crystals. Many such examples are known, and in some quarters the process is believed to be a general one; there are, however, still some people who believe that it occurs for a few crystals only.

Crystal Imperfections

The existence of growth spirals implies that crystals containing them are imperfect, and indeed it has been known for a long time that perfect crystals would not diffract X-rays in the ways observed. The study of imperfections by means of X-ray diffraction is, however, difficult; it depends upon secondary effects not easy to interpret. B. E. Warren, of Massachusetts Institute of Technology, gave a general account of the investigation of one type of imperfection—order–disorder changes in alloys. These changes may be regarded as producing an imperfection based upon a perfect lattice and so should be easier to consider than imperfections of the lattice itself; much theoretical and experimental work has been done, but Warren maintained that the physical interpretation of the results is still obscure.

The conference gave a general picture of the consolidation of existing methods and rapid development of new ones. There seems to be a thriving future for the subject of crystallography, applied to many different branches of science. Much ingenious apparatus was shown in the accompanying exhibition.

In some ways, however, regret must be felt for the departure of the days when an individual worker could make an X-ray tube, construct a simple diffractometer, buy a set of Fourier strips, and produce contributions of real value to the subject. Nowadays, he appears to need an electronic computor, or at least a punched-card machine, some complicated diffractometers and a Geiger-counter outfit. The only steps in the opposite direction seem to be those which make use of optical analogies, introduced by G. von Eller in Paris and by the writer in Manchester. Crystallography will take its own course; but it will be a pity if it follows nuclear physics as a subject which can be studied only at centres large enough for complicated and expensive apparatus to be available.

A Congress of these dimensions could not have been easy to organize. It would have been better if there had been fewer papers; but granted the necessity for accepting all the papers offered, the organizers are to be congratulated on a most successful outcome of their efforts. H. Lipson

OBITUARIES

Sir Lewis Fermor, O.B.E., F.R.S.

The death of Sir Lewis Leigh Fermor on May 24 removes one of the most distinguished geologists who have worked in India during the present century, and his passing at a time when there was still much for him to do is a severe loss to Indian geology.

Fermor was born in London on September 18, 1880. He was educated at Wilson's Grammar School, Camberwell, and was awarded a National Scholarship to the Royal College of Science in 1898. Hoping to secure a post at the Royal Mint, he took his A.R.S.M. in metallurgy. However, at the invitation of Prof. J. W. Judd, he became a student assistant in geology while working for his B.Sc., and it was Judd who persuaded him to apply for one of three vacancies in the Geological Survey of India before he had completed his B.Sc. course. He was duly appointed in 1902, along with G. E. Pilgrim and J. M. Maclaren, and thus went to India primarily as a trained metallurgist, a fact that undoubtedly influenced the course of his geological work in India.

Soon after his appointment to the Survey, Fermor was deputed by Sir Thomas Holland to report on the manganese ore deposits of the country. Holland never anticipated that the investigation would be so detailed or so prolonged. But the resulting memoir was not published until 1909, and it extended to 1,294 pages. It was by this monumental work that Fermor became best known outside India. It included not only a detailed account of all the deposits, with a discussion on their mode of origin, but also important observations on the methods of mining, in which the pitch of the folded rocks was shown to be an important controlling factor. The field-work had also brought to light six new manganese minerals: hollandite, blanfordite, winchite, vredenbergite, sitaparite and juddite, while a seventh mineral, fermorite, was afterwards named after him.

On the completion of this work, Fermor was placed in charge of a party deputed to carry out a systematic survey of the Archæan rocks of the Central Provinces, and he himself surveyed a tract of country between Nagpur and Chhindwara, mapping the rocks in a more detailed manner than had ever before been attempted. The work was interrupted by the First World War, when his services were first lent to the Railway Board in connexion with the exploration of the Bokaro–Ramgarh coalfields, and later placed at the disposal of the Indian Munitions Board. In recognition of this work he was made an O.B.E. in 1919. After the War, work in the Central Provinces was resumed, and Fermor's own portion was completed in 1926. Unfortunately, administrative and other duties prevented the publication of this fine piece of work, though a summary of it was given in his later memoir on the correlation of the Archæan rocks of India.

Work of economic importance that Fermor accomplished during the same period included examination of the Singhbhum and Sikkim copper deposits, the iron ores of Ratnagiri and Goa, the Korea coalfield, the chromite deposits of Baluchistan and Singhbhum, and mica in Ajmer and Orissa.

In 1913 he had published a paper on "Garnet as a Geological Barometer". This was the starting point of a theme that was to recur more than once in his writings; for it led him to the conception of an infra-plutonic zone in the earth's crust composed of eclogite, which he considered to be responsible for the explosive nature of deep-focus earthquakes by the exothermic change of garnet to less dense minerals, for isostatic adjustments in the earth's crust, and for the high fluidity of the lavas of fissure eruptions. He also believed that the chondrules of stony meteorites had once been garnets. His views on these matters were elaborated in a series of lectures that he delivered to the Indian Association for the Cultivation of Science as Ripon professor for 1937, entitled "The Role of Garnet in Nature".

