successively, each only for a fraction of the total time of recording. This waste of energy can be avoided by methods which are grouped together by such names as 'Fourier transform method' or 'multi-channel spectroscopy'. Their principle goes back to Michelson's interferometric analysis by 'visibility curves'. We imagine the intensity in the centre of the fringe system, produced by a Michelson or other two-beam interferometer, to be recorded while the path difference is changed at a uniform rate, for example by translational motion of one of the reflectors. If the incident light is monochromatic, a pure sine curve will be recorded, and for any arbitrary spectral distribution the record obtained will be a Fourier transform of the spectrum. In principle, and with certain restrictions which need not be mentioned here, this record can be transformed back into the original spectrum by numerical calculation, or by the use of computers. In actual fact, the primary spectrum has to be limited to a small spectral range, and certain information on the spectrum usually has to be assumed beforehand. Instead of the absolute wave-numbers, differences against a reference wave-number are often measured.

The difficulty of making the motion exactly uniform, and the small path difference obtainable in practice, limit the method to low resolving powers and mainly to the infra-red. In this spectral range, on the other hand, the gain in light-gathering power which this method achieves is most valuable: because of the photon noise in the receiver, the resolving power obtainable is often limited by the intensity. This applies particularly to astrophysical measurements for which the method offers considerable promise. A number of speakers discussed the principle of the method and described actual devices putting it into practice (P. Fellgett, G. A. Vanasse, J. and P. Connes, E. Ingelstam, P. Jacquinot, H. A. Gebbie, L. Merz).

A most unorthodox system was described by P. Connes, who uses two plane gratings to form an interferometer; they take the place of the reflectors in a Michelson interferometer and are slowly and synchronously rotated. At any given moment, light of that wave-length for which the incident and reflected wave-fronts are parallel is modulated by a longitudinal displacement of one of the gratings—in practice achieved by a to- and fro- rotation of the compensator. The device acts as a grating used with direct recording, but the absence of a slit ensures the gain in intensity characteristic of interferometers.

P. Connes also described the construction and the first successful experiments with his ingenious 'spherical Fabry–Perot interferometer'. Between the partially reflecting, spherical surfaces the wave suffers four successive reflexions before it interferes with the direct wave, as compared with the two reflexions in the plane Fabry–Perot. The path difference is independent of the angle not only to the first power of small angles as in the ordinary etalon, but even to the second. This allows a greater solid angle to be used in recording, with a resulting gain in intensity. The instrument offers considerable advantages when very large path differences are required, and the adjustment is extremely easy. The spacing cannot, of course, be varied, and this will restrict the use of the instrument to special purposes.

The use of multiple dielectric films as coatings for étalon plates were treated by F. A. Jenkins, P. Giacomo, A. Steudel, R. Lennuier, J. Ring, R. Dupeyrat and F. Abelès. Two recent advances in this field will make dielectric coatings much more attractive to spectroscopists than they have been hitherto: the width of the reflexion band can now be made large enough to cover an appreciable portion of the visible spectrum, and films can be made for use in the ultra-violet down to 2500 A.

Photographic interferometry, as a well-established method, very naturally played a smaller part at the conference. Any idea that it has now been superseded by recording methods and had become obsolete would be quite mistaken. Its great power of integrating and of simultaneously recording a large range of the spectrum will ensure its retention, and it is often preferable when wave-numbers rather than intensities are to be measured accurately. Contributions on precision measurements with a double étalon (D. A. Jackson) and on solar interferometry (P. J. Treanor) served as useful reminders of these facts.

Metrological applications, designs of special interferometers and various other topics were discussed. These have to be omitted from this report not for their lack of importance but for reasons of brevity and because they cannot easily be grouped together.

H. G. Kuhn

INTERNATIONAL UNION OF CRYSTALLOGRAPHY

CONGRESS IN MONTREAL

THE International Union of Crystallography held its fourth General Assembly and International Congress in Montreal, during July 10–17. About six hundred crystallographers from nineteen countries attended, accompanied by about one hundred and fifty wives (or husbands) and children. The Congress was followed by two symposia held during July 17–19. A full programme of social events and excursions of scenic and technical interest was arranged, and first-class facilities were provided by McGill University. During the evening spent at the Université de Montréal the retiring president, R. W. G. Wyckoff, spoke on "Electron Microscope Studies of Macromolecules", with beautiful photographic illustrations.

In the report on the meetings of the International Union of Crystallography held in Madrid in 1956 [1], it was commented that the arrangement of several simultaneous sessions was unsatisfactory, and that a number of small meetings, more restricted in scope and with a single subject only claiming attention at any one time, would be more valuable. This difficulty of fragmentation had been felt by the organizers of the Montreal Congress, and a number of general lectures were arranged on several mornings at a time when there was no competition from other meetings. These formed a valuable feature of the Congress, and provided a painless method for specialists in other branches to become acquainted with the present state of crystallography of proteins (D. Hodgkin), crystal chemistry (G. S. Ždanov), interatomic distances and molecular configurations (D. G. Jenkins, J. S. Taylor and L. E. Sutton, presented by L. E. Sutton), clay minerals (G. W. Brindley), and imperfect structures (P. B. Hirsch). In most of these fields there was steady progress but no striking new developments to report. Prof. G. S. Ždanov presented some unusual

views on crystal chemistry, and publication of his talk will be awaited with interest. Among the imperfect structures, the most interesting development was in methods for the direct observation of dislocations in crystals. It has been found possible to 'decorate' dislocations in such crystals as silver bromide and silicon with foreign atoms, thus making possible stereoscopic electron micrographs in which the dislocation network could be clearly seen. By a different technique of transmission electron microscopy, it has been possible to make motion pictures of dislocations in thin metal foils, showing pile-ups, networks, splitting of dislocations to form stacking faults, and the interaction of dislocations with boundaries.

