Moore School of Engineering in Philadelphia, where Dr Mauchly and Dr. Eckert, designers of the ENIAC, were instructors. At that time only one type of high-speed memory was envisaged, the mercury delay-line carrying a train of pulses. The EDSAC will be a serial machine working in the scale of 2, with a capacity of 500 ten-decimal-digit numbers, some of which will act as orders. This should enable a start to be made on the applications contemplated. The machine will perform the arithmetical operations at an average rate of 15,000 a minute, assuming that 25 per cent of them are multiplications.

In view of the great advance in speed obtainable by electronic methods, Dr. Wilkes does not consider that the time has come to attempt the highest possible speeds. About two thirds of EDSAC's operating time will be spent in waiting for numbers to come out of the memory, so that an instantaneous memory with the same pulse length would be three times as quick. An upper speed limit for an electronic machine using conventional elements seems to be 6 million operations a second, 450 times the speed of EDSAC; but this figure is not in sight at present.

Prof. F. C. Williams (University of Manchester) described a method of storage he has designed, using an ordinary cathode ray tube. When a beam of cathode rays strikes an insulating surface capable of secondary emission, the potential of the spot bombarded is modified relative to the potential of the adjacent spots. Changes in the potential distribution on the inner surface of a cathode ray tube screen due to this effect give a measurable signal by capacitance coupling of an external pick-up plate. The signals depend on the change of potential distribution on the screen just before the beam was turned on—the essential requirement for a memory system. The individual digits to be stored correspond to a series of square waves applied to the brilliance control electrode, giving a row of bright spots on the screen. It has been found possible to store 32 rows of 64 dots on 12-inch diameter tubes. The two elements representing 0 and 1 are 'dot' (single spot) and 'dash', formed by adding an additional period of brilliance to the short pulse producing the dot. When this display has been 'written' in one sweep of the spot, subsequent sweeps of the beam 'read' the line by delivering signals characteristic of the pattern, namely, a negative pulse for a dot and a positive pulse for a dash.

A charge distribution on a cathode ray tube surface tends to 'spread' and leak away within about a second. This effect is neutralized by 're-writing' the record at regular intervals, short compared with the leakage time. It is proposed to devote alternate line-sweeps to reading an arbitrary line for computing purposes, and reading the lines in a regular order for regeneration purposes. Regeneration will take place every 20 milliseconds on this plan. Recognizable patterns have been set up and stored without change for periods of 4½ hours. The time-scale of the storage is 8μsec. per digit (making allowance for the time spent in regeneration). This is slower than the projected 'delay-tank' systems, but time is saved by the greater accessibility. The slower time-scale has also the advantage that the various circuits can operate more slowly, permitting some under-running of the valves.

Mr. J. H. Wilkinson (Mathematics Division, National Physical Laboratory) spoke on the machine, ACE, which is being made at the National Physical Laboratory. He compared the effective speed of mercury-tank delay line and cathode ray storage. If instructions are suitably disposed in the delay lines, and if there are some short lines holding one instruction each, there need be no waiting for the right instructions to come round. The fact that a large proportion of the operations performed are devoted to counting the lengths of induction-cycles or applying discrimination tests makes it less important that a number is stored as one of thirty-two items in a long tank; and the fact that whole sequences of numbers can be transferred by one order introduces a positive simplification in the coding.

The detailed coding, depending on the type of machine, is likely to be a small job compared with the more mathematical side of the preparation of problems; for example, arranging that the numbers involved stay in the permissible range. By preliminary work of the kind now being done at the National Physical Laboratory, it is hoped to reduce this mathematical part of the preparatory work by providing standard units which can be inserted whole into larger routines. Practical numerical investigations are being carried out with ordinary desk machines, which often reveal difficulties that might otherwise be overlooked.

Mr. J. D. Booth described a parallel-operation machine which is in course of construction at Birkbeck College, in which the storage is a rotating magnetic drum, having a capacity of about 4,000 numbers, each of forty digits. Mr. Aughtie (Mathematics Division, National Physical Laboratory) spoke on the problem of input and output, namely, loading the machine with the data and instructions for a problem, and extracting the final answer in convenient form.

A detailed report of the discussion will be published in the *Proceedings of the Royal Society* in due course.

[1] von Neumann, J., and Goldstine, H. H., *Bull. Amer. Math. Soc.*, **53**, 1021 (1947).
[2] To be published shortly.

OBITUARIES

Prof. James McIntosh

MANY readers will have learned with regret of the death of Prof. James McIntosh, which occurred on April 5 at his home in Aberdeen. He was at the time of his death professor of pathology in the University of London and director of the Bland-Sutton Institute of Pathology, at the Middlesex Hospital, a post which he had held since 1920.

The purpose of an obituary notice is to give the reader a picture of the man as he was when at work, and to try to give some idea of his personality. The formal facts of McIntosh's career can always be found in standard works of reference, and therefore only a brief summary need be given here. He was born in Aberdeen and educated at the Robert Gordon College and at the University of Aberdeen, where he qualified in 1905 after a brilliant career as a student. In 1906 he was awarded the Alexander Anderson Scholarship, and this enabled him to spend the next two years at the Pasteur Institute working under Levaditi. It was here that his life-long interest in virus diseases first became aroused.

