science, and they showed what a realistic and successful contribution is being made to national development, particularly in agriculture, genetics, entomology, chemistry and economics.

In addition there were a number of general lectures; for example, by Prof. H. J. Bhabha, director of the Tata Institute of Fundamental Research, on cosmic rays, by Dr. Taylor on south-east Tibet and on the work of the British Museum, and by myself on the art of discovery and on limiting factors in production.

The Conference was extremely successful. Large numbers of young students came to the meetings and were obviously keenly interested in the papers. Both during the meeting and after its close, the twenty-five foreign delegates were able to visit a number of research laboratories, including Dr. Chaudhury's new nuclear physics institute at the Government College, Lahore, which will be finished shortly, and the Punjab Agricultural College and Research Institute at Lyallpur, where a large programme of research is in full swing. It covers the main agricultural problems of Western Pakistan and much progress has been made in improving the strains and the methods of cultivation of the staple crops.

We then motored to Peshawar, where we saw the University and the fine engineering laboratory which will soon be completed. We visited the Khyber Pass, the Malakand and Dargai power stations, and the site of the hydro-electric scheme on the Kabul River at Warsak which will produce both cheap electric power and irrigate some 65,000 acres of land on the North-West Frontier, making it available for cultivation by the frontier tribes. Financial assistance from Canada under the Colombo Plan will enable work on this site to start at once.

We were greatly impressed by the progress which is being made in the North-West Frontier Province under the dynamic leadership of the Chief Minister, Abdul Qayum, in education, hospitals, rural electrification and factories for the processing of agricultural products, like the sugar refinery at Bialpur. We went next to Rawalpindi to see the hill station at Murree, the Himalayan forest, and the ruined city of Taxila, with its fine Romano-Buddhist museum under the curatorship of Mr. Harundur Rashid.

In Karachi we saw the new University in its improvised home, the laboratories of the Department of Scientific and Industrial Research, where important researches have already started without waiting for full equipment, the Central Testing Laboratory, and the Cotton Research Institute. During our visit we were impressed by the excellent work which is being done in various centres by the British Council.

The most urgent problems of Pakistan, apart from her food shortage, seem to be supplies of irrigation water, drainage and electric power. These are all inter-connected, and it is to be hoped that the negotiations with the World Bank will soon result in engineering works for the control of the headwaters of the Indus, which could provide both perennial irrigation and ample power. The experience of irrigated zones in Egypt and Arizona suggests, however, that the problem of the salting up of the soil, which is becoming increasingly serious, will only be met by extensive drainage systems.

The Pakistan Academy of Sciences

In the afternoon of the first day of the Conference, February 16, we were present at the inauguration of the Pakistan Academy of Sciences, by the Prime Minister of Pakistan, Al-Haj Kwaja Nazimuddin. He spoke of the heritage of scientific and cultural achievement in Muslim history and of the dark Middle Ages of the West, when Muslim scientists kept the spirit of scientific inquiry alive. The Government recognizes, he said, the importance of pure scientific research as the bed-rock of all important forms of development, and it welcomes the establishment of the Academy, which was destined to play a vital part in the life of the nation.

The nine Foundation Fellows of the Academy were then presented to the Prime Minister, and they later elected the following office-bearers: *President*, Prof. M. Afzal Husain, formerly vice-chancellor of the University of the Punjab; *Secretary*, Prof. M. Raziuddin Siddiqui, director of research, University of Peshawar; *Treasurer*, Dr. Bashir Ahmad, vice-chancellor of the University of the Punjab. The other Foundation Fellows are: Dr. Nazir Ahmad, chairman, Tariff Commission, Pakistan Government; Dr. S. Siddiqui, director, Scientific and Industrial Research, Pakistan Government; Dr. M. Qudrat-i-khuda, scientific adviser, Ministry of Defence, Pakistan Government; Dr. M. Ishaq, principal education officer, Pakistan Military Academy; Dr. H. K. Bhatti, chairman, Department of Zoology, University of the Punjab; and Dr. M. Sharif, professor of zoology, Government College, Lahore.

The aims and objects of the Academy had been defined as the promotion of research in pure and applied sciences by means of publications, by the establishment of scientific libraries, laboratories, museums and research institutions, and by awarding grants, scholarships, fellowships, prizes and medals for research. The Academy will act as the National Research Council of Pakistan, for undertaking such scientific work of national or international importance as it may be called on to perform by the public and the Government. It will offer advice on all scientific matters to the Government and will represent internationally the scientific work of Pakistan.

Not more than five ordinary Fellows, distinguished for their original contributions to science, will be elected into the Academy each year until the limit of a hundred is reached. Eminent scientists of foreign countries will be elected as foreign members. These will be limited to thirty in number.

The Academy has already started work and plans are being prepared for the publication of *Proceedings* and research journals.

OBITUARIES

Prof. S. N. Winogradsky, For.Mem.R.S.

With the death on February 24 of Sergei Nikolaevitch Winogradsky, science has lost the greatest figure in soil microbiology. Winogradsky was born in Kiev in 1856 and spent his childhood there. He was a student in the University of Kiev and, later, that of St. Petersburg, where he studied chemistry and plant physiology. There, after graduation in 1881, he investigated the effects of nutrient supply and other environmental factors on the growth of the wine yeast *Mycoderma*.

This early work was one of the pioneer investigations on the effects of specific nutrients on micro-organisms grown in pure culture under adequately

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