

have a fuel bill of £355 per day and the 30,000 s.h.p. steam ship £348 per day.

When the contract for the s.s. *Duchess of Bedford* was placed, quotations showed that the cost of a motor ship of similar capacity would have been £100,000 more. The price of coal, oil fuel, and Diesel oil differs at the various ports of the world, and Mr. Johnson illustrated this by a map. He also gave a tabulated statement of the coal and oil deposits of the world as at present estimated.

This showed that whereas the coal deposits are equal to about 4000 or 5000 tons per head of population of the world, the deposits of oil are only equal to about 4 or 5 tons per head. It may be that superintending engineers of shipping companies at the present time are not influenced by these figures, but they have a direct bearing on the interesting question as to whether ocean transport in the future will depend on oil engines or steam engines.

Obituary.

SIR E. RAY LANKESTER, K.C.B., F.R.S.

WITH deep regret we record the death, on Aug. 15, of Sir E. Ray Lankester. For long he was the dominating figure among British zoologists, and he was recognised the world over as a great master in science owing to his achievements in biology and more particularly for his advancement of our knowledge of the morphology of animals. Those who met Lankester could not fail to see in him a man of exceptional intellectual power. His tall and commanding presence, his expressive face, his speech, all contributed to make up an impressive personality.

Edwin Ray Lankester was born in London on May 15, 1847, the eldest son of a well-known physician who became coroner for Central Middlesex. Educated in the classical tradition at St. Paul's School, London, he gained a scholarship at Downing College and went up to Cambridge at the early age of seventeen. Two years later, however, he migrated to the University of Oxford, where he entered Christ Church as a 'junior student'. Here he studied zoology, with his friend Moseley, under Rolleston, the first Linacre professor. Having graduated with first-class honours in natural science, and obtained the Burdett-Coutts scholarship in geology, and later the Radcliffe Travelling Fellowship, Lankester went to Naples in 1870, where he studied marine zoology with his friends Anton Dohrn, the founder of the famous zoological station, and Frank Balfour, the illustrious embryologist.

On his return to Oxford, Lankester was elected fellow and tutor of Exeter College, and began his teaching career. Two years later, in 1874, Lankester was chosen to fill the chair of zoology at University College, London. In 1882 he was appointed to the professorship of natural history in Edinburgh; but, finding the conditions of this post unsuitable, he resigned it within a fortnight, and was welcomed back to London, where he resumed the professorship at University College, which he retained until 1890. This was Lankester's best period, remarkable both for his success as a teacher and for the output of important original researches carried out in his laboratory by himself and his pupils.

In 1890, Lankester succeeded Moseley as Linacre professor of comparative anatomy at Oxford. Here, among his many activities, he greatly improved the laboratory facilities, and added a large modern building to his Department. He also devoted much attention to the reorganisation of the zoo-

logical section of the Museum, and the methods of displaying specimens with an eye to beauty and instruction. Of this experience he made full use when, in 1898, he was appointed Director of the Natural History Departments of the British Museum and Keeper of Zoology at South Kensington. These posts he occupied until his retirement at the age of sixty, in 1907.

Lankester's scientific work extended over the whole field of zoology. There is scarcely a group of animals he did not study, scarcely a problem he did not help to elucidate. Both his parents were cultivated people of intellectual interests. His father was a scientific man of distinction, a fellow of the Royal Society, interested more especially in microscopy, who contributed many papers to the *Quarterly Journal of Microscopical Science*, of which he was co-editor. In the congenial atmosphere of this family circle, where he met Huxley and other eminent men engaged in the controversies of those stirring days over the "Origin of Species", young Ray Lankester must have early developed that love of the wonders and beauties of Nature, that insatiable curiosity to know and understand, which inspired his work and lasted to the end of his career. Indeed, he began writing when a mere boy, and it is characteristic of the man that he never lost his interest in the subjects he took up; his enthusiasm and eagerness for fresh information were not blunted, nor did new interests crowd out old ones from his capacious mind. So we find that his first venture into print is a letter on *Pteraspis* (*Geologist*, 1862), beginning a series of contributions on a remarkable group of fossil fishes, and leading to the writing of the important monograph on "The Cephalaspidae", published by the Palæontographical Society in 1868-70. This work is recognised as a classic on the subject. In 1863 appeared a note on the Gregarinidæ (*Quar. Jour. Mic. Sci.*, vol. 3), the prelude to a series of researches on parasitic Protozoa that won him a place of honour in the history of protozoology and parasitology.

The Protozoa had a peculiar fascination for Lankester, who was an expert in microscopy. Later in life he did much to promote the study of parasitic Protozoa in relation to disease at home and abroad, and the success of Minchin and others in this field owed much to his encouragement.

