plex; at suitable time intervals the complex was destroyed by acid, the cobaltous ion extracted quantitatively and its specific activity determined from its gamma-radiation; the specific activity decreases, naturally, if part of the active cobalt enters the cobaltic complex. Complexes containing either ammonia or ethylenediamine were studied, and exchange-rate constants determined.

While in the above papers radioactive tracers were employed in order to study exchange reactions, M. Haïssinsky, from the Institut de Radium, Paris, gave an example of their usefulness in examining the behaviour of chemical elements in extreme dilution. Together with A. Coche, he reported new "Experiments on the Cathodic Deposition of Radioelements". Their results indicate that, contrary to some previous statements, the Nernst electrochemical equation is valid for the bismuth isotope thorium C down to 10^{-13} N, and for the lead isotope thorium B to 10^{-10} N, if the cathode consists of gold, silver, copper or nickel; they found, however, some anomalies with other electrodes. In the case of polonium, these were attributed to the penetration of polonium atoms into the metal of the cathode.

Before organic-chemical and biological problems were discussed in the afternoon session, J. F. Duncan described studies carried out by himself, G. B. Cook and A. W. Kenny at Harwell on "Techniques in Radiochemical Assay". He issued a warning against possible errors in beta counting, such as those due to multiple counts, variation of high tension or temperature, self-absorption, back-scattering, etc.; fortunately, most of these can be avoided without great difficulty if for the purpose of the experiment only knowledge of the relative values of activities is necessary, and this is the case in the majority of biological applications.

Prof. E. D. Hughes, of University College, London, spoke on "Radioactive Halogens and the Mechanism of Substitution Reactions". He showed how the study of such old problems of classical organic chemistry as the mechanism of replacement, racemization and Walden inversion can be helped by the radioactive technique; in the cases considered, it could be shown that bond-formation and bond-fission occurred synchronously.

Biochemical problems were discussed by the last four speakers. In their "Studies with Radioactive Penicillin", S. Rowlands, D. Rowley and E. Lester Smith, of the University of Edinburgh, prepared penicillin labelled with sulphur-35 by growing the mould on a medium containing activated sulphate. The penicillin obtained was sufficiently active to make it possible to follow up its fate in experimental animals. It was found that, if injected intramuscularly, 100 per cent of it was excreted with the urine. On the other hand, if bacteria were killed with the activated penicillin, no active sulphur could be detected in them, which proved that less than ten molecules of penicillin had been taken up by a bacterium.

F. D. S. Butement, of the Atomic Energy Research Establishment, Harwell, showed in his paper on "Radioactive Tracers in Antisera" how the study of problems of immunology can be refined. He succeeded in introducing iodine-131 into the globulin fraction of antiserum without destroying its specific agglutinating properties; the amount of iodine activity carried on *Proteus vulgaris* when agglutinated by the specific antiserum could be used to measure the agglutinin.

From the University of Saskatchewan came a paper by Prof. J. W. T. Spinks and G. Dion on the "Study of Fertilizer Uptake using Radio-Phosphorus"; it was read by R. Spence. The authors made use of phosphorus-32 to measure the uptake of fertilizer phosphorus and soil phosphorus by wheat plants; as fertilizers they employed, in field and in greenhouse experiments, ammonium, sodium- and calcium-phosphates. Their results showed, among other facts, that in the early stages of growth practically all the phosphorus taken up comes from the fertilizer, while during the later stages the phosphorus uptake from this source is relatively small.

In his report on "Some Chemical Problems in the Use as a Fumigant of Methyl Bromide Labelled with ^{82}Br", F. P. W. Winteringham, from the Pest Infestation Laboratory, Slough, demonstrated a new way in which the fate of the fumigant can be followed up in treated foodstuffs and in infesting insects. It concluded a well-attended and very successful discussion meeting. F. A. PANETH

PROGRESS IN HIGH-SPEED CALCULATING MACHINE DESIGN

A CONFERENCE on high-speed automatic digital calculating machines was held in the University Mathematical Laboratory at Cambridge during June 22–25 to mark the completion of the EDSAC (electronic delay storage automatic calculator).

