Dr. J. H. Orton investigated the mortality among English oysters during 1920-21, and he has issued a summary² compiled from chemical, bacteriological and biological reports, part of which are to be published in *Fishery Investigations*, series 2, vol. 6, No. 3, and part later. During the winter of 1919-20 unusual mortality was reported in the oyster beds of Italy, and in the summer of 1920 similar conditions had spread to the beds of Western France and the Thames estuary. The epidemic died down during the winter of 1920-21, but reappeared in the summer of 1921 in the beds of the Thames estuary, English Channel, and North and Western France. The abnormalities of 1920-21 in the Thames estuary were investigated, particular attention being paid to (a) physical conditions, (b) oyster pests, (c) parasites, (d) observations on sound and weak oysters, and (e) possible direct poisoning from dumped munitions.

There is a lack of trustworthy information regarding the normal mortality of oysters, but English oyster planters estimate it at 10 per cent. in locally grown and at a higher proportion in relaid oysters. The loss occurs mainly in the summer months, and there is no one assigned cause. Variations in the temperature and salinity of the sea affect oysters, especially at the spawning period, and the effects of predatory enemies are of course evident, but parasites are normally absent. None of these factors accounted for the abnormalities under review.

Little has been recorded of the pathology, physiology, or even the histology of oysters. Various hitherto undescribed symptoms observed in weak or dying oysters were found to be probably normal. The most constant abnormal symptom, now observed for the first time, was the occurrence throughout the tissues of microscopic muscle spindles, which appear to be due to muscular degeneration. They can be produced if the tissues are bruised or if the oyster is starved, but poisons appear to have little effect. The phenomenon may be normal, but the condition of excessive myolysis is pathological, and requires further study.

It is known that munitions were dumped in the Thames estuary and elsewhere prior to 1920, and this might have caused local poisoning. A saturated solution of T.N.T. (1 in 10,000) kills oysters in a few days, but no appreciable or significant amount was

present in the water of the Thames estuary after November 1920, either in solution or as floating particles. The conclusion is reached that the unusual mortality was not due to T.N.T., although a negligible amount of death may have occurred by ingestion of grains of T.N.T. by the oyster. Nitrites, oil and sodium picrate are not regarded as even probable causes of mortality.

From a large number of analyses of both healthy and sick oysters made at the Government Laboratory, it appears that oysters normally accumulate traces of metals such as copper, zinc, tin, iron, arsenic, etc. There is no uniformity in the proportions of metals present, nor do the quantities seem to be harmful to the oyster. It is suggested that the medicinal properties of oysters may depend upon these traces of metals. The metals are concentrated in the blood cells, and particular oysters may contain a far greater proportion of metals than the soil upon which the oysters rest. Mercury, barium and lead were not found either in oysters, soils or tow-nettings. Traces of arsenic are present in both sound and sick oysters, with, apparently, an accumulation in weak ones up to about five parts per million on the fresh meat. Of sound oysters yielding the maximum amount found it would be necessary, however, to eat more than two dozen to take the minimum medicinal dose of the British Pharmacopœia, and to eat about three thousand to take the minimum recorded fatal dose.

Varying quantities of arsenic from small to suspiciously large were found in soils, silts and tow-nettings; but some interesting experiments are recorded in which oysters have been kept in sea water containing white arsenic for many months without suffering harm. Under such conditions they easily absorb arsenic and easily lose it again, giving off continuously an arsenicated gas, probably arsine. The gas produced daily is minute in quantity, but can be easily recognised by the strong characteristic odour. The mode of absorption and retention of arsenic is not known, but it appears to be held differently from copper, zinc, etc. Arsenic, as well as most of the other metals, is present in sea water in very minute quantities.

No single cause or group of causes was found singly or collectively to account for the heavy and unusual mortality of 1920, but the investigation would appear to be of great interest and value to an industry to which very little scientific attention has been paid in the past.

² Summary of an Account of Investigations into the Cause or Causes of the Unusual Mortality among Oysters in English Oyster Beds during 1920 and 1921. By Dr. J. H. Orton (Journal of the Marine Biological Association, vol. 13, 1923, No. 1).

Obituary.

PROF. ROBERT TIGERSTEDT.

ROBERT TIGERSTEDT, professor of physiology at Helsingfors, died on December 2, 1923. Born in that city on February 28, 1853, he was the son of the well-known historian Prof. K. K. Tigerstedt and Evelina Degerman. Educated in Helsingfors, he took his degree in 1869, and at the age of twenty-three was appointed assistant in the Physiological Institute of the University. Ten years later he became professor of physiology at Stockholm, which post he resigned to return to Finland in 1900, at the time when that country was almost crushed out of existence by Russia. Appointed

professor of physiology in the University of Helsingfors he remained there until his death.

Tigerstedt devoted a long life to physiology, and this science has lost a most distinguished teacher, as well as one whose personality and wide knowledge rendered it easy for his contemporaries in other countries to give him a foremost place among those who have contributed to the establishment of physiology as an experimental science.

Though the names of famous physiologists from Harvey onwards are familiar to many, it should be recognised that physiology as it exists to-day has

grown with exceptional vigour during the last fifty years. If we could speak of a renaissance of science, as we can of art and literature, then the re-creation of physiology might be considered to date from about 1850, and in English-speaking countries is chiefly associated with the names of Burdon-Sanderson and Michael Foster.

