the patient in three dimensions. By means of small condenser chambers the dosage can now be measured directly in the patient during treatment, and studies are being made of the measurement of the integral dose and of the causes of X-ray sickness. Artificial radioactive substances such as radio-sodium and radio-phosphorus are being used for tracer element experiments and for radiotherapy. At the Strange-ways Laboratory, Cambridge, the action of X-rays, γ -rays and α -rays have been studied in a large variety of materials ranging from inorganic substances, through *in vitro* culture of fibroblasts, to the normal brain of mice and rabbits.

At Leeds, Rudall has examined with X-rays the crystallographic structure of the proteins in the cells of the epidermis before and after cancerization, and finds that the proteins of papilloma tissues induced in rabbits by the Shope virus differ structurally from the proteins of normal skin.

The number of compounds which have been tested for chemotherapy in cancer must now run well into the thousands, and the present situation is that Haddow finds derivatives of 4-aminostilbene the most effective against transplantable tumours in rats; oestrogens are being used for prostatic human cancer and urethane for human leukaemia. It must be noted that all three compounds are also cancer-producing agents; for example, 4-dimethylaminostilbene evokes a wide variety of tumours in the rat, and urethane produces lung adenoma in mice. Oestrogens, while only weakly carcinogenic at the site of administration, produce uterine fibromata in the guinea pig (Lip-schutz) and also facilitate cancer of numerous organs and tissues in mice of strains liable to spontaneous mammary cancer (W. U. Gardener). These findings reinforce Haddow's original theory that carcinogenicity and tumour-inhibitory capacity are closely linked properties of chemical compounds, somewhat in the same way that radiations in different dosages can either produce or inhibit the growth of tumours.

Koller has continued his cytological studies of the mechanism of radiotherapy and comes to the conclusion that the success of the treatment depends largely on the indirect action of the radiation, that is, upon the still healthy tissue forming the tumour bed, rather than a lethal action upon the tumour cells directly.

At the Cancer Research Laboratories of the Hebrew University, Jerusalem, detailed studies are being made of the malignant conversion of normal fibroblasts *in vitro* by the Rous agent, and on the cytology of the different strains of rat sarcomas *in vitro*, which present a great variety of structural peculiarities, although they were obtained by the same agent, namely, benzpyrene.

Prof. and Mrs. Kennaway, continuing their examination of that treasury of information, the Registrar-General's reports on the deaths in Great Britain, have extracted the facts that cancer of the scrotum is about twenty times less common in men of the highest social class than it is in the general population. Thus hygienic habits of cleanliness, and perhaps other conditions common in the wealthiest social strata, could, if spread over society in general, greatly diminish at least one form of cancer.

Cornelia Hoch-Ligeti has been confirming earlier results showing that milk added to the diet of rats receiving butter yellow (dimethylaminoazobenzene) gives considerable protection against the formation of liver tumours. It is therefore possible that dietary deficiencies may partly account for the widespread

occurrence of liver cancer in the Japanese, Chinese, Indian and allied Asiatic races, and particularly the Bantus of South Africa, all of whom have been, until recently, less well nourished than Europeans.

Hieger, after ten years work on carcinogenic substances in human tissues (first discovered by Schabad in Leningrad), concludes that: (a) not only liver but also lung, kidney and muscle contain these substances; (b) human subjects that have died of cancer or of other diseases contain these agents; and (c) that they are to be found in the cholesterol-rich fraction of the tissues and are probably sterols or closely associated compounds.

OBITUARIES

Prof. F. Paschen

PROF. F. PASCHEN died in Potsdam on February 26; he was eighty-two years old. According to his daughter, the extreme cold at the time resulted in his contracting pneumonia, from which he failed to recover.

Paschen was a giant among spectroscopists, and with his passing there closes a chapter in classical spectroscopy which included such other names as those of Lockyer, Kayser and Fowler. It is difficult to realize that fifty-five years have passed since Paschen first began his classical work on the infra-red. Since then a veritable torrent of publication came from his pen, and only ceased with his death. He covered the whole of experimental spectroscopy in a masterly manner, making a succession of important discoveries. Infra-red measurements, precision wave-length determinations, analysis of series, interpretation of hyperfine structures, were all illuminated by him.

He developed the delicate Paschen galvanometer, discovered the Paschen infra-red series in hydrogen, was senior co-discoverer of the Paschen-Back effect in magneto-optics, invented the Paschen hollow cathode discharge and so on. His masterly analysis of the complicated series in the neon spectrum is a classic. Although the analysis of series in spectra was his major interest, yet he realized the value of the hollow cathode for hyperfine structure studies and did a great deal of work in this field too.

