

pear juice is shown in Fig. 1 and 2. A value for the sedimentation constant of orange pectin is also inserted in Fig. 2. The increase of sedimentation with decreasing concentration indicates interaction of the molecules due to dissymmetrical shape or hydration.

The carbohydrates in the juice of bulbs and tubers have proved more nearly monodisperse in sedi-

tion than before. As a rule, two well-defined components can be distinguished. This may be taken as an indication that the breaking down of the reserve carbohydrate (starch or inulin) passes through two steps before the low-molecular stage is reached. As examples, in Fig. 4 the sedimentation diagram from the juice of a dormant potato tuber (A), from one just beginning to sprout (B) and from one in the

midst of sprouting (C) is given. With increased activity the two high-molecular components become more and more noticeable. The dotted curve in (A) represents the sedimentation of the juice after removing the low-molecular material by dialysis. This shows that the two maxima are present even in the juice of the dormant tuber although in very low concentration. Similar curves have been obtained with the juice from the tubers of *Helianthus tuberosus* and *Ranunculus ficaria*, and from hyacinth bulbs.

By ultracentrifugal analysis we have also found traces of obviously monodisperse high-molecular compounds, probably carbohydrates, in the juice from hyacinth leaves and in the sap from birch trees.

It is hoped that investigations along these lines will help to throw some light on the processes of carbohydrate metabolism in growing plants.

¹ Kraemer, E. O., and Lansing, W. D., *J. Phys. Chem.*, **39**, 153 (1935), for cellulose. Lamm, Ole, *Kolloid-Z.*, **69**, 44 (1934), for starch. Record, Basil R. (unpublished), for glycogen.

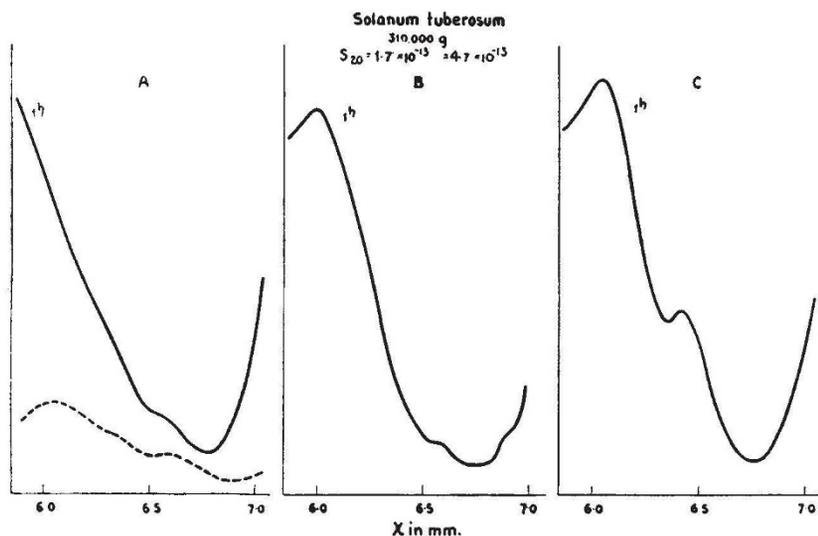


Fig. 4.

mentation and diffusion. Fig. 3 shows the sedimentation of the carbohydrate from a *Lilium* bulb. The molecular weight was 16,000.

There is a noticeable change in the sedimentation picture with the development of the plant. When a bulb or a tuber begins to sprout, high-molecular carbohydrates appear in the juice in higher concentra-

Physical Chemistry of Surfaces Annual Meeting of the Bunsen-Gesellschaft

THE forty-first annual assembly of the Bunsen-Gesellschaft was held in Breslau on June 2-3, the principal theme of discussion being "The Physical Chemistry of Surfaces". The symposia of the Bunsen-Gesellschaft are organized somewhat differently from those of its younger sister, the Faraday Society. All papers are delivered in full, only abstracts being available beforehand. Papers delivered fall under three heads: (a) summary reports, invited from various experts, intended between them to cover the whole field of discussion, (b) shorter contributions bearing on the main theme, (c) miscellaneous physico-chemical contributions. (b) and (c) were delivered in parallel sittings. This produced a very full two-day programme with little time for discussion—in fact there was no time whatever for public discussion on section (a). This disadvantage is appreciated, and the society has recently adopted a policy of holding smaller extra *Tagungen*, more after the model of the Faraday Society, in which discussion can be a principal feature.

Prof. P. A. Thiessen made some general introductory remarks and took the chair. R. Brill discussed surface films on water, a method of investiga-

tion which has been somewhat neglected in Germany since the time when Fräulein Pockels, its originator, had to arouse Rayleigh's interest to secure publication of her work. He discussed in great detail the two-dimensional equation of state, and finally the work of Blodgett and Langmuir on built-up multilayers. Of all recent developments mentioned in the symposium, the latter undoubtedly shows the most promise of great expansion and exciting progress. In a single lecture of such detail it was naturally impossible to deal with everything, but it is unfortunate that such well-established novelties as measurement of film potentials and the investigation of chemical reactions in monolayers were never brought before the meeting.

An interesting paper by K. Neumann concerned molecular motion in surfaces. He dealt first with the streaming set up at liquid surfaces by capillary forces, which often plays a large part in the rapid dissolution of surface-active substances; and, secondly, with surface diffusion on solids—a field of research first opened up by the work of Volmer and Estermann on the growth of mercury crystals. Both experiment and simple theoretical considerations

show that the activation energy for change of position of a molecule on a crystal surface is roughly one fifth of the heat of evaporation, whence it follows that a molecule after condensation will usually change its place some thousands of times before evaporating again. This enables the regular growth of crystals, which is otherwise difficult to reconcile with the existence of condensation coefficients of the order of magnitude 1. The activation energy for the motion of single ions on the surface of an ionic crystal is not much less than the heat of evaporation, but adsorbed pairs of oppositely charged ions can readily move around one another. This accounts for the surface diffusion of sodium chloride, for which experimental evidence was presented.