Lankester was only seventeen years of age when he wrote his first paper on the anatomy of the earth-worm (*Quar. Jour. Mic. Sci.*, vol. 4, 1864); this

animal, he was fond of saying, is the rock on which morphology is built. From such observations he was later led to the study of the body-cavities of animals, and finally established that, while the body-cavity of annelids and vertebrates is the coelom, in molluscs and arthropods it is of a different nature and filled with blood. This and other contributions made by Lankester have helped greatly in the clearing up of obscurities and the elucidation of many important points in the general morphology of various groups of Invertebrata, thereby laying bare their true phylogenetic relationships.

The masterly memoir entitled "Limulus, an Arachnid" (*Quar. Jour. Mic. Sci.*, 1881) is a triumph of Lankester's method, whereby he first proved the close affinity of this remarkable creature, known as the King crab, to the scorpion and not to the Crustacea as hitherto supposed. Another important line of research dealt with the development of molluscs; the memoir which followed (on "The Embryology and Classification of the Animal Kingdom", *Quar. Jour. Mic. Sci.*, 1877) contained many new and fruitful conclusions, and had a great and lasting influence on the science of embryology. His work on *Amphioxus*, and especially on its development, in collaboration with his pupil, A. Willey, also deserves special mention. On quite other lines were his pioneer researches on the pigments of animals, and his later work on flint implements. These are but a few of the subjects he studied.

In addition to these special papers Lankester wrote many works of a more general character. The articles he contributed to the "Encyclopædia Britannica", on Protozoa, Hydrozoa, Mollusca, Arachnida, Polyzoa, and general zoology, are masterpieces of scientific exposition; also his introductions to some of the volumes of the well-known "Treatise on Zoology", of which he was editor. Among his more popular, but not less excellent books, may be mentioned "Comparative Longevity" (1871), "Degeneration" (1880), "The Advancement of Science" (1889), "The Kingdom of Man" (1907), "Science from an Easy Chair" (1910), and "Great Things and Small" (1923).

It was in 1869 that Lankester, who had just graduated at Oxford, became co-editor with his father of the *Quarterly Journal of Microscopical Science*. Under his able sole editorship from 1878 until 1920 it became the leading British journal of scientific zoology.

The lasting value of Lankester's work depended, perhaps, most on the soundness of his judgment. In matters of morphology especially, a sound judgment, based on a broad foundation of accurate knowledge, a wide outlook combined with a well-trained and alert imagination, are necessary for success, and these are just the qualifications Lankester possessed. Eager as he was to hear of new discoveries, he was not easily led astray by the extravagant praise of some new theory. He delighted to share his knowledge with others, and to rouse in them the interest he so deeply felt. Hence he was a great teacher. In the simplest

language he could give vivid descriptions or lucid explanations; with impressive mastery he could marshal the evidence and develop his argument. But perhaps his most precious gift was his power of selecting the essential, of picking out the important and discarding the unimportant. Neither in conversation nor in lecture were his statements obscured by irrelevant detail. He delivered inspiring lectures spontaneously, often without notes of any kind, trusting to his memory, to the specimens on the table, and the diagrams on the wall. He would illustrate them by skilfully executed drawings in coloured chalks on the blackboard.

Always ready to help and advise colleagues or pupils, Lankester took the keenest interest in their work. When consulted he never seemed at a loss for a helpful suggestion or an appropriate comparison drawn from his vast store of well-ordered knowledge. To any sincere inquirer he gave unselfishly of his best; those who worked with him owed much to his inspiration, for which he claimed no credit. But he never forced his opinions on them, and allowed them free choice to pursue their own lines of research.

Lankester's services to the cause of protozoology and medicine have already been mentioned. Even more has zoological science in Great Britain benefited by his help in the foundation of the Marine Biological Association and the erection of its Laboratory at Plymouth. For long he took an active interest in its welfare, and the proud position this laboratory now holds as a centre of biological research is largely due to him.

The reputation of Ray Lankester at home and abroad was great. Elected a fellow of the Royal Society so early as 1875, he was awarded the Royal Medal ten years later and the Copley Medal in 1913. From the Linnean Society he received the Darwin-Wallace Medal and the Gold Medal. A knighthood was conferred on him on his retirement from the British Museum. He received many honours from universities at home, and from numerous learned societies on the Continent and in America.

Lankester was a man of strong feelings, which he did not hesitate to express. Any form of sham, fraud, or injustice roused his anger, and his impetuous temperament sometimes led him into difficulties, even injured his worldly prospects. But he had high ideals and a kind heart. His many interests, artistic and literary as well as scientific, his great personal charm, won him many friendships. During his frequent visits to the Continent he made friends with most of the eminent zoologists of his day.

His friends will mourn his loss, but his work will remain and bear fruit, the best memorial to a life devoted to the advancement of science.

E. S. GOODRICH.

ZOOLOGICAL teaching in the broadest sense, including animal physiology, was given a new impetus in Oxford by the completion of the University Museum about 1860, in Cambridge by the inspiring personality and administrative power of Michael