a fault of the teaching rather than of the person. Mr. Foody commented that the search for suitable staff had been made difficult by the shortage of mathematicians, particularly numerical analysts, in Northern Ireland.

For training, new recruits are given first an introduction to the kind of work done in the computing group, which covers a very wide range; this is followed by instruction in the simpler techniques of programming, and they are then left for about two weeks to study the programme manual, working out examples so far as possible on their own. After this they are taught more about the logical structure of programmes, with particular emphasis on the ideas of loops and sub-routines and from then onwards take up progressively more difficult 'live' work. A lot of emphasis is put on the need to keep proper records of all work done and the importance of neat and orderly paper-work. Mr. Foody concluded by saying that he considers the quality of management to be of vital importance in a computing group. Good management will not only ensure that the group is well organized and run, but also that the power and value of high-speed computation are made clear to all those who might benefit.

Mr. P. V. Ellis (International Computers and Tabulators, Ltd.) described the method of selection and training used in his Company, which makes computing, data processing and accounting machinery on a large scale. Programming to them means a wide range of activities, including service to customers to help with the use of existing machines, provision of assembly, interpretative and related programmes, detailed appraisal of projected machines in advance of any construction and assistance in the logical design of new machines.

Primary selection is made by interview and formal aptitude tests. A candidate successful at this stage embarks on a training course, but may at any stage of this be declared unsuccessful if it has become clear that he is not going to reach the required standard. The tests, the form of which has been evolved over several years, are administered by a professional organization; they do not call on factual knowledge, but are intended to test observational powers and ability to think quickly and logically. They include problems in arithmetic, in the detection of faults in statements, in the application of selection rules, in logical inference and in logical deduction from sets of statements. Existing staff are used as a control, and Mr. Ellis said that the distribution of scores is satisfactorily stable. Candidates are assessed objectively by these tests and subjectively by personal interviews held before the results of the tests are known; agreement is usually good, and if there is any disagreement it is the usual practice to reject the candidate.

Training starts with a residential course lasting five weeks, new people being taken on in groups so that a class of ten or so can be formed. There are lectures, written papers and various co-operative activities. Those who complete the course satisfactorily move into different groups in the Company and continue training on 'live' work, each with an experienced member of the staff as mentor until they can stand on their own feet. The Company considers that the contacts made during the training course are of very great value in helping new people to acclimatize themselves to their new environment and to gain confidence.

Mr. H. Devonald (Ferranti, Ltd.) said that the comments he had heard during the interval suggested to him that many in the audience were unfamiliar with the ideas of programming and that he proposed, therefore, instead of further accounts of selection and training methods, to explain the essential points by means of a simple example. He then showed how one constructed a programme to solve a general quadratic equation, reading the coefficients from tape and printing the roots; he used the notation of the *Pegasus* auto-code.

In the brief discussion which closed the meeting, the principal speaker was Dr. A. D. Booth (Birkbeck College, University of London), who emphasized the importance of a constant mathematical awareness in all computing work. He instanced the difficulties one can get into by attempting to solve a partial differential equation by finite-difference methods without having a proper understanding of the mathematics of the process.

J. HOWLETT

PHYSICAL CHEMISTRY OF AEROSOLS

AIRBORNE clouds of small particles, or aerosols, are so widespread in Nature and arise in so many phases of modern industry that their study brings together a large group of physicists, chemists, meteorologists and engineers, each, of course, with his own special interests but all concerned with the generation, dispersion, sampling, counting, sizing, structure, composition, growth and aggregation of small particles. Such a heterogeneous ensemble aggregated in Bristol during September 13–15 to sample twenty-four well-dispersed papers at a discussion arranged by the Faraday Society, under the chairmanship of its president, Sir Harry Melville.

Broadly, there were four main topics for discussion: the nucleation of liquid and solid particles from the vapour phase; the coalescence, growth, evaporation and stabilization of liquid droplets; chemical reactions involving aerosols; and light-scattering by aerosols.