McIntosh's first studies were concerned with the etiology and chemotherapy of syphilis. He began these in Paris and continued them on his return to

Aberdeen and later at the London Hospital, where he worked in collaboration with Fildes. He also carried out some work on the etiology of acute anterior poliomyelitis. During the First World War he did invaluable work on the isolation, recognition and classification of the anaerobic bacteria of war wounds, and the results were outlined in a special report to the Medical Research Committee. His interest in virus diseases continued after his appointment as director of the Bland-Sutton Institute, and he made a special study of the virus infections of the central nervous system. The experiments of Gye and Barnard on the Rous filterable sarcoma turned his attention to the possible connexion between virus infection and cancer. His most important work in this direction was the production of filterable tumours by means of chemical carcinogens. This work may prove to be of the greatest significance and, in fact, to be a turning point in the history of cancer research.

In appearance McIntosh was a shortish man with black hair turning to grey in later years, with slightly rounded shoulders, which he himself attributed to having spent the greater part of his life looking down a microscope. He had a curious offhand way of speaking which gave the mistaken impression that he was not particularly interested in what one was saying. This characteristic was displayed at meetings, when he would apparently go off at a tangent and introduce what seemed to be a lot of irrelevant material. Frequently his points would be dismissed as being of no importance; but almost invariably McIntosh would come back and secure a complete victory for his views, before his opponents had realized what had happened. At scientific meetings he gave the impression of being difficult; but people in his own laboratory were always struck with his kindness to them and knew they could rely on his continued help and interest.

In conclusion, one must say that McIntosh's scientific career was a stormy one, as he wished it to be. But in whatever he touched, however, whether it be vaccinia, anaerobes, syphilis or the etiology of malignant disease, he stirred up a controversy necessitating a great deal of experimental work, and this work will go on for a very long time. E. C. DODDS

WE regret to announce the following deaths:

Dr. Vaughan Cornish, president in 1928 of the Geographical Association, on May 1, aged eighty-five.

Dr. J. G. Parker, sometime principal of the Leathersellers' Technical College, London, honorary secretary during 1897–1912 of the International Association of Leather Trades' Chemists, on April 30, aged seventy-eight.

NEWS and VIEWS

Plant Breeding Institute, Cambridge

BY agreement between the University of Cambridge, the Ministry of Agriculture and the Agricultural Research Council, it has been decided that, as soon as conditions become favourable, the Plant Breeding Institute at Cambridge shall be transferred from its existing site on the University Farm to one offering greater facilities to an increased staff. When the move is made, management by the University will be transferred to an independent body comparable with those which govern such agricultural research institutes as Rothamsted and East Malling. Meanwhile, the Plant Breeding Institute will remain attached to the School of Agriculture at Cambridge as at present. The future expansion in plant breeding which is envisaged is a notable part of the general programme of development of agricultural research in Great Britain, financed by the Ministry of Agriculture in consultation with the Agricultural Research Council. The Institute will concern itself with the full range of arable and pasture crops grown in the eastern and drier parts of Britain, although the interests of other regions in certain crops will not be neglected. It already handles wheat, barley, oats, potatoes, sugar beet, beans, peas, lucerne and sainfoin, and in addition to expanding the work on these crops, others such as rapes, kales and certain herbage plants will be included. Fundamental breeding problems are envisaged as an important part of the Institute's programme in the future.

Since the Cambridge Plant Breeding Institute was established with Sir Rowland Biffen as first director, several new varieties of crop plants, which are now well known and commercially successful, have been produced, including 'Little Joss' and 'Yeoman' wheats (by Sir Rowland Biffen), 'Holdfast' and 'Steadfast' wheats (by Sir Frank Engledow), and 'Picton' oat and 'Camton' barley (by Dr. H. Hunter). Sir Rowland Biffen was succeeded as director by Dr. Hunter, who retired in 1946. Dr. G. D. H. Bell was then appointed acting director and he has now been confirmed as director of the Institute, which, as indicated above, is to be expanded and established as a separate research organisation.

Dr. G. D. H. Bell

DR. BELL, the new director of the Plant Breeding Institute, is a fellow of Selwyn College and University lecturer in agricultural botany, and has been a member of the staff of the Plant Breeding Institute since 1932. He received his early scientific training at University College, Bangor, whence he obtained an agricultural scholarship for postgraduate study in genetics and plant breeding at Cambridge and in the United States. He has travelled extensively in western and northern Europe and in the West Indies. His teaching duties are now confined to lecturing to graduate classes on agricultural botany, with particular reference to problems of crop improvement; but these teaching duties will be reduced as his responsibilities as director of the Plant Breeding Institute increase. He will shortly publish a book on "Cultivated Plants of the Farm". His investigations have been centred on the breeding of barley, field peas and sugar beet; but he is now also interested in wheat and oats. He has produced two new varieties of barley, already on the market, 'Prefect' and 'Pioneer', the latter being the first winter-hardy malting barley to be bred in Great Britain. Much of his time during the War was occupied with problems concerning sugar beet. With regard to general crop improvement in Britain, he is anxious to increase the