In this development of physiology the work of Tigerstedt played a large part. He was among those who early came under Carl Ludwig's influence at Leipzig, about the time when Bohr, Gaskell, v. Kries and a number of others were working in his laboratory. This was the period when a large amount of experimental work on the behaviour of the objectively excitable tissues, muscle and nerve, was in progress, and electro-physiology possessed a powerful attraction for those engaged in research. Tigerstedt's early papers, which extend between 1880-1884, were concerned with a study of the excitation processes in nerve. These were communicated to the Royal Academy of Sciences in Stockholm, and subsequently translated into English in the *Biological Memoirs* edited by Burdon-Sanderson in 1887. A later paper on the duration of the latent period in muscle appeared in 1885.

It was during his professorship at Stockholm that Tigerstedt became well known by the publication of two books. His "*Lehrbuch der Physiologie des Kreislaufs*" appeared in 1895 and was at once recognised as a work which presented a complete historical retrospect of the subject together with much original material. It is among the comparatively few volumes in physiological literature which stand out conspicuously as a permanent source of special information. The "*Lehrbuch der Physiologie des Menschen*" appeared in 1897, and an eleventh edition in 1923. An English translation of the third edition by Prof. J. R. Murlin, of New York, was published in 1906. This text-book shows distinctly the original bent of Tigerstedt's mind. Regarded by himself as a book designed primarily for medical students, special stress is laid upon the normal functions of the human body. But in the arrangement of material, the extended treatment of the general physiology of the cell, together with a general account of metabolism, Tigerstedt's text-book, which is a standard one among German students, preserves a marked individuality. His chapter on metabolism is probably the most complete general account given in any text-book, and many of the results of the metabolic experiments on man carried out with Söndén are to be found in this book.

Shortly before leaving Stockholm, Tigerstedt, in 1898, succeeded Holmgren as editor of the *Skandinavische Archiv für Physiologie*. Following a custom not uncommon on the Continent, on the anniversary of his seventieth birthday the forty-third volume of this publication was dedicated to him by his friends and pupils. Several monographs were contributed by Tigerstedt to the "*Ergebnisse der Physiologie*," Nagel's "*Handbuch der Physiologie*," Oppenheimer's "*Handbuch der Biochemie*," and Winterstein's "*Handbuch der vergleichenden Physiologie*." The publication of the "*Handbuch der physiologischen Methodik*" extended from 1908-1914. Among the contributors to this were Pavlov, Bohr, Gullstrand, Ewald, and v. Frey. The editing of this encyclopedic work was undertaken

by Tigerstedt, and it is at the present time indispensable in any working physiological laboratory.

Tigerstedt, like most educated Scandinavians, was an excellent linguist. I met him not infrequently at various congresses, and at times in London and Vienna. He possessed a strongly developed patriotism, and took an active interest in whatever tended towards the preservation of the nationality of the Finnish people. His sympathies also spread to the Bulgars, who are ethnologically of the same stock. He was an able and successful exponent of his science, and published a number of popular works and pamphlets on hygiene. He also took a great part in the modern temperance movement, and must be ranked as one of the foremost scientific advocates of this cause. In several widely circulated publications he exposed the injurious effect of alcohol on the human body, but he was in no sense an ally of those who would enforce total abstinence by legislation.

The strong personality of Robert Tigerstedt made itself prominent even in private life. By his idealism, rich humour, and warm heart, he made lasting friends even among those who did not in all respects agree with his conceptions of life. From youth to death he maintained an optimistic trust in the future of his own nation. This trust it was that enabled him to bear the adversities and burdens which life also gave him in no small degree. Among these may be mentioned the loss of the greater part of his valuable library by fire. His relation to physiology in some respects resembled that of Bunsen to chemistry. The minds of both were alike in their singleness of purpose and the devotion of a long life to science, in the same sense that a life may be given to art or literature. Both men were endowed with the gift of making and preserving friendships, and the personality of each was, in a marked degree, shown by their power of attracting students of other countries to their laboratories. It is in these that the real progress of knowledge takes place, and where those intimate relationships between the teacher and the students are established which tend to the advancement of science. Robert Tigerstedt possessed a generous nature, a comprehensive capacity of critical judgment, a persistent industry, and a heart which sympathised with all truly human interests. Those were the qualities that marked his scientific, literary and social work, and won him a place in the foremost ranks of those who have striven for the advancement of Finland.

G. A. BUCKMASTER.

WE regret to announce the following deaths:

Dr. W. Hatchett Jackson, sub-warden and tutor of Keble College, Oxford, and Radcliffe librarian, Oxford, on February 21, aged seventy-five.

Mr. A. H. Jones, formerly treasurer and vice-president of the Entomological Society, London, on February 24, aged eighty-four.

Prof. A. C. O'Sullivan, professor of pathology in the University of Dublin, on February 18, aged sixty-six.

Prof. J. Symington, F.R.S., emeritus professor of anatomy, Queen's University, Belfast, on February 24, aged seventy-two.

Dr. B. H. Wedd, who, with his sister, Miss A. F. Wedd, translated Duclaux's "*Pasteur and his Work*," formerly bacteriologist to the London School of Tropical Medicine, on January 28, aged forty-seven.