flow down the steep littoral region until they reach levels below the thermocline, thus maintaining the lower temperature of the deep water. A notable example of this is the Ruzizi. The formation of this inflow was probably an extremely significant event in the history of the Lake. Not only did it raise the level of the Lake and give Tanganyika an outlet, but also it probably very greatly reduced the productivity of the Lake by making its waters more stable. The abundance of empty shells on the beaches and the present apparent paucity of the molluscan fauna lends support to this theory. The oligotrophic nature of the Lake is due to its thermal stability, yet it is potentially very productive. Locked up in the hypolimnion are all the nutrient salts to support a prolific flora and fauna.

This storage of nutrient salts in the hypolimnion indicates a number of ways in which the productivity of this Lake and the surrounding agricultural areas might be increased. Any agency which will affect mixing between the epi- and hypo-limnion will have an immediate beneficial effect on the Lake. This might be achieved mechanically in suitable localities or by irrigational schemes designed primarily to benefit agriculture. At the present time the inflows, rich in nutrient salts, are to a large extent unused, since they tend to enter the Lake at levels below the thermocline. If these inflows were used for irrigation, their temperature would be raised and their waters could then mix with the surface waters of the Lake, thus not only making their salts available, but also reducing to some extent the thermal stability of the Lake. In addition, the drainage of low-lying areas and the fertilizing of these areas with the rich bottom deposits of the Lake would again benefit both agriculture and the fisheries, and would also improve the malarial situation. It is to be hoped that developments along these lines may one day be carried out.

The conditions obtaining in Tanganyika are ideal for studying the chemical factors which limit and control plankton development, since for considerable periods the thermocline is so well differentiated that the epilimnion is depleted of nutrient salts and the plankton so reduced that prolonged tow-netting yields only insignificant quantities. At other times seasonal variations in temperature, or changes in the strength and direction of the wind and internal wave (temperature seiche) effects, cause mixing between the surface and deep water which leads to considerable variations in the amounts of nutrient salts in the epilimnion. However, during the year, the temperature of the epilimnion varies little more than 3° C. (from 23·5° C. to 26·5° C.), and since the Lake lies close to the equator the seasonal variation in the amount of light falling on it is slight. Thus the effects of change in the chemical composition of the water can be studied in the absence of confusing alterations in light and temperature. The exceptional suitability of this Lake for such investigations is apparent when one considers some of the difficulties met with in other tropical lakes and also in temperate lakes. In other tropical lakes thermal instability prevents complete utilization of the nutrient salts in the surface waters, so no estimate can be made of the limiting values of these salts; while in temperate lakes, which are thermally stable during the summer, the reduction in temperature and light during the winter, as well as the constant daily fluctuations in light, superimpose other factors which limit plankton development and prevent a proper evaluation of the effect of change in the composition of the water.

In Tanganyika changes in the hydrology of the Lake may at times be marked by very obvious changes in its biology. At the end of the cool season there is a well-recognized drift in the 'dagaa' fishery from the south end of the Lake towards the north end. The 'dagaa' are small plankton-feeding fish. At the same time the Tanganyika jelly-fish makes its appearance at the south end of the Lake and later is found farther and farther north. These events express in a most striking manner the effect of mixing between the surface and deeper waters of the Lake. At this season there is a gradual fall in the temperature of the surface water, greatest towards the south, so that while it may be 25° C. at the north end, it is only 23·5° C. at the south end. As a consequence the thermocline occurs at lower and lower levels and becomes less well defined, until in the shallower waters at the south end of the Lake it ceases to exist and very considerable mixing occurs with the deeper water rich in nutrient salts. There is then an immediate and abundant development of the plankton. The prevailing wind, which at this season is from the south, drifts this more productive water northwards. These happenings are brought to an end by the onset of the warmer weather, which is marked by a change in the wind, which now tends to blow from the north. This change in wind direction, however, has one further disturbing influence on the Lake; by changing the direction of the currents in the epilimnion, frictional disturbances arise at the level of the thermocline and bring about further mixing. From then on, more stable conditions arise, and continue, with minor changes, throughout the warm season.

Quite apart from biological studies on this Lake, which have scarcely been started, an immense amount of hydrological work remains to be done and should yield results of quite exceptional interest and value; for they will not only help towards reaching an understanding of Tanganyika and its many problems, but will also advance appreciably our knowledge of the basic principles of hydrobiology.

A list of references to work on Tanganyika is given in a paper by me published in 1939 but not readily available (*Int. Rev. Hydrobiol.*, **39**; 1939), which also contains a more detailed account of the hydrology of Lake Tanganyika.

OBITUARIES

Prof. E. S. Goodrich, F.R.S.

Edwin Stephen Goodrich was born on June 21, 1868, at Weston-super-Mare and died at Oxford on January 6. He was brought up in France, spoke French like a Frenchman, and always remained a great admirer of that country. After returning to England he entered University College, London, in 1888, and it was while studying there as an art student at the Slade School that he heard some public lectures given by Ray Lankester and realized that zoology was his proper profession. He became assistant to Ray Lankester, and when the latter went to Oxford to become Linacre professor of zoology and comparative anatomy, Goodrich followed him. He entered Merton College as a commoner in 1892, and ultimately became a fellow and a professorial fellow of the same College, when he succeeded to the Linacre professorship in 1921. He always prided himself on his undivided allegiance to Merton, and it must have been a source of great satisfaction to him when, a month before his death, he was made an honorary fellow of Merton.

