controlled conditions. In 1885, Winogradsky moved to the University of Strassburg, where he became interested in micro-organisms concerned with the oxidation of sulphur and sulphides. He found that *Beggiatoa* was able to assimilate carbon dioxide, obtaining the necessary energy by oxidation of sulphur. This discovery started him on the classic series of investigations concerning autotrophic bacteria which opened up one of the most interesting fields in bacterial nutrition. He next passed to the study of the iron bacteria, some of which he claimed could similarly derive energy by the oxidation of ferrous iron.

Winogradsky went to Zurich in 1888 and in the following year began research on the problem of nitrification, that is, the oxidation of ammonium salts to nitrate. The importance of this process had already resulted in a search for the causative agents, and there was evidence that the process proceeded in two stages with the formation of nitrite and nitrate, and that the causative agents were biological. But attempts to isolate the responsible organisms had been unsuccessful. Winogradsky, with his experience of sulphur-oxidizing organisms, divined that those causing nitrification were also autotrophic, and he therefore used for their isolation an inorganic medium with a base of silica jelly. By this means he obtained two groups of autotrophic bacteria, one able to oxidize ammonium salts to nitrite and the other nitrite to nitrate. His investigation of the physiology of these organisms constitutes one of the classic researches in bacteriology. In 1891 Winogradsky returned to St. Petersburg, where he was appointed chief of the Division of General Microbiology at the Institute of Experimental Medicine. There he began work on a second soil process of fundamental importance in the economy of Nature, the fixation of atmospheric nitrogen. When he began this investigation, Hellriegel and Wilfarth had recently demonstrated symbiotic nitrogen fixation in the nodules produced by bacteria on the roots of leguminous plants. Winogradsky studied the gains in nitrogen of soil and showed the existence in it of an anaerobic organism, *Clostridium pastorianum*, that was capable of fixing nitrogen. This was the first non-symbiotic organism shown to possess this ability.

In 1905, after a period of ill-health, Winogradsky retired from scientific work and lived on his estate in Russia until 1921, when he finally left the country and, after a short stay in Switzerland, accepted the offer by the Institut Pasteur of a post and a laboratory at Brie Comte Robert, about twenty miles from Paris. During this phase of his work, he was much concerned with the difficulty in studying the micropopulation as it actually exists in the soil. He pointed out that most of the methods that were in common use consisted in isolating a number of organisms from soil and studying their behaviour under the unnatural conditions of the laboratory. He therefore devised methods for the purpose of investigating the micropopulation in the soil itself. In the first place, he developed and used a technique previously tried by H. J. Conn, namely, the microscopic examination of a film of soil suspension, dried and suitably stained to reveal the micro-organisms. Samples of soil with and without the previous addition of organic matter were thus examined. Winogradsky concluded from these observations that untreated soil contained a static micropopulation, but that the addition of decomposable nutrients caused the rapid increase in numbers of certain groups of organisms, the soil then passing from the static to the dynamic condition. A special example of this differential increase, that of *Azotobacter* in soil enriched with mannitol or starch, was investigated. This led to the invention of a method for detecting phosphate deficiency in soil, by observing the growth of *Azotobacter* colonies on the smoothed surface of a soil sample wetted to a thick paste after the addition of starch.

Another method developed by Winogradsky was that of sprinkling fine granules of soil on the surface of silica gel plates to which a specific nutrient had been added. He used this method for studying the development of colonies of *Azotobacter* arising from the soil granules. Later the method was used, with appropriate media, to obtain nitrifying organisms from soil. In the course of this further study of nitrifying organisms, several new genera were described. By similar methods, Winogradsky also studied aerobic soil organisms that attack cellulose, and made a special study of the Myxobacteria possessing this power, for which he proposed the generic name *Cytophaga*.

But his work at Brie Comte Robert, while yielding valuable new information on interesting groups of soil organisms, owes its main importance to his individual approach to the subject and to his constant aim at discovering what organisms were active in the soil itself and what were the conditions governing their activity therein. The methods that he developed all had this object in view. Indeed, throughout his life's work, Winogradsky showed an unequalled ability to devise experimental methods of elegant simplicity, but directly suited to the problem under investigation. This ability, together with the clarity of thought which characterized his work, enabled him to discover and develop new fields in bacterial physiology, particularly relating to specialized organisms of the greatest importance in the economy of Nature, and later on to change and enlarge our views on the ecology of the soil micropopulation.

H. G. Thornton

Prof. R. D. Laurie

Robert Douglas Laurie, whose death occurred on April 7, was born in 1874; he was educated at Birkenhead School. After a period on the staff of the Bank of Liverpool (1891–99), he studied in the Universities of Liverpool and Oxford, and was afterwards appointed to the staffs of the Zoology Department first of the latter and afterwards of the former. He remained at Liverpool for some years; but in 1918 he was appointed head of the Zoology Department in the University College of Wales, Aberystwyth, and was given professorial status four years later. He remained at Aberystwyth until his retirement in 1940.

Laurie's scientific work was of two main types. He published systematic reports on some Brachyura collected by Herdman in Ceylon in 1902 (Ceylon Pearl Oyster Fisheries Reports, 1906) and on the Anomura of Stanley Gardiner's *Sealark* Expedition (1926). After his appointment at Aberystwyth he took a keen interest in local problems of natural history—especially in the bottom-fauna of Cardigan Bay, and in the effects of pollution of certain Welsh rivers by lead. In collaboration with various colleagues he produced a number of reports on these

subjects, notably a paper (with Erichsen Jones) on the faunistic recovery of the Rheidol after lead-pollution (*Journal of Animal Ecology*, 1938).