The EDSAC is a serial binary machine based on the ideas put forward in an unpublished report circulated in 1945 by von Neumann on behalf of the group working at the Moore School of Electrical Engineering in Philadelphia, where the ENIAC—the first electronic calculating machine ever built—was at that time under construction. The EDSAC is believed to be the first complete machine of its kind to be put into operation, although a slightly smaller machine, without automatic input and printing devices, has been built at the University of Manchester. This machine was described to the conference by Prof. F. C. Williams and Dr. T. Kilburn. Several machines are nearly completed in the United States. Information about these was given in a paper communicated by Dr. H. D. Huskey (National Bureau of Standards).

In the EDSAC, ultrasonic delay units are used for storage, the total capacity for orders and numbers (each with sixteen binary digits—equivalent to five decimals) being 1,024. There are facilities for combining two adjacent storage locations so as to hold a number with the equivalent of ten decimal digits. The programme of orders and any numerical data required are fed into the machine from a punched tape, and the results of the calculation are printed automatically on a teleprinter. The EDSAC was demonstrated to members of the conference by the writer and Mr. W. Renwick.

The EDSAC and the machines like it are a great advance on the ENIAC in that they are very much smaller and yet have greater storage capacity for numbers. Most people will, however, agree that electronic calculating machines are still too large—the EDSAC has more than three thousand valves—and that one of the primary aims of future research must be to reduce their size. In the present writer's

view, this is at present more important than attempting to achieve the maximum speeds which are possible using electronic methods. Reliability of operation and the rapidity with which faults may be located depend on size and, as Dr. H. H. Aiken, director of the Computation Laboratory of Harvard University, is fond of pointing out, the overall speed of operation depends as much on these factors as on the intrinsic operating speed. It was unfortunate that Dr. Aiken was not able to attend the conference, since developments in his laboratory are proceeding along rather different lines from those indicated in this article.

The component parts of an automatic computing machine are : control, store, input–output unit, and arithmetical unit. The arithmetical unit usually provides for addition, subtraction and multiplication, and perhaps for division. It may also include special devices for extracting square roots, for evaluating sines and cosines, and for other similar functions. Since the whole of arithmetic can be reduced to addition and subtraction, it is strictly only necessary to provide for these two operations ; multiplication, for example, is then done by a programmed series of additions. There must, of course, in any automatic machine, be provision for some kind of conditional order by which, at any given stage in the calculation, the action of the machine may be made to depend on the results of previous calculations.

So far as the writer is aware, no full-scale machine which does not include a multiplier has been proposed, although the first experimental machine to be built at Manchester had provision for subtraction only ; on this machine even addition had to be programmed as two subtractions. On the other hand, judging by the discussions which took place at the conference, few designers would now wish to provide special equipment for the evaluation of square roots and special functions, and many would not provide a divider, preferring to rely on the use of an iterative formula involving multiplication and addition only.

The disadvantage of providing specialized equipment for particular functions is that the machine is thereby made more complicated than it need be. The main advantage is that the operating speed can be increased. For example, a programmed multiplication on the EDSAC would take about 0·5 s. compared with 5 ms. for the built-in multiplier. Most of this time is spent in waiting for orders and numbers to come out of the delay-type store, and, if a store from which any order or number could be obtained within a few microseconds were available, a machine without an automatic multiplier would be a practical proposition. Mr. J. H. Wilkinson (National Physical Laboratory), in opening a discussion on programming, pointed out that, even with an ultrasonic delay store, if orders and numbers are so located that they become available just when required, the time for a programmed multiplication can be reduced to about 16 ms. as compared with 3 ms. for a built-in multiplier. These figures apply to the ACE, a machine for which a pilot model is now being built at the National Physical Laboratory. This loss of speed is a price which might very well be paid for the resulting simplification of the arithmetical unit.