After some introductory remarks by Dr. R. Lessing, the symposium opened with a review by Dr. J. W. Dunning (University of Bristol) of the Volmer–Becker–Döring theory of homogeneous condensation and of various experimental studies of the phenomenon. Dr. Dunning was of the opinion that the results of expansion-chamber experiments had provided acceptable confirmation of the theory, but that condensation in expanding jets provided a more convenient and reliable technique of investigation.

Dr. B. J. Mason (Imperial College of Science and Technology, London) described some recent studies of homogeneous and heterogeneous nucleation of water aerosols involving vapour–liquid, supercooled liquid–solid and vapour–solid transitions. He underlined the limitations of the Volmer theory of homogeneous condensation and did not consider that this had been adequately tested and confirmed by experiment. He next discussed the growth of water droplets on ions and on hygroscopic nuclei and their relevance to cloud physics. There followed a description of his recent work on heterogeneous and homogeneous nucleation of supercooled water droplets, of the efficiency of natural and artificial ice nuclei in relation to their crystalline and surface structure, and of the formation of ice crystals by direct sublimation from the vapour.

Dr. N. H. Fletcher (University of New England, New South Wales) had applied the Volmer theory of heterogeneous nucleation to calculate the conditions under which ice nuclei would form on a perfect spherical particle. Curves were presented showing the temperatures at which nuclei could be expected to form at the rate of one per second in a water-saturated atmosphere on particles of various radii and forming various angles of contact with the ice embryo. These results were then used to calculate the maximum number of silver iodide nuclei produced from 1 gm. of the material which would be active at various temperatures. In the discussion which followed, doubt was expressed concerning the validity of this treatment, which did not recognize that nucleation of ice on silver iodide and other substances occurs preferentially at surface imperfections.

Phase changes involving salt-vapours were the subject of a paper by Dr. E. R. Buckle (Imperial College of Science and Technology, London), who described his observations of condensation, growth and evaporation of liquid and solid particles of alkali halides in a high-temperature cloud chamber. It appears that for a wide variety of substances (for example, metals, ionic salts, water) condensing and crystallizing homogeneously, the maximum attainable degree of supercooling is almost exactly 15 per cent of the melting temperature. Interesting information on the structure and growth of particles formed by the vaporization of metals in air was provided by the electron- and X-ray diffraction and electron microscopy work of J. Harvey, H. I. Matthews and H. Wilman (Imperial College of Science and Technology, London).

In the final paper bearing on nucleation phenomena, Prof. F. P. Buff (University of Rochester, N.Y.) examined, from the point of view of molecular hydrostatics, the Gibbs theory of capillarity which calculates the higher terms in the asymptotic expansion of the free energy with respect to the geometrical parameters of the system, and provides a criterion for the breakdown of macroscopic thermodynamical concepts for small aggregates of molecules. In Buff's analysis there appear two tensions rather than a single surface free energy, and he argues that Gibbs's formulation is correct only in the (practically important) case when these two tensions are equal.

In the next group of papers, dealing with the growth, evaporation and coalescence of drops, Dr. D. P. Benton (Battersea College of Technology, London) and Dr. G. A. H. Elton (British Baking Industries Research Association, Chorleywood, Herts) presented experimental evidence for coalescence between micron-size water droplets colliding in highly turbulent air being affected by the addition of electrolytes and ionic surface-active agents to the water. The hypothesis is that these modify the structure of the surface electrical double layer, the existence of which is normally a barrier to the coalescence of two colliding drops. Discussion centred on the importance of this for the stability of non-turbulent water fogs where hydrodynamic forces prevent collisions between such small droplets, and on whether an appreciable electrical field would exist outside the surface double layer.

