The attention of the Department has been so largely concentrated on field work that the laboratory side has seemed to occupy a second place. For a long time there were no laboratory facilities at all, yet valuable studies were carried out using portable or improvised equipment. For two years the headquarters laboratories were housed in tents; but on August 20, 1951, the Kongwa chemical laboratory, a well-equipped establishment of modern design, was formally opened after having been in use with temporary fittings for eighteen months. The remaining laboratories at Kongwa have been housed in converted accommodation for the same period. At all times, however, the Department has had a reliable routine laboratory service. The chemical staff have analysed many thousands of soils and of crop samples, and their work has also extended to the analysis of fertilizers, studies of the effect of shipment and storage on produce, work on the contamination of crops and analyses arising from pedological problems. Much help has been given to other departments of the Corporation, and the Scientific Department was responsible for the chemical aspects of the recent experiments at Kongwa on the artificial precipitation of rainfall.

The statistical section has been responsible for the design and analysis of more than seven hundred field experiments of modern design, ranging in size from 16 to 300 plots, and has had considerable responsibilities in the planning of programmes and in the evaluation and reporting of results. In addition to papers which have appeared in the specialist and technical Press, the Department has issued annual reports for 1947–48, 1948–49 and 1949–50, which have been summarized in the annual reports of the Corporation published by H.M. Stationery Office. The full data on which these reports have been based may be obtained in mimeographed form from the Scientific Department, Overseas Food Corporation, Kongwa, Tanganyika.

EIGHTH INTERNATIONAL CONGRESS OF REFRIGERATION

THE Institut International du Froid (I.I.F.), which has its headquarters in Paris, normally arranges for an international congress to be held every four years in one of its member countries. The intervention of the war years, however, broke the continuity of its meetings and no congress had been possible since that held in the Hague in 1936. For this reason the recent Congress, held at Church House, Westminster, during August 28–September 10, had more than usual significance, and the field of activity to be reviewed was particularly wide.

The presidency of the Congress was shared by the Right Hon. Viscount Bruce, of Melbourne, and Prof. W. J. De Haas, of Leyden. The Institute of Refrigeration in Great Britain undertook the arrangement of all meetings and functions. The attendance was approximately seven hundred, of which the proportion of overseas visitors was more than two to one. Thirty countries were represented.

The work of the Congress was divided among seven commissions, the subjects of which ranged from low-temperature physics and the low-temperature industry through all branches of refrigeration, including purely biological problems associated with the storage of food and other perishable materials, to problems of statistics and education in refrigeration.

In the meetings of Commission I, no attempt was made to embrace the general field of low-temperature physics, since by agreement this was delegated to the Oxford Low Temperature Conference held a few days previously (p. 807). One session was devoted to the subject of hydrogen and helium liquefaction. This meeting directed attention to the present situation, where there are now scores of laboratories throughout the world equipped to produce liquid hydrogen or helium. In the case of helium liquefaction, while many laboratories use the Simon direct-expansion type of liquefier, a description was given of a small completely automatic helium liquefier, employing a Collins expansion engine, which is now produced commercially in the United States. Dr. A. Wexler, of the Westinghouse Research Laboratories, Pittsburgh, also described a type of small metal Dewar vessel for liquid helium which has an evaporation loss of only one per cent per day. The vessels are shielded by liquid nitrogen boiling under atmospheric pressure. He suggested that larger vessels for storing liquid helium for as long as a year could readily be constructed.

A further session, devoted to thermodynamics, heard reports on the construction of thermodynamic charts for pure substances both by the Kamerlingh Onnes Laboratory, Leyden, and by the Heat Division of the Mechanical Engineering Research Organization (Department of Scientific and Industrial Research). So far, at Leyden, eleven diagrams have been completed and made available for the common industrial gases and helium; while the British body has also completed preliminary surveys for air, carbon dioxide, acetylene, propane and ammonia.

A paper by Prof. Jiro Oishi, of Japan, described a new experimental procedure for determining the absolute temperature of the ice point by the isotherm method. Two advantages were claimed: first, the elimination of dead-space errors, and, secondly, greater reliability of the results since the measurements can be confirmed by the use of at least six different gases in the thermometer. The mean value of the ice point determined by these experiments is 273·15, compared to the mean value of 273·155 obtained from the experimental results of all workers since 1929. Considering both sets of data and the absolute accuracy of the method, he proposed 273·15 to be the best value now available.

Measurements of heat transfer were reported by many authors both to Commissions I and II, the range of temperatures extending from normal refrigeration temperatures down to that of liquid hydrogen. New values for the thermal conductivity of liquid nitrogen were given by Prof. H. L. Johnstone, Ohio State University, while Prof. L. Weil, of Grenoble, gave values for the rate of heat transfer to boiling liquid hydrogen.

The greatly increased importance and activity of the low-temperature industry both in Great Britain and abroad was evidenced by the fact that no fewer than twelve papers were given on subjects connected with industrial gas separation and liquefaction. Many of these were concerned with plant for separating air into its constituents, from the scale of small transportable units mounted on trailers to single industrial units for producing 1,000 tons of oxygen a day. The increasing use of argon-arc welding for fabricating aluminium and alloy steels focused attention on methods of extracting this gas from the

atmosphere. The separation of ethylene from coke oven gas and from the gases obtained by the cracking of oil is another field in which low-temperature gas separation is now widely practised.