In zoology, Goodrich's interests were primarily those of a comparative anatomist, in which field he can without exaggeration be claimed as the greatest in the world of his day. There was scarcely a group of the animal kingdom to which he did not devote his attention, or to which he did not make a lasting contribution to knowledge. His first paper was published in 1892, and in the following year he started the remarkable series of papers in which he unravelled the problems of the structure and development of the nephridium and of its distinction from the cœlomoduct. This line of work led him to study the structure and development of most of the forms in which nephridia occur, especially the Annelida and *Amphioxus*, and to determine the relations of the cœlomic cavity, in molluscs, arthropods and the Actinotrocha larva of *Phoronis*, to mention only a few. He also investigated the systematic position of the Archiannelida in the light of his researches into their structure and development. For the series of text-books on zoology edited by Ray Lankester, Goodrich contributed the section on the holothurioid echinoderms, and the volume on fish. This last work, which was almost entirely based on personal investigation and verification of all facts contained in it, marked an epoch in the study of fish, and through them, of all higher vertebrates. Goodrich clarified the puzzle of the different types of so-called ganoid scales and enabled fossil forms to be compared profitably with living ones. His interest in fossils was indeed no new one, for among his earliest works was a paper on the fossil mammalian jaws from Stonesfield, to which later workers have been able to add very little. He investigated the segmentation of the heads of amphibians and selachians, which paralleled for vertebrates the work which he had done in invertebrates on the segmentation of the arthropod head.

Goodrich's "Studies on the Structure and Development of Vertebrates", a large book in which every item was either a result of his own work or was checked by him, is a monument of accuracy, completeness and clear exposition.

His mastery of analytical detail in so many groups enabled Goodrich to make synthetic studies of subjects of general application, such as the relations between metameric segmentation and homology, or the 'faithfulness' of motor nerves to their segmental muscles.

While his predilection for morphological studies may have led some of his contemporaries and juniors to consider him as old-fashioned, Goodrich was always keenly interested in the progress of genetics and experimental zoology, and his acuteness enabled him to cut right through fallacies, some of very old standing, like a knife. He regarded all the changes undergone by an organism during its development as responses to stimuli, some internal (and hereditary) and some external. This point of view not only rendered him appreciative of the results of experimental embryology, but also enabled him to demonstrate the illogicality of the expression 'inheritance of acquired characters' and of Lamarckian hypotheses of the causation of evolution.

From 1915 until 1923 Goodrich was zoological secretary of the Linnean Society of London. In 1921 he began his association with the *Quarterly Journal of Microscopical Science*, which continued until his death; and all contributors will remember the personal interest which he took in every communication submitted to him, and the helpful suggestions which so frequently increased the value of the paper.

His early training in art served Goodrich in good stead throughout his life. Not only were the illustrations to his papers and his drawings on the blackboard while lecturing really beautiful, but also he had a genuine gift for landscape painting in water colour. He travelled all over the world and always brought back with him a set of pictures, striking alike for their draughtsmanship, composition and colouring. Some of them were shown by him at exhibitions in Bond Street, London.

In 1913 he married Dr. Helen L. M. Pixell, and he collaborated with her in researches on Protozoa.

Goodrich was elected into the fellowship of the Royal Society in 1905 and was awarded a Royal Medal in 1936. He received the Linnean Medal in 1932. In addition to his Oxford degree of D.Sc., he was an honorary LL.D. Edinburgh, honorary D.Sc. Dublin, and a foreign or corresponding member of the New York Academy of Sciences, the Swedish Royal Academy of Sciences, the Academy of Sciences of the U.S.S.R., the Belgian Royal Academy, and the Paris Society of Biology.

As a man of science, Goodrich attained the highest standard, but no record of him would be complete without paying tribute to the quiet unassuming charm and loyal friendliness which distinguished him as a man. G. R. DE BEER.

Academician V. L. Komarov

VLADIMIR LEONTIEVICH KOMAROV died on December 5, 1945, in his seventy-seventh year. He was the doyen of systematic botanists in Russia, ex-president of the Academy of Sciences, a deputy of the Supreme Soviet, and holder of the highest Soviet civil award—a Hero of Socialist Labour.

Komarov was born in St. Petersburg in 1869, and was educated at the University there. He was a younger contemporary of Mendeléeff and Timiriazeff. He set out at an early age on a life of exploration, plant collecting, and systematics; and throughout his career these remained his interests in botany. For some years after graduation he collected material; then followed a series of memoirs on regional floras and studies of separate genera, carried out with a thoroughness and precision which put him in the front rank as an investigator. His travels ranged from Manchuria to Turkistan; and his researches from taxonomy to evolution and anatomy.

Komarov had a forceful, vigorous personality and advanced political opinions; accordingly he was chosen after the October Revolution to be one of the leaders of science in the new Soviet Union. He threw himself with great energy into this task, and he welcomed the increased opportunity for exploration and scientific research. As early as 1914 he had been made a corresponding member of the Academy. In 1919 he was given the chair of botany at Petrograd; and in 1920 he was elected an academician. His outstanding leadership was recognized by his election as vice-president of the Academy in 1930 and president in 1936. During the last ten years Komarov has organized and edited the splendid "Flora of the U.S.S.R.", which has now reached its tenth volume, and which it is planned to complete in twenty-four volumes by 1948.

During his term as president, Komarov organized the very important war-time activities of the Acad-