One further advantage of providing separate equipment for specialized functions is that it simplifies programming and hence makes the machine easier to use. This advantage is not, however, so substantial as at first sight appears. The reason is as follows. The programme for a practical problem will normally be constructed by assembling a number of ready-made 'sub-routines' drawn from a 'library' associated with the machine. The library will include a sub-routine for evaluating square roots, one for evaluating sines, etc. Apart from other considerations, experience at Cambridge has shown that, if sub-routines are not used, it is quite difficult to construct a long programme which is free from accidental errors. Once a sub-routine has been incorporated in a programme it can be called in whenever it is required by a short group of orders. The work of constructing a sub-routine can be compared to that of building a piece of equipment for p r forming the same function. For example, one can either employ an engineer to construct a device for evaluating square roots, or a mathematician to design a sub-routine, based on the four rules of arithmetic, for the same purpose. In either case, the work is done once for all, and the degree of convenience for the ultimate user is much the same. The difference is that the mathematician's work will not need any maintenance, whereas the engineer's will. A machine which makes use of sub-routines instead of specialized units will, of course, need slightly greater storage capacity in order to hold the necessary orders, and this fact must not be forgotten when assessing the relative advantages of the two systems.

Most of the automatic calculating machines now being designed make use of the binary scale for all internal calculations, conversion to and from the decimal scale being done during input and output by means of a sub-routine. Prof. D. R. Hartree expressed the view that this is a passing phase and that designers will revert to the use of the decimal system throughout. While agreeing that this may perhaps be so, the writer would wish to draw a distinction between decimal machines constructed from elements with two stable states, such as 'flip-flops', and those constructed from elements with ten stable states such as counter wheels. The former can be described as 'disguised binary' machines, and it would appear that they will always be less economical in equipment than pure binary machines.

The choice between having complications in the machine or complications in the programme arises also when methods of checking are considered. Dr. A. M. Uttley (Telecommunications Research Establishment) put the case for building into the machine a complete series of checking circuits so arranged that the machine will stop the moment any element fails to operate correctly ; if necessary, he would be prepared to increase the size of the machine by 50 per cent for this purpose. Mr. S. W. Noble and Mr. R. H. A. Carter described some three-state trigger and adding circuits which have been developed at the Telecommunications Research Establishment for use in a machine in which a positive indication is to be provided for both 0's and 1's. The case for relying on mathematical checks incorporated in the programme was put by Mr. D. J. Wheeler (Mathematical Laboratory, Cambridge) and supported by Prof. F. C. Williams (University of Manchester) and Dr. J. C. P. Miller (Scientific Computing Service).

Mr. E. N. Mutch (Mathematical Laboratory, Cambridge) opened a discussion on permanent and semi-permanent storage facilities for sub-routines and numerical data. Punched paper tape and celluloid film on which records are made photographically or mechanically and read by photo-electric means are examples of methods of permanent storage ; magnetic

recording on wire, tape or a drum is semi-permanent. Mr. G. E. Thomas described a magnetic-drum system in use in Manchester, and Mr. A. Tutchings spoke of some work in progress at the Telecommunications Research Establishment.

When a sub-routine is incorporated in a programme, it is often necessary to modify some of the orders according to their location in the main programme. Mr. Wheeler described how this is done at Cambridge; at the time the sub-routines are taken into the machine, the orders are modified by means of a sequence of 'co-ordinating orders'. Dr. Kilburn and Prof. M. H. A. Newman explained a different system used in the machine at Manchester, where an extra adding circuit is associated with the control system in such a way that one of two numbers (as the programmer may choose) can be added to the numerical part of each order (the address) before it is executed.

Much of what has been said about electronic machines applies also to relay machines; but since a single relay can carry a number of contacts, and since problems of interaction are not so serious as with valves, more elaborate circuit arrangements are possible without increasing the size of the machine unduly. On the other hand, relays suffer from contact bounce and from transient faults caused by dust between the contacts.

