for all time a standard work on the subject of East African big game. The volume contains an introduction by Sir Sidney Harmer, and in addition to the chapters on elephants, giraffes, rhinoceroses, buffaloes and hippopotamuses, also has an interesting appendix on the ancestry of the African elephant, and the relationship of primitive elephants to primitive man. The volume concludes with a chapter on some of Maxwell's experiences in hunting elephants in India. This *édition de luxe* was followed a year later by a somewhat smaller and cheaper volume containing the same text and illustrations.

Always seeking after new experiences, in 1925 Marius Maxwell visited the Birunga Mountains north-east of Lake Kivu, in the Eastern Belgian Congo, to study and photograph the Eastern gorilla. He was accompanied by Mr. J. H. Barnes, the well-known white hunter, who had been with him on his two previous trips in Kenya Colony. Although not having very great luck in photographing the gorilla itself, he took some very interesting photographs of the gorilla forests, of their sleeping platforms and of gorilla shelters. Further, he secured a unique snapshot of a female gorilla carrying on her back a young one; this, I think, is the only pictorial record of this method of juvenile transport in this species.

Maxwell had graduated at Zurich and took up the profession of engineering, specializing in the machinery concerned with the manufacture of cane-sugar, and he erected many sugar factories in India. Latterly, he had interested himself in coffee-farming, and lived on a large estate at Thika Bridge in Kenya Colony. He married in 1929 Miss Winifred Ramsay.

GUY DOLLMAN.

Lieut.-Colonel Robert Knowles, C.I.E.

IT is no exaggeration to say that tropical medicine has sustained a grievous loss through the early decease, on August 3 at fifty-two years of age, of Robert Knowles after a brave struggle with prolonged ill-health, aggravated by exceptionally hard work which a keen sense of duty would not allow him to relax.

After completing his medical studies at Cambridge and St. Mary's Hospital, Knowles took the first place at his entrance into the Indian Medical Service in 1908 in its palmiest days, and, after some years in military employ, obtained his first opportunities for research under favourable conditions at the Kasauli Institute. Here he began a happy and successful collaboration with his friend, H. W. Acton, and they made important contributions on the subject of snake venoms. Here he also commenced his fruitful work on protozoology in connexion with the halteridium. After the interruption caused by the Great War, when he was severely wounded in Mesopotamia, he took charge of the recently founded Pasteur Research Institute in the beautiful hill station of Assam at Shillong, where his energies and organizing ability found ample scope, and where he commenced his important investigations on kala-azar.

When Sir Leonard Rogers had to return home a few months before he had completed the organization of the Calcutta School of Tropical Medicine, he asked that Knowles should succeed him, and once more he was an outstanding success, and soon became professor of protozoology, with his friend Acton as professor of bacteriology, and during the next sixteen years his work there can only be described as most remarkable. His most outstanding discovery was the demonstration, with the aid of L. E. Napier and R. O. A. Smith, that the sand-fly, *Phlebotomus argentipes*, was the long sought-for carrier of the infection of kala-azar. Later he did valuable work on a parasite of monkey malaria called *Plasmodium knowlesi* after him.

Knowles was equally distinguished for his medico-literary work, and was a clear and prolific writer, his work on medical protozoology being of exceptional merit, and those with Acton on the dysenteries of India, and with S. White on malarial literature in India were of great value. First as assistant editor with Sir John Megaw, and later as editor of the *Indian Medical Gazette*, he raised its standard and contributed invaluable summaries of the advances during each year, at the compilation of which he was a master.

Knowles's short, thickset figure, abounding in energy and enthusiasm, combined with the unselfish and cheerful manner in which he always found time to help any of his colleagues, British or Indian, makes his early loss quite irreparable to his innumerable friends.

Dr. W. F. Sheppard

DR. W. F. SHEPPARD, late assistant secretary, Board of Education, died on October 12 in his seventy-third year. He went up to Trinity College, Cambridge, was Senior Wrangler in 1884 (Parts I and II) and was placed in Division I of Part III in 1885. He was elected a fellow of Trinity in 1887. For these particulars we are indebted to the obituary in *The Times*.

The name of Sheppard is well known to mathematical statisticians. In 1898 he published in the *Phil. Trans.* (A, **192**, 101) a memoir "On the Application of the Theory of Error to Cases of Normal Distribution and Normal Correlation", in which the theory is developed by very elegant geometrical methods. It was in this memoir that he gave the noteworthy theorem, that if a fourfold table is formed from a normal correlation table by division at the medians, the coefficient of correlation r is given by

$$r = \cos\left(1 - \frac{2n}{N}\right)\pi,$$

where n is the frequency in either of the positive quadrants.