Before he retired from India, Fermor began the writing of a memoir that was to be an attempt at correlating the ancient schistose formations of India. After giving a general discussion on the factors to be considered in effecting a correlation, he had planned to give a summarized account of the geology of the

eight Archæan provinces into which he divided India and Burma. Of this plan only the general discussion and about a quarter of the account had been published by 1940, and other commitments prevented the completion of further sections before his death. Thus a work that would have been of the greatest value to geologists in India has been left largely uncompleted.

In the Geological Survey of India, Fermor was promoted to the grade of superintending geologist at the early age of thirty. Though he first officiated as director in 1922, it was not until 1932 that he was substantively appointed to the post. It was unfortunate for him that his period of office coincided with a period of financial stringency in India. This compelled him to reduce the staff of his Department, and prevented him from planning the work of the Survey as he would have liked. In other directions, however, he was able to render service to India, in particular by the part he played in helping to bring into existence a national scientific academy for the whole of India at a time when conflicting interests were tending to divide scientific India. This was effected by the formation of the National Institute of Sciences of India, of which he became the first president in 1935. During the same year he was president of the Royal Asiatic Society of Bengal, while earlier he had been president of the Mining and Geological Institute of India in 1922, and general president of the Indian Science Congress in 1933. To each of these institutions he delivered original addresses that indicated the wide scope of his outlook. He was elected a Fellow of the Royal Society in 1934 and the honour of knighthood was conferred on him on the eve of his retirement after thirty-three years service.

Though he retired from official service in India in 1935, he continued to play an active part in scientific matters. Perhaps the most important of these was his visit to Malaya in 1938 to report on the mining industry of that country. This report must have proved of the greatest value when the time came to reconstruct the country after the Second World War.

On retiring to Bristol, Fermor took an active part in local scientific life, and became president of the Bristol Naturalists Society in 1945 and 1946. Finally, he was elected president of the Institution of Mining and Metallurgy for the year 1951–52, the subject of his presidential address being "The Mineral Deposits of Gondwanaland".

From the time that he first went to school until he left for India, Fermor's education cost his father little, for both at school and at college, by hard work and ability, he won scholarships that paid for his school and college fees. No doubt it was due to this that he was able throughout his life to apply himself with great concentration to the task in hand, while it may also have been responsible for the relatively spartan life that he led. In later years he mellowed, and the patience and tact that he displayed at the time of the formation of the National Institute of Sciences of India revealed to many a new aspect of his character, and won him many friends.

W. D. West

Dr. Saul Dushman

By the death of Saul Dushman on July 8, the General Electric Company of Schenectady has lost one of a small group of scientists who became world-famous and who established the scientific traditions of the Company's research laboratories—the group which included W. D. Coolidge, Irving Langmuir and W. R. Whitney.

Dushman was born on July 12, 1883, in Rostoff, Russia, and his family migrated to Canada in 1892. They settled in Toronto, and when Saul Dushman left the high school there in 1900 he had the best scholastic record ever achieved in the province of Ontario. This won him the Prince of Wales Scholarship at the University of Toronto, where he obtained his A.B. degree in 1904 and Ph.D. in 1911. Soon afterwards he joined the Research Laboratory of the General Electric Co. and remained on its staff until his retirement thirty-seven years later. He was assistant director from 1928 until 1948.

His early work was on physico-chemical problems; but at the suggestion of Dr. Langmuir he changed over to experimental and theoretical work on thermionic emission, to which branch of physics he soon made important contributions. In 1923 he applied the theory of the vapour-pressure constant for monatomic gases to the derivation of an expression for the constant A_0 of Richardson's equation, which differs only by a factor of $\frac{1}{2}$ from the expression accepted to-day (electrons were not spinning in 1923 !). On the experimental side, with various colleagues he determined the thermionic constants for a number of pure metals and also for metals covered with adsorbed layers.

This work led Dushman to take an interest in vacuum physics, an interest which persisted to the end of his life. He wrote a short book on the subject in 1922, upon which many of us were brought up, and in 1949 there appeared his monumental volume of 882 pages on the same subject. Throughout the book Dr. Dushman's wide personal experience in the field is evident, and his early interest in physical chemistry coloured his choice and treatment of various topics—as indeed it did in his work on thermionic emission. The book will long be a memorial to his encyclopædic knowledge of his subject, his enthusiasm and his desire to serve others.

His colleagues in the laboratory remember him also for his deep interest in human beings, his friendliness and, again, his desire to serve. Physicists all over the world will join with them in paying tribute to his memory.

F. A. Vick

Dr. K. T. Compton

Karl Taylor Compton was born on September 14, 1887, in Wooster, Ohio. He received his bachelor's and master's degrees from the College of Wooster, where his father, a Presbyterian clergyman, was dean and professor of theology. Compton spent the first part of his academic life doing research and teaching physics. He was awarded a doctorate at Princeton in 1912 and, after teaching for two years at Reed College, Oregon, returned to Princeton in 1915, where he remained until 1930, becoming chairman of the Department of Physics in 1929. His numerous papers covered a variety of physical topics, including ionization of gases, soft X-rays, spectroscopy in the extreme ultra-violet, fluorescence and dissociation of gases, electric arcs and other types of gas discharge and photoelectricity. His contributions in spectroscopy and thermionic emission were recognized by the award of the Rumford Medal of the American Academy of Arts and Sciences. In 1927