Miss K. H. V. Britten (British Rubber Producers' Research Association) presented, on behalf of Dr. A. D. Booth (Birkbeck College, London), a paper on relay machines, and described the automatic relay calculator which is now nearly completed. This is a parallel binary machine with a magnetic-drum store, and is notable for its small size; it contains only about eight hundred high-speed relays. Numbers contain twenty binary digits and a sign digit. Dr. A. van Wijngaarden described a somewhat similar machine under construction at the Mathematische Centrum at Amsterdam. Dr. S. H. Hollindale gave some information about a relay machine being built at the Royal Aircraft Establishment. This is a true decimal machine, using stepping switches for the registers, and has a floating decimal point. Another relay machine, under construction in Sweden, was described by Mr. G. Kjellberg. M. V. WILKES

NEWS and VIEWS

Newcastle upon Tyne and District

IN preparing a handbook for members of the British Association attending the Newcastle meeting, the local committee has reverted to the older scheme of a publication embracing all aspects of natural history and botany as well as industries of the city and district entertaining the Association. "The Scientific Survey of North Eastern England", which is to be given to each member attending the meeting, is now successful and should find ready acceptance. Physiography, geology and climate are specially notable, while iron and steel, shipbuilding and engineering, of course, command full notice. Broadly speaking, the area covered is Northumberland and Durham, with the northern part of the North Riding of Yorkshire, which Prof. G. H. J. Daysh, who writes an introductory note, points out is a clearly defined region with a character and individuality of its own, though with great and contrasting interests within its boundaries. At least two new towns, Newton Aycliffe and Peterloe, fall within the programme of development of the region. The survey is well documented and has adequate maps, including an ingenious one showing forms of rural and urban buildings in the area.

Sir Gilbert Blane (1749-1834)

GILBERT BLANE was born at Blanesfield, Ayrshire, on August 29, 1749. After studying at Edinburgh and graduating M.D. at the University of Glasgow in 1778, he sailed to the West Indies in 1779 as private physician to Admiral Lord Rodney. His ability and coolness in action won him the Admiral's friendship and the appointment of physician to the Fleet. On his return to London he was elected physician to St. Thomas's Hospital. When Blane was a boy of four, James Lind recommended the use of fresh fruit and vegetables for the prevention of scurvy. At forty-seven, Blane, as commissioner for sick and wounded seamen, succeeded in getting Lind's pioneer suggestion officially adopted by the Admiralty. The disease at once disappeared from the official sick-returns. Other naval reforms effected by Blane were the ventilation and cleansing of ships, the supply of soap and medical necessities, and the introduction of hospital ships to take the place of shore hospitals. He also advised on quarantine legislation, on the prevention of prison fever, and on many other public health problems. He became a baronet in 1812 after his return from Walcheren, where he had arranged for the transport of the sick following government acceptance of his advice to withdraw the disease-stricken troops from that unhealthy island. Physician-in-ordinary to George IV, and a Fellow of the Royal Societies of London and Edinburgh, his most important book was "Observations on the Diseases Incident to Seamen" (1785). Blane's health began to fail in 1821, and he died on June 27, 1834. Because of his austerity he was nicknamed "Chilblain"; but in the annals of history he lives as the 'Father of Naval Medical Science', whose memory is honoured by the Royal College of Surgeons in the annual award of the Blane Gold Medal.

Standardization

AT the recent forty-eighth annual general meeting of the British Standards Institution, the president, Lord McGowan, referred to the greatly increased interest during the past year, both by industry and Government, in the extension of voluntary standardization on a national basis. Under the chairmanship of Sir Ernest Lemon, the investigations by the committee for standardization of engineering products, which was set up by the Ministry of Supply, have substantiated the view, long held by British industry, that the principles under which the British Standards Institution works are effective and can be considerably extended. The Anglo-American Productivity Council has recently stressed the importance of standardization and simplified practice, and Lord McGowan submitted that there is probably no more effective means for increasing productivity. Another significant development during the past year has been the co-operation of the great nationalized