Climatic Optimum. It is probable that the changes from year to year due to changes in the circulation are of the same order of magnitude as the average changes between the different post-glacial periods, and the problem now becomes that of finding out why such conditions persisted through decades or centuries instead of only for a year or two at a time.

Dr. C. E. P. Brooks said that the extreme climate, with cold winters and hot summers, which followed the retreat of the ice, could reasonably be put down to the combination of a greater inclination of the earth's axis and the fact that the earth was only just passing out of the condition in which the northern hemisphere was in aphelion in winter. The Climatic Optimum, which was not only mild but also seems to have been on the whole a period of greater rainfall than the present, required some other explanation. The highest temperatures preceded the maximum submergence of the Litorina Sea in Scandinavia; moreover, such a local cause could not explain a change over the whole hemisphere. He thought that the most likely cause was an increase of solar radiation, and he asked whether this could have been brought about by a cosmic cloud. Later, Prof. E. A. Milne and Mr. Hoyle replied that there could not be clouds small enough to cause changes of only a few hundred years, and, though there may be changes of density within a cloud, astronomical theory cannot be tied up with recent climatic changes.

The period which comes at the end of the Climatic Optimum had a peculiar, very extreme climate. Botanists thought that there were alternating contrasted periods of heavy rainfall and drought; at the end, from about 800 or 700 B.C. until 500 B.C., was a 'dry heat wave', after which the climate became very wet and stormy. Such oscillations must be due to changes in the frequency and tracks of depressions, and these might result either from changes of solar activity as indicated by the frequency of sunspots and auroras, or from changes in the outflow of Arctic ice into the Atlantic. The curve of solar activity cannot be traced with any reliability before A.D. 1000, and though there is some resemblance to the variations of rainfall, this is not very close. Dr. Brooks then referred to a theory put forward by O. Pettersson in 1914 that changes of climate since about 3500 B.C. were due to variations in the tides, and particularly in the submarine tides at the boundary of the Atlantic and Arctic. Tidal maxima occurred about 3500 B.C., 1900 B.C., 250 B.C. and A.D. 1433, and about these dates the Arctic ice-cap would tend to be broken up and much ice drift out into the Atlantic. These maxima agreed very well with the periods of maximum rainfall in the northern hemisphere, derived from peat bogs, levels of lakes and rivers, migrations and documentary evidence. He thought that after the Climatic Optimum, before the Arctic ice-cap had firmly re-established itself, the changes of climate resulting from changes in the ice would be very large. With regard to minor oscillations of the order of a decade, he asked if they must have a cause. Could they not just happen, as variations happen in any random series of events?

Mr. D. J. Schove described recent documentary evidence from China, which pointed to great droughts in the third and fourth centuries A.D., floods in the eleventh and drought in the twelfth. He remarked that in Europe the first half of the sixteenth century was very similar to the first half of the twentieth, but about 1540 there was a sudden change to good summers and cold winters. Other speakers men-

tioned the possibility of causes such as the disappearance of seaweed in the Sargasso Sea and the occurrence of great volcanic activity, for example, in the Rift Valley of Africa. Prof. P. A. Sheppard remarked on the tendency to look for the causes of climatic change everywhere but in the atmosphere, which goes through quite considerable swings not inspired directly by the sun. Although these are generally short-lived, they may be slowed down by the influence of a snow-cover, which may cause long-period variations.

The discussion showed that the various lines of attack on the problem of climatic change are beginning to converge. Our knowledge of the succession of events is becoming very detailed, and the meteorology of climatic change is becoming clearer; but there is not yet any general agreement on the causes. Variations of solar radiation are fundamental, however, and the problem is not likely to be finally solved until these have, in one way or another, been elucidated.

OBITUARIES

Prof. J. H. MacLagan Wedderburn, F.R.S.

JOSEPH HENRY MACLAGAN WEDDERBURN, emeritus professor of mathematics, Princeton University, died at his home in Princeton on October 9, 1948, at the age of sixty-six.

Prof. Wedderburn was born at Forfar in 1882 and educated in Edinburgh, where he graduated in 1903. While still an undergraduate, he was elected in 1902 to membership of the Edinburgh Mathematical Society, and soon afterwards, in 1903, to fellowship of the Royal Society of Edinburgh, which later, in 1924, awarded him the Makdougall-Brisbane Prize for his researches into hypercomplex numbers. He obtained the degree of D.Sc. of the University of Edinburgh in 1908. During 1905-9 he was assistant to Prof. George Chrystal, and is remembered as introducing the course in general analysis; but the natural bent of his mind was towards abstract algebra. This interest had been fostered by post-graduate residence in Leipzig, Berlin and Chicago, especially the last, where his mentors, E. H. Moore and L. E. Dickson, were to him a help and permanent inspiration. His first papers on modern algebra were published in 1905 in the *Transactions of the American Mathematical Society*. At the age of twenty-five he had acquired a mastery of the structure of algebras and had made a classical contribution to the theory of semi-simple algebras.

In 1909 Wedderburn left Edinburgh and joined the faculty of mathematics at Princeton University. The First World War interrupted his career for five years. He served in the Seaforth Highlanders, later in command of an observation group in the Royal Engineers, and was mentioned in dispatches. It is characteristic of his unassuming disposition that he had enlisted as a private.

Returning to Princeton, Wedderburn was assistant professor of mathematics during 1921-23, then associate professor until 1928, and finally full professor until he retired in 1945. In 1933 he was elected a fellow of the Royal Society. He never married, and was accustomed to spend his vacations in a remote farm in the Adirondacks.

