interactions, particularly how it is possible to reconcile the violation of parity in strong interactions involving K-mesons with the quasi conservation in nuclear interactions involving π-mesons. Another problem being studied relates to the magnetic moment of the μ-meson.

Apart from the two accelerators, their experimental programmes and theoretical work, CERN is carrying out a basic research programme on new methods of accelerating particles, the results of which can be used as a basis for future machines and to improve the existing machines. The Accelerator Research Group is at present studying intersecting-beam machines that will yield energies in the centre of mass system higher than is practicable with existing machines using targets in which the bombarded nuclei are at rest, very high current machines using beam stacking techniques, and plasma accelerators that can either be used as high-current machines or to provide, by means of very high circulating electron beam currents, intense magnetic guide fields for heavier particles. Several experimental plasma betatrons have been built, and an electron beam stacking model is now being planned which will provide a flexible experimental tool for investigating stability problems in high-current beams and in intersecting-beam machines.

The total staff of CERN is nearly a thousand, about two hundred of which are physicists and engineers, and in addition to staff appointments CERN offers fellowships to enable physicists from all over the world to participate in the work of the Laboratory. About sixty physicists are currently using these fellowships at CERN.

THE BRITISH COMPUTER SOCIETY

FIRST CONFERENCE

IN view of the widespread interest in computers nowadays, particularly in the fields of science and engineering, it is perhaps, a little surprising that the British Computer Society should have held only its first conference last June. However, as the president, Dr. M. V. Wilkes, reminded us, it was not the first time that a conference of those interested in computing had been held at Cambridge, the last one being almost exactly 10 years previously, when the subject was in its infancy. The rapid growth of interest in the subject is instanced by the capacity attendance of 330 at the conference and by the increasing membership of the British Computer Society, which is now more than 2,000, drawn from a wide variety of backgrounds.

These differing backgrounds accounted for the considerable range of topics discussed, running from the structure of myoglobin through automatic programming and logical design to the problems of auditing accounts kept by computers. The work currently being done by Perutz, Kendrew and others on protein structures would scarcely have been possible without the use of fast computing machinery, and Dr. J. C. Kendrew, in his interesting address, brought out clearly the importance of the existence of, and of further developments in, these powerful tools. He described the work recently done on the structure of myoglobin, mainly using X-ray diffraction techniques applied to structures into which a heavy atom had been artificially introduced by chemical methods. Photographs of diffraction patterns from single crystals have enabled the broad outlines of the structure to be determined and a model of the polypeptide chain to be built up. It is hoped next to determine the detailed atomic positions within the structure by more sophisticated techniques. These techniques will involve processing very large amounts of data, some thousands of reflexions being obtained from the X-ray apparatus.

All these must be included in the refinement calculations, which result in the tabulation of electron density values over a hundred or more two-dimensional Fourier sections through the crystal, each section involving evaluations at many hundreds of points. The processing will thus require not only very rapid calculation facilities, but also adequate supporting equipment for input of data and output of results. Furthermore, myoglobin is one of the simpler protein structures, so that future advances in this field will undoubtedly require the fastest and largest equipment available.

Developments in very fast computers were described in a crowded session by Drs. T. Kilburn (Manchester), M. Lehmann (Israel), and N. C. Metropolis (Chicago). Dr. Kilburn described the *Muse* project, which is now in an advanced stage of planning, to build a computer at the University of Manchester with speeds of operation in the millimicrosecond range. This machine, like most other modern developments, will rely primarily on transistors and magnetic cores as fundamental elements for storage, arithmetic operation, and control. The arithmetic unit, a prototype of which has been built and is now being tested, is capable of carrying out multiplications and additions on numbers in floating point representation in less than 2 microseconds, and administrative instructions will be carried out in less than 1/5 μsec. The main storage is to be on magnetic cores, with an access time of 2 μsec. However, overlapping of operations in some parts of the machine will reduce the effective access to $\frac{1}{2}$ μsec. In addition, a special store is also provided from which words can be read in about 1/7 μsec., but into which writing is restricted. A wide use of time sharing is to be made in controlling input, output and bulk storage mechanisms, such as magnetic tapes. Up to 16 magnetic tapes and, in addition, up to 16 slower mechanisms can be feeding into or be fed by the computer simultaneously, the computer control scanning these units in sequence at a pace sufficiently rapid to allow inspection of each one at a suitable interval.

It is hoped that this very powerful machine will be working in just over two years time, and that copies will later be available commercially.

Dr. Lehmann described a fast but comparatively small computer which is being designed for the Israeli Ministry of Defence. This will include an 8,000-word drum and a core store of 128 words, and is expected to be very cheap to produce, although comparable in speed with many of the large machines of to-day, which cost hundreds of thousands of pounds.