Much of Dr. Sheppard's work, in the *Proceedings of the London Mathematical Society* and elsewhere, was concerned with the method of finite differences and its applications. By this method he derived the well-known 'Sheppard's corrections' for determining

more accurately the moments of a grouped frequency distribution (*Proc. Math. Soc.*, **29**, and *Biometrika*, **5**, 1907). For these, and for his tables of the ordinates and integral of the normal curve given in "Tables for Statisticians", his name is known to almost every student of the subject. But his work really covered a considerable range, and we may note, amongst others, papers "On the Statistical Rejection of Extreme Variations" (*Proc. Math. Soc.*, **31**), "On the Use of Auxiliary Curves in Statistics of Continuous Variation" (*J. Stat. Soc.*, **63**, 1900) and on "Graduation by Reduction of Mean Square Error" (*J. Inst. Actuaries*, **48**). Of recent years he does not seem to have written so much on statistical matters, but some time since he made a return to pure mathematics and published through the Oxford Press a small book "From Determinant to Tensor" (1923).

G. UDNY YULE.

News and Views

Nobel Prize for Chemistry: Prof. P. Debye

THE award of the Nobel Prize for chemistry for 1936 to Prof. P. Debye will give great pleasure to his friends everywhere. Debye's contributions to science have been many, and have covered a wide range of subjects, but they all have certain features characteristic of the man who made them. He combines, in a remarkable way, ability in mathematical analysis with a sturdy sense of physical realities, so that he is able to make bold approximations without invalidating the formulæ at which he arrives. His early training as an engineer, followed by his training in theoretical physics under Sommerfeld, must have contributed to this striking combination of qualities. They have been shown equally by his all-important work on specific heats, on dipole moments in gases, and on the theory of strong electrolytes. He has made notable contributions to X-ray analysis, in particular the 'powder-method', the theory of scattering of X-rays by molecules, and the effect of temperature on X-ray diffraction. He is a delightful and inspiring lecturer. All who know him have the double pleasure of seeing the award so appropriately bestowed, and of being able to congratulate a kindly and delightful friend. Prof. Debye received the Royal Society's Rumford Medal in 1930, and in 1933 was elected a foreign member of the Society.

Nobel Prize for Physics: Prof. Victor F. Hess

THE Nobel Prize for physics for 1936 is divided equally between Prof. Victor F. Hess of Innsbruck for his work on cosmic radiation and Dr. C. D. Anderson of Pasadena for his discovery of the positron. It was Prof. Hess's experiments in manned balloons in 1912 which first definitely proved the existence of penetrating rays which enter the earth's atmosphere from outside. This conclusion followed from the discovery that the ionization in a closed ionization chamber at a height of 4,000 metres was greater than at sea-level, and above this increased rapidly. Hess also showed that the ionization due to this new radiation decreased neither during the night nor during an eclipse of the sun, thus showing that the rays cannot come directly from the sun, so long, at any rate, as the rays travel in straight or nearly straight paths. It was this pioneering work of Hess which led to the view that the penetrating rays were really cosmic in origin. In more recent years, Prof. Hess, besides contributing much to the subject of atmospheric electricity, has paid especial attention to the study of the variation of the intensity of the cosmic rays with time. This work demands very accurate measurements over a period of years, since the variations are complicated and small in magnitude. From these and other similar investigations, a small daily variation has been established with certainty, and probably also a quite small variation with sidereal time of the order of 0·1 per cent. The existence of such an effect was predicted by Compton as a consequence of the assumption that the rays had their origin outside the Galactic System, and about the expected variation was found from the measurements of Hess and Steinmaurer. Prof. Hess's work on cosmic rays has extended over a period of more than twenty-five years, and it is with very great pleasure that all workers in this field now see this work receiving its due recognition.

Dr. C. D. Anderson

DR. ANDERSON'S discovery of the positive electron or positron arose also through the study of cosmic radiation. During an investigation of the properties of the rays by means of a cloud chamber in a strong magnetic field, Anderson found certain photographs which revealed the tracks of particles with about the same ionization, and so about the same mass, as electrons, but which were curved by the magnetic field in the direction corresponding to particles with a positive charge. This exceedingly important result was published in 1932 as a short communication to *Science*, in which Dr. Anderson wrote: "For the interpretation of these effects it seems necessary to call upon a positively charged particle having a mass comparable with that of an electron." Thus a new member was added to the select list of fundamental particles. Subsequent work has shown, not only that about half the cosmic ray particles are positrons, but that they are also often produced as one of the partners of pairs of positive and negative electrons, when gamma-rays of high energy are absorbed by matter. These positrons do not live long, as they readily combine with other negative electrons to form more radiation. The discovery of