A further contribution to this session was an account of the work pioneered by Sir Alfred Egerton at the Imperial College of Science and Technology, London, into the utilization of liquid methane. Trials with motor vehicles adapted for running on liquid methane, carried in a vacuum-jacketed tank, have now totalled about 25,000 miles, of which the greater part has been made with buses in full passenger service. It is considered that sufficient knowledge now exists for the use of liquid methane as an automotive fuel to be considered for certain types of vehicles where methane is available. The use of stored liquid methane to meet peak loads at gas works was also discussed.

Commission III of the Congress was concerned with fundamental biochemical and biophysical studies related to refrigeration. Dr. P. Becquerel reported on experiments in which dehydrated organisms such as Protozoa, seeds, and spores of bacteria and fungi were mixed with iron alum powder and cooled by the magnetic method to within 0·2° C. of absolute zero. All the organisms frozen in this way recovered their full vital activity when thawed. It is thus shown that by the action of dehydration, vacuum, and extremely low temperatures it is possible to suppress the colloidal state of protoplasm necessary for biological changes without affecting its power to recover.

In organisms having a higher water content, the chance of survival decreases, although it was shown by Dr. L. Geneves in experiments in which microscope observations were made of cooling thin sections from the roots of the chicory plant that the disturbance of the cell structure by cooling was often reversible on thawing. Similar work was reported by Miss I. Modlibowska, East Malling Research Station, who directed attention to the causes of frost injury to fruit trees, relating it to the water content of the affected cells. The effect of low temperatures on the survival of animal cells was discussed by Dr. L. Bucciante. The usefulness of these researches was instanced by the present use of the low-temperature preservation of animal spermatozoa and of insulin in frozen pancreatic glands.

A novel approach to these problems described by Dr. W. H. Cook, National Research Council of Canada, involves the study of freezing processes in artificial cells constructed from 'Cellophane' or rubber. Films produced from these materials exhibit high resistance to penetration by ice crystals.

The effect of low temperatures on enzyme activity was discussed by Prof. M. A. Joslyn (California) and others. While this field is still only partially explored, it appears that the concentration of the substrate by freezing of some of the water may protect the enzyme and allow the continuance of its activity at lower temperatures than would otherwise be possible.

A further biological problem which arises in refrigerated food storage is the shrinkage and loss of weight of meat and fish which can occur on thawing, due to the extrusion of fluids from muscle. In this field a most valuable paper was presented by J. R. Bendall (Department of Scientific and Industrial Research) and Dr. B. B. Marsh, of New Zealand. They have been able to relate the shortening of muscle fibres and the consequent extrusion of liquid to the decline in the concentration of adenosine triphosphate in the muscle. The reversibility of the process has been demonstrated, and also its dependence on the *p*H value.

The present state of gas storage for apple and pears was outlined by Dr. C. West, of the Low Temperature Research Station, Cambridge. Wide experience has now been gained in the optimum refrigeration temperature and composition of atmosphere required for different varieties, and the importance of this method is such that it already provides storage for 80,000 tons of fruit in Great Britain alone. Other speakers reported its use overseas.

The work of other commissions covered the purely technical and engineering questions involved in the design of refrigerating machines and insulated chambers of all types. Facilities were also provided for members of the Congress to visit research laboratories and industrial installations in many parts of England and Scotland.

The occasion of the Congress was made the opportunity for drawing up and sanctioning extensive measures for the reorganization of the International Institute of Refrigeration under its new director, M. C. David. It is a matter of the greatest satisfaction to scientific men and refrigeration engineers in Great Britain that Dr. Ezer Griffiths was elected as the new president of the General Conference of the International Institute of Refrigeration; he is succeeded in his post as head of the Technical Board of the Institute by Prof. C. J. Gorter, of the University of Leyden.

G. G. HASELDEN

LOW-TEMPERATURE PHYSICS

THE conference on low-temperature physics, held at Oxford during August 22–28, constituted the second meeting of the Commission for Very Low Temperatures of the Union de Physique Pure et Appliquée, the first having been held at the Massachusetts Institute of Technology in 1949; and at the same time it formed part of the first post-war meeting of the Institut International du Froid, which has a Commission primarily interested in the pure physics of low temperatures. A conference on the technical and industrial aspects was held in London (p. 806) immediately after that at Oxford. Visitors were invited to the Royal Society Mond Laboratory at Cambridge on August 21.

A feature of the Oxford conference was the presence of a large number of younger research workers who, the organizing committee felt, had in general insufficient opportunities of attending international meetings of this kind. They were able to be there through the generosity of the Royal Society and a number of industrial organizations, the contributions of which substantially augmented the grant made by the Union de Physique from Unesco funds. The presence of a large number of delegates from the United States was ensured through the continued support of the Office of Naval Research.

Except for three introductory papers, contributions were limited in duration to ten, fifteen or twenty minutes. The total number was about a hundred and ten. A reporting system similar to that of the Harwell conference on nuclear physics (1950) was used, with the aid of fifty of the junior research workers, to make the report available in a few weeks.