Dr. Metropolis described the computer being developed at the University of Chicago under his direction. This machine is to be in the same speed-range as the

Muse, but is not planned, at present, on quite such a large scale. Nevertheless a core store of more than 8,000 words with an access time of 2 μsec. is to be provided, and there is provision for at least four magnetic tape mechanisms to be attached to the machine. Two very interesting features are the proposed structure of the arithmetic unit and a new method of number representation it is intended to incorporate. The arithmetic unit is to be built on the same principle as that of the *Maniac* at Los Alamos, using asynchronous circuitry, but will include many additional cross-connexions between registers to facilitate rapid arithmetical working. A number representation, called 'significant digit' representation, will be used. This is a form of floating point representation which avoids the appearance of many meaningless digits at the end of approximate numbers, while retaining a few guarding digits against rounding errors.

An important application of fast machines is to problems in supersonic flow-past aerofoils and other surfaces. An interesting contribution to this subject was made by Mr. D. S. Butler of the Armaments Research and Development Establishment, who described some recent work he has carried out on this problem.

In order to calculate the lines of flow around and pressures on a solid figure in a supersonic airstream it is necessary to solve a hyperbolic partial differential equation in three variables. He discussed various methods of doing this and made particular reference to the method of characteristics, a powerful technique for solving equations of this type. He went on to describe a particular example of stationary flow around a body shaped like a delta-wing aircraft and showed how the calculations had been carried out in this case using the computer at Fort Halstead, a Ferranti Mk. 1*.

Other topics at the conference which excited considerable interest concerned the control of production in factories and the application of operational research techniques to this and allied problems. Mr. F. Bryen of Imperial Chemical Industries described an application of punched card machinery to factory control, and Mr. J. Harling of Urwick, Orr and Partners dealt very interestingly with the use of computers for operations research. An application of one of the latter techniques within the Shell group of companies formed the subject of a later address by Mr. C. S. Galer. There were also sessions on keeping accounts by computer, on auditing the accounts so kept, on the training and selection of programmers, on automatic programming, and on working experience with magnetic tape mechanisms. On the mathematical side, Dr. A. S. Householder of the Oak Ridge National Laboratory, Tennessee, directed attention to some of the pitfalls in the techniques commonly used on computers. In particular, he considered the stability of two methods of inverting a matrix, and concluded that the method of rotation is not more stable than the method of elimination, although an argument can be adduced to the effect that it is. After this paper, as after all the formal papers presented, there was a lively discussion, in which many of the delegates took part.

A wide-ranging review of the state of the computing art was given by two speakers, Mr. J. A. Goldsmith of Robson, Morrow and Co., and Dr. A. S. Douglas of the University of Leeds. Mr. Goldsmith noted that delivery of 76 installations of electronic computers had so far been made in the United Kingdom and that 33 were on order, although recently the tempo of orders had slackened. Much of the work in the commercial field had so far been unambitious and the results somewhat disappointing. He felt that it would be 5–10 years before computers played a full part in helping management to control their organizations. Dr. Douglas reviewed the work of computers in British universities. Much work has been done in training in their use at the postgraduate-level, and he felt that this could well be extended to the undergraduate-level. He discussed the problem confronting universities in the installation and use of large-scale machinery, and suggested that it would be desirable for three or more of the large fast computers such as *Muse* to be installed in universities, where they would act (on a service basis) as focuses for local computer users. He gave details of serviceability and use of typical present-day university installations, and concluded that a high standard of efficiency can be attained.

All the sessions were very well attended throughout. It is intended in the future to hold annual conferences of the Society at various centres in the United Kingdom, the next conference being planned for June or July 1960.

A. S. DOUGLAS

THE INTERNATIONAL INSTITUTE OF REFRIGERATION

THE first International Congress of Refrigeration was held in Paris in October 1908. Shortly after this, in January 1909, the International Association of Refrigeration was established, following the suggestion of Kamerlingh Onnes, the name being changed to the International Institute of Refrigeration just after the First World War. The organization has therefore just celebrated its jubilee.

The general objective of the Institute is the development of the science and techniques of refrigeration in the international field. It promotes scientific research, as well as the teaching and popularization of refrigeration and its application in all fields, particularly in food preservation, health and industrial processes. The International Institute of Refrigeration headquarters are in Paris.

The main tasks of the Institute are determined by the general conference, at present presided over by Dr. Ezer Griffiths. This meets every four years, at the same time as an International Congress of Refrigeration, also organized by the Institute. Executive power is vested in an executive committee. A technical board, of which Dr. J. C. Fidler is the current president, co-ordinates the scientific and technical activity of nine commissions, which between them cover all aspects of refrigeration matters from fundamental research to applications in agriculture, transport, etc.

The tenth International Congress of Refrigeration was held in Copenhagen during August 19–26 and was attended by about 1,500 delegates from all over the world. About 300 scientific and technical