Wedderburn was not a prolific writer, committing himself to publication only when he had something

of essential significance to impart. This gives an impression of reserve and distinction to his work. The present eminence of American mathematicians in algebra owes not a little to his pioneering, to his excellent teaching and to his editorship-in-chief, for nearly twenty years, of the *Annals of Mathematics*, which in 1911 became the charge of the Department of Mathematics at Princeton, and steadily rose to its present distinguished position among the mathematical periodicals of the world. The volume of the *Annals* published in 1946 was in effect a *Festschrift* dedicated to him. This may be taken as an indication of the respect in which he was held, not only by mathematicians in the United States, but also by mathematicians everywhere.

A. C. AITKEN

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Dr. George Scott Robertson

GEORGE SCOTT ROBERTSON, permanent secretary of the Ministry of Agriculture, Northern Ireland, died on December 22.

Although his family had been closely associated with Aberdeen for a long period, he was born in 1893 in Middlesbrough, where his father, William Robertson, was for many years editor of the *North Eastern Daily Gazette*. Robertson graduated B.Sc. (Agr.) at Armstrong College, University of Durham, and spent two years there as lecturer in agricultural chemistry. In 1914 he became head of the Chemistry Department of the East Anglian Institute of Agriculture, and in 1920 lecturer in agricultural chemistry at Queen's University, Belfast. A year after going to Northern Ireland he received, for his work on basic slag and rock phosphates, the first D.Sc. degree ever conferred by the University of Durham in its Faculty of Agriculture.

When the Government of Northern Ireland was formed, Robertson's inspiration and drive resulted in the creation of the Faculty of Agriculture in Queen's University, Belfast, which developed in the closest association with the Ministry of Agriculture, Northern Ireland. By 1924 he was professor of agricultural chemistry and dean of the Faculty, as well as senior research officer of the Ministry of Agriculture. By 1933 he became permanent secretary of this Ministry, and for fifteen years directed the work of his Department in peace and war, and saw it grow from a comparatively small organisation into one which to-day touches almost every phase of the life of agricultural Ulster.

Robertson's reputation extended far beyond Northern Ireland. He served with distinction on the Empire Marketing Board, the Imperial Agricultural Bureau, the Food Investigation Board of the Department of Scientific and Industrial Research and the Agricultural Research Council. For many years he was closely identified with the work of Section M (Agriculture) of the British Association; owing to illness, his presidential address at the Brighton meeting last September was read by a colleague.

In 1947 a striking tribute was paid to him when he was invited to become the first director of the new Agricultural Production Division of the Food and Agriculture Organisation of the United Nations. Robertson was absent from Northern Ireland on this work during the greater part of 1947, and when he returned to Belfast it was evident that his health had been impaired by the heavy work he had undertaken—a task superimposed on many years of active endeavour.

Robertson's great services to agriculture in Northern Ireland and in the furtherance of agricultural science throughout the world generally were recognized by Queen's University last year, when the degree of LL.D. (*honoris causa*) was conferred upon him.

His publications include "Basic Slags and Rock Phosphates" (1922) and many other contributions to scientific journals. His main research work was concerned with phosphatic fertilizers in Essex and later in Northern Ireland—investigations which were of outstanding importance and are quoted to-day as classics in their sphere—and pioneer work in collaboration with Sir John Boyd Orr on the mineral requirements of farm livestock.

Robertson was respected for his outstanding ability and qualifications as a leader by his colleagues. He was held in deep and abiding regard as a friend by very many who will mourn his loss.

J. HOUSTON

M. Louis Rapkine

1616

LOUIS RAPKINE was born at Chichenich in White Russia on July 14, 1904. His father, who was a tailor, migrated to Paris in 1911, taking his family with him, and after a difficult year, went to Montreal, where he worked in a factory. Rapkine grew up as a Canadian citizen. He gained his school education by scholarships. He was a good athlete, excelling in netball and swimming. He spent three years at McGill University, supporting himself by working in the summer vacations. When he was twenty, he left Canada to pursue scientific research in France.

Rapkine's scientific training was unusual, for he never took a doctorate. He worked in the laboratories of Caullery and Fauré-Fremiet, and in Wurmser's laboratory at the Institute of Physico-Chemical Biology. In France, at first, he had very meagre means of support. He kept himself by hawking in the countryside and selling boots at country fairs. Sometimes he starved, and was reduced to eating glucose from laboratory bottles.

In spite of these conditions, Rapkine did important work before he was twenty-one. With various collaborators, he published in 1925 extensive observations on the hydrogen ion concentration in egg-cells by the micro-injection of dissolved indicators. He investigated the oxidation-reduction potentials of the nucleus and cytoplasm, and showed that the old idea that the nucleus was a special centre of oxidation was without foundation. His situation was relieved by the award of a Rockefeller fellowship in 1926. He found that the respiratory quotient for the echinoderm egg at four hours after fertilization was extremely high, and then slowed down. He concluded, contrary to Warburg and Shearer, that in the initial period oxidation-reduction was concerned with synthesis, and independent of respiratory processes. He published a monograph in 1928 on the energetics of the development of the egg. He pointed out that the developing organism may have at its disposal sources of energy other than complete combustion to carbon dioxide and water, and remarked that peak-protein catabolism coincides precisely with the stage of development at which chick embryos best provide plasma for tissue culture. In the same year, he was appointed assistant at the Institute of Physico-Chemical Biology, and afterwards received appointments from the Centre National de la Recherche Scientifique.