The technical scientific papers were arranged in seventeen sections, of which four or five were generally meeting simultaneously. There was, therefore, little relief from the overcrowding experienced in Paris[2] and Madrid[1]. It is clearly impossible to detail the proceedings of all the sections, but a few of the more important features may be mentioned. In the Section on apparatus and technique, developments in the use of high-speed electronic computers were perhaps the most interesting. Methods for the accurate measurement of integrated intensities, the basic requirement for all structure work, were also described. The section on structure determination reported progress in phase-determination by several methods, but there seems to have been nothing as striking as the first impact of sign relations[2]. Minerals, clay minerals, and metals yielded a considerable number of new structures; the increasing complexity of structures of metals is noteworthy. Aside from numerous monoclinic alloys, elemental plutonium is monoclinic, with 16 atoms per cell and a co-ordination number of about 14. Complex oxides were perhaps the most interesting of the new inorganic structures; ribonuclease and viruses claimed attention in the Section devoted to the proteins and related compounds—which ranged from glycine to hæmoglobin. The Section on order–disorder phenomena and deformations and imperfections formed a rather artificial division of an active field. The 'spikes' in the reciprocal lattice of some diamonds and the distribution of intensity in reciprocal space corresponding to crystals with mistakes are still not completely understood. Disorder phenomena (in cobalticyanides, for example) were also reported in other sections. Crystal growth was perhaps remarkable in that little mention was made of dislocations. Neutron diffraction provided information about structures not easily obtained by X-ray means, including the location of hydrogen nuclei in hydrogen bonds.

Two Commissions of the International Union, on data and teaching respectively, held open meetings virtually amounting to additional sections. In the meeting of the Teaching Commission, H. Lipson showed the importance of Fourier transforms, especially those produced with such ease by optical means, as a teaching method. Other papers discussed band groups (A. Pabst), and crystal growing (R. Kiriyama) as student exercises, and the lessons to be gained from a study of the historical development of our knowledge of zeolites (R. Hocart). The Data Commission was chiefly concerned with possible improvements, both in the data themselves and in methods of their use, in the "X-ray Powder Data File", though single-crystal and electron-diffraction data were not quite forgotten.

Both the Apparatus and the Teaching Commissions organized non-commercial exhibitions. In addition, there were many exhibits of X-ray generators, cameras, diffractometers and other equipment available commercially, some exhibits of apparatus and techniques from university and government laboratories, and a stand of crystallographic books on show.

The symposia were concerned with physical techniques and electron diffraction. Much attention was paid to nuclear magnetic resonance, on which an introductory lecture was contributed by C. J. Gorter. Like neutron diffraction, this technique provides a method of locating the hydrogen nuclei in crystals. There were also one or two papers on dielectric and diamagnetic measurements. The symposium on electron diffraction was one of the most interesting parts of the Congress, and one in which much progress was reported, but there seem to be outstanding problems in relating diffraction intensities with structure. The contributions from Russian and Japanese members of the Congress were particularly noteworthy.

Much of the time of the business sessions was taken up with the discussion and adoption of a new set of statutes and by-laws. A new Commission on Electron Diffraction was set up, and the membership of the Commission of Crystallographic Nomenclature was severely pruned—possibly indicating changes in the emphasis on these fields. Preparations were made for holding the next Congress and General Assembly in Cambridge in 1960, and for the celebration of the fiftieth anniversary of the discovery of X-ray diffraction in Munich in 1962. A new publication of the International Union of Crystallography, reporting apparatus and techniques, was projected, but it is not yet certain whether this will be found practicable. J. Wyart (Paris) was elected president of the Union for the period to the next General Assembly.

A. J. C. Wilson

[1] *Nature*, **178**, 177 (1956).
[2] *Nature*, **174**, 378 (1954).

RHEOLOGY OF DISPERSE SYSTEMS

Rheologists from Holland, Germany, Israel, Canada and New Zealand were among nearly a hundred who met during September 19–21 to discuss the flow properties of dispersions at the Annual Conference of the British Society of Rheology, held this year in the University College of Swansea.

In his presidential address to the Society, under the title "Complicated Rheological Properties", Prof. J. G. Oldroyd developed the thesis that even the simplest dispersions cannot, from their very nature, exhibit anything like simple rheological behaviour. Any system in which one component has viscosity and another has some degree of elasticity of shape must show a combination of viscous and elastic effects when subjected to a variable shear stress; this must apply whether the system as a whole is solid or fluid. Precise calculations have been made of the type of the response to small variable shear stresses to be expected in disperse systems containing two components, at infinite dilution of one component in the other, in terms of arbitrary elastico-viscous or visco-elastic properties at small shear stresses assumed for the two components separately. Even a simple