through the interfibrillary air spaces and that diffusion through the fibres themselves is negligible. In "Tanning as a Rate Process", N. L. Holmes and H. G. Wollenberg described the use of buoyancy measurements for following the uptake of tannin by skin. Equilibrium values agreed well with chemical analysis. The uptake was exponential, with half-periods varying from several days with dilute solutions to 18 hr. for strong solutions. "The Examination of the Fastness Properties of Leather Dye-stuffs", by W. Weber, put forward a proposal, eventually agreed in a plenary session of the conference, that an international commission be set up to co-ordinate the activities of the various national committees interested in this subject. Other papers dealing with dyeing were: "The Colouring of Suede Leather" (C. Alabouvette and C. Rouanet) and "The Measurement of the Colour of Leather" (J. A. Sagoschen). The problem of effluent disposal, which is becoming increasingly pressing in the leather industry, was discussed in two papers: "The Problem of Sewage in the Leather Industry" (H. Scholz) and "Financing Waste Disposal Installations" (E. B. Thorstensen). The impregnation of sole leather with synthetic resins, with the view of improving wearing properties, was discussed by P. Chambard.

In addition to the scientific and technological communications, useful committee work was carried out by the two existing International Commissions dealing with Leather Analysis and Tannin Analysis.

Social events included a visit to Skansen, where a replica of an ancient tannery and of many other craftsmen's shops attracted much attention, a sea trip to part of the Stockholm Archipelago, a reception by the Stockholm City Council and the closing banquet in the famous Gyllene Salen of the City Hall.

The conference attracted a good deal of attention in Stockholm, and besides the usual news conferences, Radio-Tjänst relayed an account of the proceedings given by the retiring president, Dr. K. H. Gustavson, and his successor, Dr. H. G. Turley. At the final meeting of the conference it was decided to accept the invitation of the Italian Society of Leather Trades' Chemists to hold the 1957 Conference in Rome. K. G. A. PANKHURST

CANADIAN COLLOQUIUM ON THEORETICAL PHYSICS

A COLLOQUIUM on theoretical physics was held at the Canadian National Research Council, Ottawa, during June 9-17, arranged by the Division of Pure Physics of the Council in honour of Prof. P. A. M. Dirac. Owing to a prolonged illness, Prof. Dirac was unable to attend the colloquium, but he was to visit the National Research Council later. The colloquium was attended by a hundred and twenty-one physicists from Canada and forty-one from the United States. At the opening session, Dr. E. W. R. Steacie, president of the National Research Council, welcomed the speakers and visitors, and Dr. G. Herzberg, director of the Division of Pure Physics, explained the general scope and purpose of the colloquium; he said that there would be twenty-one invited papers and twenty-four contributed papers covering a wide range of subjects in theoretical

physics, and he hoped that sufficient time would be available for the speakers to give an account of their subjects which would be of value both to the non-specialists and to the specialists. This purpose was admirably achieved, and the colloquium was a valuable contribution both to theoretical physics in general and, more particularly, to physics in Canada.

The opening lecture was the first of three lectures by H. A. Bethe on the scattering of π -mesons. Dr. Bethe gave an account of the experimental evidence and showed how the main properties of the meson-nucleon system could be deduced. The dominance of the $p_{3/2}$ state in π -meson scattering and the energy dependence and sign of the principal phase shifts were shown to follow from the scattering data independent of any perturbation method or detailed use of theory. His second talk gave an account of Goldberger's proof based on causality that the real part of the forward-scattering amplitude changes sign at a resonance, and then described the successes of the Chew-Low theory of meson scattering, and of the Cornell calculations based on the Tamm-Dancoff equation. Dr. Bethe's third talk gave Wick's derivation of the Low equation in meson theory and noted that Low and Chew had now shown that this equation followed from causality rather than from any detailed structure of meson theory.

S. Chandrasekhar gave a series of five lectures on problems of stability and turbulence in hydrodynamics and hydromagnetics. In his lectures on stability he concentrated principally on the manner of the onset of thermal instability in a layer of fluid heated below when it is subject to rotation and/or a magnetic field. He showed that, when subject to rotation, instability can set in either as convection and a stationary pattern of motions, or as overstability and a purely oscillatory pattern of motions, depending on the ratio K/ν of the thermometric conductivity to kinematic viscosity. The dependence on this ratio is such that, for a layer of water subject to rotation, instability should set in as ordinary convection, while for mercury it should set in as oscillations of increasing amplitude. In these instances the experiments by D. Fultz and Y. Nakagawa confirm all aspects of the theoretical predictions. Similarly, Prof. Chandrasekhar showed that an external magnetic field should inhibit the onset of convection by thermal instability in an electrically conducting fluid such as mercury; and that the extent of the inhibition should depend on the strength of the impressed magnetic field and the electrical conductivity in a determinate way. Here again the theoretical predictions have been confirmed by experiments. In his lectures on turbulence, Prof. Chandrasekhar described his recent efforts to develop a deductive theory of turbulence. He suggested that the similarity principles of Kolmogoroff (and their extensions) provide boundary conditions at infinity for the basic equations he has derived (*Proc. Roy. Soc.*, **229**, 1 (1955), equation 32). In this way he has been able to determine in a unique manner the function and the constant which are left unspecified by the dimensional arguments. In his last lecture he outlined an elementary theory of hydromagnetic turbulence and showed that two distinct modes of turbulence exist. He distinguished these as the velocity mode and the magnetic mode, respectively. In both modes, equipartition between the two forms of energy (kinetic and magnetic) prevail among the largest eddies present; however, in the velocity

mode the magnetic energy (relative to the kinetic energy) tends to zero in the small-scale Fourier components, whereas in the magnetic mode the magnetic energy tends to about two and a half times the kinetic energy. He described the bearing of these results on the possible character of the interstellar magnetic field and on Fermi's ideas on the origin of the cosmic rays.

