power as may be required, and develop on an experimental basis isolated schemes in isolated districts. Local requirements should be given priority.

The Committee also considered the safeguarding of fishery interests, the need for compulsory powers, the present inequitable valuation and rating of hydro-electric undertakings, and the preservation of the amenities.

From the foregoing digest of the report, it will be seen that the Committee has not only considered all relevant matters, but has also taken into account the views of opposing interests. A careful examination of the report leads to the conclusion that this is the first complete study that has been made of this matter, and that the general conclusions reached are the only sound ones possible.

S. PARKER SMITH.

OBITUARIES

Dr. C. Tate Regan, F.R.S.

CHARLES TATE REGAN, formerly director of the British Museum (Natural History), who died on January 12, was born at Sherborne in February 1878 and was educated at Derby School and Queens' College, Cambridge. The choice of Derby was probably influenced by the fact that his parents were professional musicians, for the head-master at that time was J. R. Sterndale-Bennett, a son of the composer, and music took a serious place in the life of the School. The appreciation of great music thus inherited and cultivated gave Tate Regan great pleasure in later years. It was L. J. Fuller, the science master at Derby, who first suggested a career at the Natural History Museum to the boy, among whose interests natural history was already prominent, and Tate Regan stayed a fourth year at Cambridge to wait for a vacancy to occur at South Kensington. At Cambridge he studied under Sedgwick, and he worked and played with equal zest. He played both Association and Rugby football, and was a good sprinter, hurdler and jumper. At this time he was uncertain whether to specialize in plants or animals, but of one thing he was sure, that his interest would be in the structure of living organisms, and its bearing on their relationships and evolution.

In 1901 Regan joined the staff of the British Museum (Natural History). Günther, who was then keeper of zoology, advised him to specialize in fishes, and he joined G. A. Boulenger on this group, starting, at Günther's suggestion, with a revision of the family Stromateidæ, which was the subject of his first paper (1902). Boulenger had just received the proofs of the "Cambridge Natural History" volume on fishes, and asked his young colleague to look through them. Regan suggested that the Gadoidea were wrongly placed and Boulenger challenged him to prove it, finally accepting Regan's arguments (published in 1903) and altering the book accordingly. Regan would tell this story in later years, wondering at his own temerity.

From this time on, every year saw a long list of titles under Regan's name in the *Zoological Record*, and one is left amazed at the mental energy that allowed him to work on so many lines at once. His most important contribution to ichthyology was the series of papers on the major classification of living fishes, beginning with the "Classification of the Selachian Fishes" (1906) and continuing with the Teleostean orders and sub-orders, which were treated severally in some score of papers appearing in the *Annals and Magazine of Natural History*, mainly during the years 1911–13. This work was based on the study of a big collection of dried skeletons and on spirit specimens, and was written in a form and style so concise as to give little idea of the amount of research behind it. It is summarized in articles on selachians and fishes in the fourteenth edition of the "Encyclopædia Britannica", and presents a classification which is accepted as a basis by serious ichthyological workers all over the world.

In 1911 there appeared a work of a very different type, "The Freshwater Fishes of the British Isles". This is perhaps the most fascinating of Regan's works, combining as it does the results of intensive studies in the museum with knowledge gained in delightful days spent angling in the rivers and streams near his home in Dorset, and in visits to the English and Scottish lakes that harbour the relict char. At once authoritative and readable, this is a model book of popular natural history.

It fell to Regan's lot to write the section on fishes in the "Biologia Centrali-Americana" (1906–8) and to report on the fishes of the Antarctic expeditions of the *Scotia* (1913) and *Terra Nova* (1914, 1916). From these results syntheses were made which increased considerably our knowledge of the laws governing the geographical distribution of fishes. His conclusions on this subject, too, are gathered together in an "Encyclopædia Britannica" article. Regan's systematic revisions of families are many, and in every case have that masterly quality which has put subsequent work upon a sound basis, and has been a powerful influence in keeping the standard of systematic ichthyology high.

I first met Dr. Regan in 1921, when as a student I visited the Museum to learn something about the classification of fishes, and received unstinted help. Regan had then just become keeper of zoology. When, in 1927, he was appointed director, he found that administrative duties left him little time for scientific work. He was able, as always, to do a great deal in the evenings, but he needed a collaborator who could deal with the practical work on the collections all day, allowing him to follow it in what time he could spare, and in the following year I was appointed as his scientific assistant. He had already, in 1925, dealt with the deep-sea angler-fishes of the first *Dana* expedition, and had described for the first time the dwarfed and parasitic males of this group. He was now about to tackle the *Dana* Stomiatoid fishes, and had also large collections of African Cichlidæ to work out. I soon understood that I was highly privileged to work upon such material under the guidance of such a man, and my admiration for his outstanding brain, his memory, his enthusiasm and drive grew with our association. With the second collection of *Dana* deep-sea angler-fishes, we elaborated together Regan's earlier discovery of the parasitic males. Parr's announcement that some males were dwarfed but free-swimming came when we were already working on this collection, and was not a surprise, and the *Dana* material made it possible for us to relate the free males to their extremely dissimilar mates. This work gave Regan special pleasure, as also did his earlier discovery of the nature and structure of the complicated copulatory organ of the minute East Indian fishes of the family Phallostethidæ. The latter work appeared in 1916, the year before his election to the Royal Society at the age of thirty-nine.