O. Hahn reported on the investigation of surface processes by radioactive methods. Of particular interest is his "emanation method" of investigating the 'inner surface' of a solid. This is a development from the older adsorption method used by Paneth. Hahn makes solid preparations containing minute quantities of radium, and determines the nature of the surface by the readiness with which the material gives up emanation. By this means, changes in the surface of a material (for example, iron oxide-hydroxide gel or a catalytic thorium oxide) with time or heating can be followed with great sensitiveness. Later in the meeting, K. E. Zimens reported on theoretical work of S. Flügge which shows that the method can also be used to investigate diffusion constants in solids, in principle quite easily for values as small as 10^{-28} cm.²/day. (The smallest measured diffusion constant in a solid is 10^{-17} found by Cremer in solid hydrogen from the rate of disappearance of isolated *ortho*-hydrogen molecules, which are only destroyed by magnetic reaction with one another.) A very remarkable result obtained by the older methods is that found by K. Starke, that mixtures of ZnO-Fe₂O₃ or ZnO-Cr₂O₃ in equimolecular (spinel) proportions develop a very much increased adsorptive power for lead above that of the components, even at room temperature.

Th. Schoon dealt with electron diffraction as a means of investigating surfaces. He discussed the evidence for the Lennard-Jones effect (predicted contraction of the surface layers of ionic crystals, and a corresponding expansion in molecular crystals), which remains doubtful, owing to uncertainties about the refractive index for electrons of the possible presence of adsorbed gas layers. Among other points dealt with were the depth of penetration of electrons, by which is meant the depth to which an electron at grazing incidence (3°) can pass in and out of the crystal, being scattered only once. From the fact that with 25 kv., cetyl palmitate and stearic acid crystals, grown from hydrocarbon solvents, give the same diagram, but differ at 40 kv., it is concluded that electrons at these voltages have respectively shallower and deeper penetrations than 20 Å.

P. Harteck dealt with the various types of adsorption (Van der Waals adsorption, capillary condensation, and reversible and irreversible activated adsorption). R. Suhrmann reported on electron emission phenomena. C. Wagner gave a masterly survey of reactions at phase boundaries, classified according to the nature of the velocity-determining stage. This was so closely packed as to be incompressible, and it is recommended that the original paper be referred to when it appears in the *Zeitschrift für Elektrochemie*. K. Fishbeck made much the same attempt with narrower limitations. Finally, G. M. Schwab sur-

veyed surface catalysis. This paper also, unfortunately, lends itself to compression as little as the subject lent itself to compression into a single lecture of 35 minutes.

An arbitrary selection must suffice for the miscellaneous papers. L. Bergmann demonstrated a number of interesting experiments with supersonics. Th. Förster showed how it is that the strength of a C-H bond is influenced by the state of binding of the carbon (single, double or triple bond, or strained ring). The mutual influence arises from the fact that the sum of the mixture ratios of 2s and 2p states in the four bonds must remain constant and equal to 1:3. Reduction of the angle below the tetrahedral angle reduces the ratio below 1:3, and hence increases it in the other bonds. The maximum binding is reached with a ratio of about 1:1 (C-H bond in acetylene). With nitrogen, the bonding of which is not a mixture of electron states, but purely 2p in the first approximation, there is no mutual influence, as the Raman spectra have shown. Schmid and Larsen showed that the increase of conductivity at high frequencies ($\lambda = 12$ m. and 20 m.) is very large in solutions of soaps, etc. containing ionic micelles. This indicates that the reduced conductivity and activity in such solutions is a Debye-Hückel electrostatic effect (theory of Hartley and others) rather than reduced dissociation as supposed by McBain. H. J. Antweiler and M. v. Stackelberg reported further experiments on the peculiar currents of liquid, with speeds up to 8 cm./sec., which are set up in the electrolyte at liquid metal cathode surfaces under certain conditions. This can now be satisfactorily interpreted as a cataphoretic effect. K. Clusius and K. Weigand have measured the pressure dependence in the transformation II (isotropic) \rightleftharpoons III (anisotropic), in solid hydrogen sulphide and heavy hydrogen sulphide. The hysteresis in this change is still something of a mystery, but the authors suppose it means that many molecules must become rearranged simultaneously. X-rays indicate that the S-atoms scarcely move in the transition. F. C. Frank presented a descriptive theory of the phase-change liquid to liquid-crystal, showing the way in which the quasi-crystalline structure of the former can develop semi-continuously into the latter. This was intended to be a contribution to the general theory of phase changes from the point of view that this is one of the simplest of all crystal-non-crystal transitions.

On the whole, in spite of the high quality of individual contributions, the meeting produced nothing of great novelty. This applies particularly to the main theme. Partly this reflects a certain lack of enterprise in German physical chemistry, which is at the moment mainly distinguished by painstaking covering of well-trodden ground; partly it indicates that the time was well chosen for a summarizing symposium designed to report progress, rather than to make it.

There were as usual a number of social events in a programme which scarcely left a minute unprovided for. Of these the most memorable was a concert in the *Schloss*, with music by Mozart and Frederick the Great—the latter appropriately as the one who gave the *Schloss* its present inner form. At the final dinner, we learnt that this was the fortieth *Bunsentagung* which Prof. Bodenstein had attended, without interruption. Finally, many members took part in a visit to the Waldenburger Bergland and Salzbrunn, and some continued home *via* the ridge-way of the Riesengebirge.

F. C. FRANK.