It was my good fortune to go to Berlin to study under Paschen in 1931, and he welcomed me as his first (and last) research student from England since 1914. My most vivid recollection is of a man with a dynamic virility, a freshness of mind and a generous nature. He had a profound understanding of most of the techniques of experimental spectroscopy, and it was an inspiration to see the energetic, impulsive manner in which he worked. His eyesight was unusually keen and he missed nothing. Withal he was an engaging raconteur, telling his amusing stories about physicists equally well in English and German. The Zeeman pictures he obtained will be surpassed only with difficulty, and he had a fund of knowledge on the use of high-resolution interferometers. He was essentially an exact experimenter, with little use either for gadgets or for those statistical methods which attempt to extract as much as possible out of observational data. In 1931 I showed him a trivial statistical trick I had developed. His smiling comment was: "If measurements on a plate are not self-consistent, smash the plate and take another. This is far better than statistics." A rash procedure

possibly, yet typical of the man, whose first aim was self-consistency and internal checking in all he attempted. Yet he was bold and adventurous in interpretation, with a masterly grasp over complexity. He had a deep respect for A. Fowler, who went to the other extreme and was hesitating and cautious. Paschen admired this caution and once remarked: "Fowler has never yet made a mistake". He confided to me that independently and simultaneously with Fowler he had arrived at the important analysis of carbon and silicon which showed the existence of multiple ionization spectra. Fowler's classic paper on this appeared first, and Paschen considered it was so much better than his work that he tore up his own manuscript. This was typical, for Paschen was the last man to take even due credit for himself, and was scrupulously just in apportioning credit and priorities to others.

Until the advent of Hitler, Paschen was president of the Physikalisch Technische Reichsanstalt; in 1933 he was dismissed by the Nazis and replaced by Stark. He had made himself highly unpopular with the Nazis by persistently purchasing considerable costly spectroscopic equipment from England, maintaining that German makers could not equal the British products. After 1933 he was permitted to use a small room in the Reichsanstalt. He strongly disliked the Nazis and their methods; but possibly his age saved him. He wrote me an open denunciatory letter in 1936, which if intercepted must surely have led him to the concentration camp. Between 1933 and 1939 his time was largely devoted to measuring old plates, and a few papers were published. In 1943 he lost all his possessions in a fire raid, but although seventy-eight years of age still kept on working, and to the last was engaged on calculations.

He had many pupils and has trained a whole generation of spectroscopists who have much to thank him for, particularly in Germany and in the United States.

S. TOLANSKY

The Right Hon. Sir Halford Mackinder, P.C.

BORN at Gainsborough on February 15, 1861, Halford John Mackinder was the son of a medical practitioner and received his school education at Epsom College, whence he proceeded to Christ Church, Oxford, becoming president of the Oxford Union in 1883.

It is not clear what turned Mackinder's attention in his student days to geography, which was then a subject unknown in the universities and despised by schools, but it was almost immediately after graduation that he planned a series of lectures under the title of "The New Geography" for the Oxford University Extension Lectures. His ideas he crystallized into a paper on "The Scope and Methods of Geography" which he read before the Royal Geographical Society in 1887. It was through the interest created in the Council of the Society that the University of Oxford appointed Mackinder in the same year to a readership in geography, the only previous holder of such a post having been Richard Hakluyt in the reign of Queen Elizabeth.

Although called to the Bar in 1886, Mackinder devoted himself to university work. He became a Student of Christ Church, Oxford, in 1892, and in the same year was appointed principal of University College, Reading, now the University of Reading.

While holding those posts he became president in 1895 of Section E (Geography) of the British Associa-

tion for the Advancement of Science, and put forward a powerful plea for the formation of a university institute of geography, where might be brought together what we now call 'physical' and 'human' geography on the same platform. It is again to the credit of the University of Oxford that the School of Geography there was created in 1899.

Mackinder lived to see his great aims for the university teaching of modern geography realized by the creation of honours schools in nearly all the universities of Great Britain, and there is no doubt that the part he himself played was an extremely important one.

Although he continued as reader in geography at Oxford until 1905, in 1903 he left Reading to become director of the London School of Economics and Political Science. The School was then only eight years old, and Mackinder succeeded Prof. W. A. S. Hewins. It is well known that the School was founded by a group of Socialists headed by Mr. and Mrs. Sidney Webb and Bernard Shaw; but its founders realized the danger of allowing party political views to dominate the activities of a young institution the sphere of work of which was, and is, a dispassionate academic study of economics, politics and the social sciences generally. Mackinder was already known for his Liberal-Unionist political views (he had contested Warwick as a Liberal in 1900), and his choice as director of the School supplied a valuable balancing influence and removed once and for all what might have been a real danger.

In 1909, at the age of forty-eight, Mackinder entered his political career by standing as Unionist candidate for Hawick Burghs. Though not successful in this attempt, in the following year he was elected for the Camlachie Division of Glasgow, a seat which he retained until 1922. He relinquished his post as director of the London School of Economics in 1908 but remained as reader in geography at the School (a post he had held part-time since 1900), later as professor, until 1925, serving under Pember Reeves and Sir William (now Lord) Beveridge as successive directors.

In 1920 Mackinder took charge of a special temporary mission as British High Commissioner for South Russia, at the completion of which he was knighted. After his retirement from academic work he served as a member of the Royal Commission on Food Prices in 1925, and in the following year was made a Privy Councillor, and became chairman of the Imperial Economic Committee. He was already chairman of the Imperial Shipping Committee, a post which he held from 1920, the year of its formation, until 1945.

It is difficult to assess the whole influence of Mackinder on the development of geographical thought. Although what he initiated and taught at Oxford, Reading and London has become absorbed as an essential part of geography as it is now studied throughout the universities of Britain, his ideas were often so in advance of those of his political contemporaries that they are only now coming to be appreciated. His most famous work, "Britain and the British Seas", appeared in 1902. It is rightly described as a classic. For the first time it related the physical features of our own familiar land with the sequence of human occupation and development and with our economic interests. In lucidity of language which is used to clothe the thoughts of a clear and brilliant brain, it has never been surpassed. His masterly analysis of the factors of position is only