Dr. R. M. Schotland (New York University) had carried out experimental work on the coalescence of falling drops, 200–800μ in diameter, with large liquid hemispherical targets. He claimed that the coalescence mechanism was governed by two dimensionless parameters which, surprisingly, did not include the viscosity of the fluid separating the two liquid surfaces.

Measurements of the growth-rate of water droplets condensing on hygroscopic nuclei as a function of the humidity, temperature and velocity of the surrounding air stream were described by Dr. W. L. Dennis (Chemical Defence Experimental Establishment, Porton Down). Experimental results for drops of 0·3–1·0 mm. diameter agreed within about 20 per cent, with theoretical values derived from the standard equations for the growth of ventilated drops containing dissolved salts.

A remarkable experiment designed to measure the long-range diffusive forces between water drops and solid particles was described in a paper by Prof. P. S. Prokhorov and L. F. Leonov (U.S.S.R. Academy of Sciences, Moscow). The authors claim to have measured repulsive forces of order 10^{-6} dyne between a 1-mm. evaporating water drop and a glass sphere of similar size attached to one arm of a torsion balance, and to have shown that the magnitude of the force varies inversely as the square of the distance between them.

The influence of a foreign surface film on the evaporation of liquid drops, in particular its effect on the condensation coefficient, was discussed theoretically in papers by Prof. B. V. Derjaguin, S. P. Bakanov and I. S. Kurghin (U.S.S.R. Academy of Sciences, Moscow) and by Dr. P. G. Wright (University of St. Andrews). Some measurements on the stabilization of water mists containing droplets of 2–20μ radius by insoluble monolayers were presented by Dr. H. S. Eisner, B. W. Quince and C. Slack (Safety in Mines Research Establishment, Buxton). The addition of about 0·1 per cent of fatty alcohols to the water increased the lifetime of the drops several hundredfold.

The importance of aerosols in catalysing chemical reactions in the atmosphere was brought out in two papers. Dr. R. D. Cadle and Dr. R. C. Robbins (Stanford Research Institute, California) had applied chemical kinetic theory to calculate the rates of heterogeneous chemical reactions involving aerosols, and compared the theory with experimental results for the systems nitrogen + ammonia + sulphuric acid and air + water + nitrogen dioxide + sodium chloride. A. C. Chamberlain, Dr. A. E. J. Eggleton, W. J. Megaw and J. B. Morris (Atomic Energy Research Establishment, Harwell) had investigated the rate at which radioactive iodine vapour in concentrations of less than 1 μgm./m.^{3} was adsorbed on atmospheric nuclei, and demonstrated that this must be allowed for in the design of systems for removing radioactive iodine from reactor shells.

The next three papers, on light scattering by aerosols, provoked a lively discussion. E. Matijević, Prof. M. Kerker and K. F. Schulz (Clarkson College of Technology, New York) described how, using silver chloride aerosols, they had obtained excellent agreement between the polarization ratio from light-scattering measurements and that calculated from the particle-size distribution and theoretical scattering functions. Since the light-scattering itself was insensitive to particle-size distribution over the range studied (r = 200–800 mμ) the particle size could not be determined from light scattering, but there was an optimum size-range around 55 mμ for which this was possible. Prof. F. K. Gucker and R. L. Rowell (Indiana University) had succeeded in determining the light-scattering diagrams of single aerosol droplets by first charging and suspending them in an electric field, illuminating them with monochromatic light and measuring the light scattered into a photometer over the arc 40–140° from the direction of illumination. Good agreement was obtained with calculations based on the Mie theory. The effect of particle separation on the light-scattering properties of monodispersed spheres was investigated by Prof. S. W. Churchill (University of Michigan), G. C. Clark (Continental Oil Co., Ponka City, Oklahoma) and C. M. Sliepcevich (University of Oklahoma) by measuring the transmission of light through a hydrosol of latex spheres as a function of the particle concentration. According to their measurements, optical interference between the particles is negligible when their average separation exceeds 1·7 particle diameters.