Although he was a good systematist, Regan never mistook the minutiæ of taxonomy for an end in themselves, and his outlook is well summarized in the following quotation from his address on "Organic Evolution" before Section D (Zoology) of the British Association in 1925: "Every good systematist must feel some satisfaction when he has written a diagnosis that is diagnostic, or has made a key that will work; but this satisfaction is small compared with that which he feels when he has reason to think he has settled the position of some doubtful form, or has discovered the origin of a group and the lines of evolution within it. The main interest of systematic work lies in the fact that it is a study of the results of evolution, and that from such a study one may hope to get some light on the meaning of evolution".

Regan found in the fishes ample scope for his energies, but his interests extended beyond, and especially into other vertebrate groups. His interest in the geographical distribution of animals led him to suggest to other specialists lines of research on the interrelationships of frogs and the classification of mammals. He was convinced, moreover, that false ideas were prevalent as to the origin and classification of the primates, including the ancestry of man, and in 1930 he published a preliminary statement of his views. He followed this by an elaborate investigation into the structure and relationships of insectivores and lemurs, and left unfinished manuscripts and drawings which it is greatly to be hoped will be put into order and published. Of recent years, too, he had embarked on a general classification of the fish-like vertebrates, and, to clear up a doubtful point, had undertaken an investigation of some fossil forms. This paper also was left unfinished.

In addition to his scientific work, Regan performed important services for the British Museum (Natural History) as keeper of zoology and director. His first duty on taking the directorship was to give evidence before the Royal Commission on Museums, and as a result of this the Commission recommended increases of staff and of buildings. The increase in staff, though delayed, was finally accomplished, but the financial crisis of 1931 interfered with the plans for building to such an extent that the War found them still only partly carried out. It is sometimes thought that Regan had little interest in the exhibition side of the Museum. This was not so, but his large-scale ideas were bound up with the new building plans, and were never even put on paper.

Regan had the gift of lucid expression, founded on clear and concentrated thinking, and he enjoyed talking on a subject that interested him. He was a member of the Royal Society Dining Club and often entertained his fellow "royal philosophers" over their port with an account of his latest discovery, illustrated by specimens and drawings. Many an impromptu lecture, which would have delighted a class of students, has been reserved for my unworthy ears at South Kensington, illustrated by drawings on the back of an envelope or an empty cigarette packet.

Tate Regan was an honorary fellow of his College, received the degree of D.Sc. *honoris causa* from the University of Durham, and was *Academico Honorario* of the University of La Plata. He was a foreign member of the Royal Danish Academy, of the American Academy of Arts and Sciences, and of the American Society of Ichthyologists and Herpetologists; the Geoffrey de St. Hilaire Medal was awarded to him by the Société Nationale d'Acclimatation de France.

Regan's outstanding qualities were generosity and frankness, which endeared him to his friends, and an enthusiasm and energy which made him, like the sprinter he was in his youth, go all out for some desired objective, and left him the victim of a too severe disappointment if it failed him. He was a keen gardener and enjoyed watching a good game of football or an athletic contest. His friends mourn a rare and stimulating companion.

Sincere sympathy goes out to Mrs. Regan and their four children, one of whom is now a prisoner of war.

E. TREWAVAS.

Dr. Nikola Tesla

NIKOLA TESLA, who died on January 7, was born in 1857 at Smiljan in Croatia. His father, a Serb, was a clergyman of the Greek Church; his mother is remembered as very inventive and is credited with making improvements in churns, looms and other rural machinery. Nikola, while at school, began to make electrical experiments, and finished his formal education in the engineering faculty of the Graz Polytechnic School. After a period in the Government telegraph department at Budapest, he joined the Edison concern in Paris and went to the United States about 1883. Here he worked under Edison for a time, but soon set up his own firm for the manufacture of arc lighting plant.

At this period the applications of electric power in industry were effected mainly by direct current, but many inventors were attacking the problem of making motors suitable for use with alternating current. Tesla in the United States and Ferraris in Italy each published in 1888 the results of several years of independent work on motors utilizing rotating magnetic fields produced by two-phase currents. Both inventors envisaged machines in which the rotor is propelled asynchronously by means of currents induced in it by the rotating field, and Tesla described also motors in which the rotor is pulled round in synchronism with the rotating field. Neither type need employ brushes or commutators. These rotating-field motors, together with the introduction of polyphase currents, proved to be the solution of the problem of using alternating current in factories. In addition, by 1890, Tesla also invented methods of starting and running motors on single-phase current. His designs were so sound that his larger machines attained efficiencies of 95 per cent. Having completed his task, he disposed of his patents to the Westinghouse Company and dropped the subject.

Hertz's work was directing attention to high-frequency alternating currents, so Tesla turned to the problem of generating these currents on an engineering scale. First he designed and built a succession of alternators, and by 1891 attained a frequency of 30,000 cycles per second. He studied the properties of these currents in circuits possessing distributed inductance and capacitance, and developed tuned coupled circuits for enhancing their voltage by resonance. For higher frequencies he employed the discharge of condensers through induction coils, obtaining big powers by aid of rotating dischargers or magnetic blow-outs at the spark gap. On coupling the primary circuit to a resonant secondary circuit comprising metal areas, large flaming and streaming ionization currents were obtained in air and in Geissler tubes. Ionic bombardment was observed to