As a professor, Laurie was genial, imperturbable, persistent in the face of difficulties, and regarded with sincere affection by students and colleagues. His personal characteristics—he was like a cheerful robin—gave rise to a whole series of tales (true and legendary) which in time constituted a veritable collection of affectionate 'Lauriana'. His unflagging attempts to develop his department, including a phase during which he and his students built a lecture-room with their own hands, were prevented by fate and the Second World War from reaching full fruition by the time of his retirement.

It was not, however, Laurie's activities as a zoologist or as a professor which will be remembered as his leading contribution to the welfare of his subject or his colleagues. The outstanding interest of his later years, and his chief service, lay in the field of organizations designed to promote the interests of university teachers and of university and educational affairs in general. It was Laurie's unfailing zeal, more than that of any other single person, which brought into existence the Association of University Teachers. He was its first president, in 1919, and was its honorary general secretary from 1920 to the time of his death. In addition (1943–53) he was honorary secretary-general to the International Association of University Professors and Lecturers, and it was at a conference of this organization that he died, after flying to Amsterdam, at the age of seventy-eight. Much of the credit for the achievements of these organizations may be traced back to Laurie's energy and enthusiasm. His educational interests were revealed in other ways, as in his reports for a British Association committee on the position of animal biology in the school curriculum; and he was responsible for the introduction of biological teaching in the grammar schools of Wales.

Laurie married Elinor Beatrice Ord in 1912, and both she and his daughter survive him. Mrs. Laurie has also for many years been beloved, not only by her family, but also in no common degree by her many friends, including those connected with her husband's enterprises.

T. A. STEPHENSON

Dr. T. A. Jaggar

DR. T. A. JAGGAR, dean of American volcanologists, died in Honolulu on January 17, just one week before his eighty-second birthday. Born in Philadelphia, Pennsylvania, on January 24, 1871, Thomas Augustus Jaggar, jun., was trained in public and private schools, and in 1893 received the degree of bachelor of arts in geology from Harvard University. He remained at Harvard to take his M.A. degree in 1894, and then spent most of the next two years studying at Munich and Heidelberg. Returning to Harvard, he was awarded the doctorate of philosophy in 1897.

During 1895–1903, Jaggar held an appointment as instructor in geology at Harvard, and in 1903 he was made an assistant professor. In 1906 he became professor and head of the Department of Geology at the Massachusetts Institute of Technology. During the summers he was a member of the United States Geological Survey, working in the Black Hills region of South Dakota and adjacent parts of Wyoming, in the Yellowstone National Park region, and in Arizona. In 1901 he published, in the Annual Report of the Geological Survey, an important study of the laccoliths of the Black Hills.

Very early, Dr. Jaggar's interest turned to experimental geology, and the study of earth processes in the field. His visit to Martinique in 1902, to study the results of the catastrophic eruption of Mont Pelée, decided him to adopt as his life-work the field-study of geophysics. From that time forward his major interest lay in the fields of seismology and volcanology, with a strong emphasis on the humanitarian aspects of both. His aim was the saving of human lives and property through the prediction of earthquakes and volcanic eruptions, the design of suitably resistant structures for countries subject to frequent earthquakes, and development of methods of protecting communities from the ravages of lava flows, glowing clouds, and heavy ash falls. Although he took part in many expeditions, Jaggar was firmly convinced that the only satisfactory way of studying volcanoes was by means of permanent observatories, keeping continuous records.

In 1912, Dr. Jaggar established the Hawaiian Volcano Observatory, for the continuous study, by direct physical methods, of Kilauea and Mauna Loa volcanoes. This was made possible by money provided from the Whitney Fund of the Massachusetts Institute of Technology, and funds subscribed by a group of business and political leaders of Hawaii that had formed the Hawaiian Volcano Research Association. For more than forty years the Hawaiian Observatory has carried on its work, under the Massachusetts Institute of Technology and later under successive agencies of the United States government. Dr. Jaggar remained its director until his retirement, in 1940. He then became research associate in geophysics in the University of Hawaii, a position he still held at the time of his death.

Dr. Jaggar's contributions to the science of volcanology have been very great. Studies of the Kilauea lava lake demonstrated its complex nature, with a shallow pool of hot fluid lava lying on a semi-solid but mobile plug. Measurements ascertained the distribution of temperature in the lake, and the composition of the liberated gases was determined. Tumescence and detumescence of the volcanic structure were demonstrated, probably resulting from changes in magmatic pressure beneath. The entire picture of volcanic activity was augmented and clarified. Perhaps most important of all, however, was the development by Jaggar and his associates of methods of aerial bombing to deflect lava flows, and the concept of huge diversion barriers to protect cities or harbours from inundation by lava. Jaggar never lost sight of the fact that the real purpose of science is to serve mankind.

GORDON A. MACDONALD

WE regret to announce the following deaths:

Sir David Anderson, president during 1943–44 of the Institution of Civil Engineers, on March 27, aged seventy-two.

Dr. F. W. Edridge-Green, C.B.E., for many years special examiner and adviser to the Ministry of Transport on vision and colour vision, on April 17, aged eighty-nine.

Dr. G. F. Herbert Smith, C.B.E., formerly of the British Museum (Natural History), and honorary secretary since 1921 of the Society for the Promotion of Nature Reserves, on April 20, aged eighty.