Collective motion in nuclei and nuclear moments was discussed by G. M. Volkoff in two lectures, the first of which described the main ideas of the Bohr-Mottelson model of the nucleus. In his second lecture, Dr. Volkoff referred to recent work at the Massachusetts Institute of Technology and at Columbia University on nuclear magnetic octopole moments, and indicated briefly some features of the Bohr-Mottelson model relevant to nuclear moments. He concluded with an outline of the nuclear moment aspects of the work of his own research group at the University of British Columbia on radio-frequency spectra of nuclei in crystals, which has been reported in a series of papers in the *Canadian Journal of Physics*. In particular, a new method of measuring nuclear spin was described.

W. H. Watson gave a review of the experimental work on mechanical properties of helium II carried out at the University of Toronto and discussed their interpretation on the two-fluid theory. He pointed out that a hydrodynamical explanation cannot be given for the experimental results for the viscosity measured by the rotating cylinder method and for the relation of the zero shift of the inner cylinder, and he suggested that a better understanding of the kinetic theory of classical liquids would promote our understanding of the behaviour of a quantum liquid like helium II.

A description of the many-body problem in nuclear structure was given by R. J. Eden, the account being based on recent work by Brueckner and others at Indiana University. The simplicity of certain nuclear models gives hope that corresponding simple features can be derived by considering a system of many nucleons in strong interaction. The many-body method was illustrated by applications to the problem of nuclear saturation and to the theory of low-energy neutron reactions with nuclei.

G. Breit gave three lectures on nucleon-nucleon scattering. The first of these gave a historical survey of the subject and explained the general features of the experimental evidence and its mathematical interpretation in terms of partial waves and phase shifts. It was shown that a careful analysis of experiments at low energy is insufficient to determine the nucleon-nucleon potential, and it was indicated how high-energy data can be interpreted by a boundary condition which corresponds to a repulsive core potential between nucleons. In his second lecture, Dr. Breit discussed the limitations of potential theory in nucleon-nucleon scattering, and he described difficulties which arise when one tries to interpret meson field effects in a wave equation. Dr. Breit's third lecture was primarily concerned with high-energy data; he discussed the successes and failures of various potentials in the high-energy region and indicated the importance of relating the data for pion-nucleon and nucleon-nucleon interactions.

G. Wentzel gave two lectures on hyperon-nucleon interactions and one on rotational states of deformed nuclei. His first lecture classified the experimental information on hyperons by interpreting it in terms of their masses, spins, isotopic spins, and decay

schemes. He showed that the Q -values indicate that very strong selection rules must operate to slow down the decay of hyperons, and described Gell-Mann's interpretation of the data by isotopic spin-selection rules. In his second lecture, Dr. Wentzel showed how some information can be deduced about Λ^0 if one assumes that the observed binding in a hyperfragment comes about by coupling to nucleons via θ -particles. In his lecture on deformed nuclei, he considered the discrepancy between nuclear distortion deduced from quadrupole moments and rotational energy-levels using the Bohr-Mottelson theory. He concluded that this discrepancy cannot be removed by refining calculations and that the theory, in its present form, is untenable.

V. F. Weisskopf lectured on nuclear reactions, on the shell theory of deformed nuclei and on the proton-neutron mass difference. His first lecture described the relation between the resonance fine-structure for low-energy neutron reactions with nuclei and the broad structure obtained by averaging over resonances. It was shown that the latter can be described by neutron scattering on a complex potential having a mean absorption similar to that of a neutron in a Fermi gas. In a discussion of detailed reaction cross-sections, significant departures from the statistical theory of Niels Bohr were noted, particularly in the medium-energy range. Dr. Weisskopf's second topic was an account of the work of K. Gottfried at the Massachusetts Institute of Technology, who has calculated the ground-state energies of a deformed independent particle model of nuclei. These predict a distortion giving a minimum energy for each nucleus which agrees well with observed quadrupole moments. Dr. Weisskopf's third talk described the work of Feynman and Speisman on the electromagnetic origin of the proton-neutron mass difference and showed how an analogous mass difference also exists in a classical theory.

In addition to the invited papers described above, papers were contributed covering topics ranging from the Dirac equation in Finsler space to thermal conduction in solids. These papers were read by P. Havas and C. R. Mehl, F. A. Kaempfer, R. H. Good, C. O. Hines, H. Jehle, H. Feshbach and E. Lomon, I. Kay and H. E. Moses, D. K. C. MacDonald, Y. Takahashi, R. J. Eden, D. R. Inglis, U. Ingard and D. C. Pridmore-Brown, A. B. Bhatia, S. Gasiorowicz, R. Jastrow, H. Yilmaz, F. R. Tangherlini, F. H. J. Cornish, A. E. S. Green and K. Lee, T. Y. Wu, S. Shanmugadhasan, T. F. Morris, A. Klein, and O. Theimer. After a dinner on June 16, given by the Royal Society of Canada, Dr. D. C. Rose gave a talk on the recent cosmic-ray expedition to the Arctic and Antarctic of members of the National Research Council.

The colloquium was the first of its kind in Canada, and, judging from the comments of the principal speakers and other visitors, it was both enjoyable and useful. The distinction of the visitors from the United States indicated the great interest of American scientists in Canadian physics, and it should perhaps be noted that a fault of the meeting was the small number of papers read by Canadians. It is to be hoped that the success of the colloquium will encourage the organizers to provide further opportunities for Canadian theoretical physicists, usually so widely dispersed, to gather together and talk with each other and with visitors from the United States and elsewhere.

R. J. EDEN