The wide scope of the conference was epitomized in the last two papers, representing meteorology and fuel technology. Dr. C. L. Hosler and Dr. R. E. Hallgren (Pennsylvania State University) described how the aggregation of small ice crystals was affected by their shape, and particularly by the air temperature ; Dr. R. H. Essenhigh and Dr. I. Fells (University of Sheffield) presented a mathematical theory of the combustion of liquid and solid aerosols.

The conference enjoyed the generous hospitality of the University of Bristol and the excellent facilities of the new Queen's Building. One's main regret was that the Russian contributors were not there to present and discuss their four papers.

B. J. Mason

PHYSICS OF SEMICONDUCTORS

An international conference on the physics of semiconductors, sponsored by the International Union of Pure and Applied Physics and arranged by the Czechoslovak Academy of Sciences, was held in Prague during August 29–September 2. In recent years this has become a biennial conference, the previous one having been held in Rochester, New York (*Nature*, **108**, 1067 ; 1958), in August 1958, and it is proposed that the next of the series should be in Britain in 1962. The present conference showed clearly that semiconductor physics still represents a very active and indeed an expanding field of research. It is, of course, unwise to judge only by the numbers of papers submitted or by the number of physicists attending the conference ; but this gives some indication, and was supported by the fact that new ideas emerged and many new and exciting developments were reported. Indeed, the chief problem which had to be faced by the organizers was that of selecting from the large number of papers submitted. Approximately 265 papers were selected for inclusion in the conference proceedings, of which only about half were actually read. The geographical division of these papers is of some interest ; approximately 110 originated in the United States, 40 in the U.S.S.R., 22 in Germany, 20 in Great Britain, 15 in France, 14 in Czechoslovakia, 9 in Poland and 7 in Japan, the remainder being distributed over a large number of participating nations.

The number of physicists attending was much larger than for any previous conference of the series, being nearly 750. As a result, it was necessary to divide the conference into four parallel sessions, three of which were run on the normal pattern of papers followed by discussions and one using *rapporteurs* followed by discussion. In the former, translations into Russian, Czech and English were available, though the English translations were frequently very difficult to follow. The chief drawbacks of the conference arose from its large size, there being many overlapping papers of interest, and it is hoped that future conferences will revert to a smaller and more intimate form.

It is impossible in the space available even to mention all the interesting topics discussed at the conference, and only a few of the highlights can be selected that left the most vivid impressions in the memory. Introductory papers were given by (the late) A. F. Joffe and by W. Shockley. The former stressed the urgent need for a new theoretical approach to the problem of low-mobility semiconductors for which conventional theory based on a nearly perfect crystalline lattice is clearly inapplicable, the mean free path for current carriers being comparable with the lattice spacing. Various discussions based on 'electron hopping' were later given ; but it is clear that a lot more work is required before these processes are as well understood as transport phenomena in high-mobility semiconductors. Later in the conference Joffé discussed some of the difficulties associated with the understanding of thermo-electric phenomena in semiconductors. In his introductory paper Shockley discussed a wide variety of phenomena associated with avalanche breakdown in p–n junctions induced by high electric fields, and introduced some new theoretical ideas which might lead to a better understanding of these complex phenomena.

Discussion of transport phenomena again dominated the conference, there being no less than 48 papers submitted on this subject, dealing mostly with silicon and germanium, which remain the basic semiconductors for the study of fundamental phenomena. C. Herring (United States) reviewed developments in the theoretical formulation since the Rochester conference and directed attention to some recent clarification of the difficult problems associated with multi-phonon scattering, and of scattering of carriers in the presence of strong magnetic fields. Two interesting new experiments on transport stood out. The first was described by W. Shockley and K. Hubner (United States) in which an n-p–n structure was used to demonstrate phonon drag on electrons. Some electrons given momentum by an electric field applied in one n-type region pass into the p-type region where they are scattered, producing phonons with a preponderance of momentum in