation of Mayor La Guardia in the endeavor to acquire a permanent building for the museum at the close of the fair. At the dedication ceremonies of the museum on the Theme Plaza of the fair on June 17 the mayor announced that he had in mind to assign for this purpose the court house building now occupied by the Appellate