The Chemistry Section has continued the analysis of the long-term field experiments and investigated the effect of different manurial treatments on soil structure. An examination of the biochemical factors affecting the germination of seeds was commenced. The chemical changes occurring in the root of red beet when clamped and during flowering are being studied. The nature of the competition between weeds and vegetables is one of the problems being investigated in the Physiology Section, which is also concerned with growth studies of vegetable crops with the object of finding how various manurial treatments affect the growth and yield of crops. The influence of various treatments on the flowering of vegetables is being studied. In the Irrigation Section emphasis is shifting from treatments applied throughout the life of the plant to treatments applied at certain stages of growth. In general, it has been found that abundant water supply increases the quality of foliage of most vegetable plants and also increases the yield of saleable material. It seems clear that each crop will have to be considered on its merits regarding irrigation requirements. Work has continued on the development of an irrigation gauge.

The Entomology Section has made further studies on beetle predators of the cabbage root fly. It was confirmed that low rates of soil insecticides broadcast on the soil resulted in an increased infestation of cabbage root fly. Further work is being carried out on the soil application of soil insecticides for control of carrot fly on carrots and parsnips. An outstanding result obtained by the Pathology Section was the successful use of zinc frit for control of the crook root disease of watercress, resulting in increased yield. Weed investigations include observations on the effect of vegetable cropping on the weed population of original corn land. Various herbicide trials are also in progress. The Statistics Section has, besides handling routine inquiries from other Sections, investigated fitting of growth curves and has worked out designs for the assay of virus preparations on *Nicotiana glutinosa* and *Phaseolus vulgaris*. Apart from the usual weather observations, the use of a special rain-gauge with its rim only 1 in. above ground was continued. Rainfall collected in this gauge was 5 per cent greater than that collected in the standard gauge, thus confirming previous observations at this Station. By using gauges at different heights above the ground it was found that the amount of rain collected was a function of the height of the gauge above the ground and the run of the wind.

METALS AND ALLOYS ABOVE 1,200° C.

A SYMPOSIUM on "The Study of Metals and Alloys above 1,200° C." was held in the Department of Metallurgy of the University of Oxford on September 17 and 18; the subjects discussed at the four sessions are outlined below. Prof. W. Hume-Rothery welcomed the visitors to the symposium in an introductory address, and emphasized the increasing importance of the topic under discussion. He urged that metallurgists should look ahead five or ten years: design engineers were always limited by the high-temperature alloys available to them.

Metals and Alloys of High Melting-point

The first session was devoted to a study of the properties of some refractory metals and alloys—the platinum metals, tungsten alloys, molybdenum, and titanium–carbon alloys. Prof. E. Raub (Forschungsinstitut für Edelmetalle und Metallchemie) emphasized the relatively high reactivity with gases and refractory materials possessed by the platinum metals and alloys at high temperatures. Subsequent discussion centred on whether oxygen diffusion can take place through platinum, and it was concluded that it did not diffuse through metal of very high purity, although internal oxidation, for example, has been observed in dilute alloys. Raub also considered the reaction of the platinum metals with refractory materials, and described methods of melting and annealing these alloys, pointing out the main difficulties encountered by metallurgists studying their behaviour.

R. Kieffer, K. Sedlatschek and H. Braun (Metallwork Plansee, Reutte-Tirol) presented a paper on sintered high-melting tungsten alloys, outlining various methods for preparing the metal and for the production of cold ductile alloys. The alloy systems described were tungsten–molybdenum, tungsten–niobium and tungsten–tantalum; in the last case the following properties of sintered tungsten alloys with 0–100 per cent tantalum were outlined: density, hardness, elastic moduli, electrical resistivity, ease of hydrogenation, oxidation behaviour and corrosion resistance in acids and alkalis.

A. R. Moss (Armaments Research and Development Establishment, Woolwich) considered the thermal, mechanical and physical factors affecting the grain structure of arc-melted molybdenum, and finally R. L. Bickerdike and G. Hughes (Royal Aircraft Establishment, Farnborough) described a vacuum-quenching furnace which had been used to examine the titanium-rich end of the titanium–carbon system between 1,558° C. and 1,763° C.

High-temperature Techniques

The session opened with papers on zone melting by G. A. Geach and F. O. Jones (Associated Electrical Industries) and J. A. Belk (Woolwich). The first paper described an arc-melting technique and also a floating-zone method, using electron-bombardment heating to melt a narrow zone of the specimen, applied to refractory metals including rhenium and tungsten. Belk gave further details of the latter method, applied to the removal of carbon from vacuum-cast molybdenum. The mechanical properties of the purified material in single crystal and polycrystalline form were summarized.

Arc-melting processes were outlined in papers by A. R. Moss (Woolwich), J. R. Murray and G. K. Williamson (Atomic Energy Research Establishment, Harwell) and F. O. Jones, A. G. Knapton and J. Saville (Associated Electrical Industries). Moss discussed the basic principles of the various vacuum-arc and inert-gas arc-melting processes, followed by a consideration of the electrical and mechanical equipment in common use. Murray and Williamson reviewed the application of arc-melting, and other melting techniques used in alloy investigations at temperatures above 1,200° C. at Harwell, and further

descriptions of arc-furnace techniques were given by Jones, Knapton and Savill, who also considered electron bombardment heating as supplementary to arc-furnace techniques. Finally, a special molybdenum-wound cooling curve furnace was described by W. Oldfield (British Cast Iron Research Association), in which the element completely surrounds the specimen container.

Physical Properties and Equilibria at High Temperatures

The first two papers were concerned with crystal structure. A. J. Martin and A. Moore (Atomic Weapons Research Establishment, Aldermaston) discussed the structure of beryllium at temperatures between −185° C. and 1,290° C. No evidence was found to support other workers' claims of allotropy in the range 400–800° C. They showed, however, that the lattice is hexagonal up to about 1,250° C., above which the structure is body-centred cubic, and the authors discussed the possibilities of retaining this structure form at temperatures below 1,250° C.

The Metallurgy Department, Royal Aircraft Establishment, Farnborough, then presented a paper on the structures of graphites deposited from hydrocarbon gases at various temperatures and pressures. The effect of changes in deposition temperature on the density and X-ray diffraction pattern was shown. 'Flecks', not unlike deformation bands, are produced on the surface of these graphites when they are deformed.

The remaining papers of the session were concerned with high-temperature equilibria; C. W. Haworth (University of Oxford) described tungsten-resistor furnaces in which specimens weighing 1–5 gm. can be annealed *in vacuo* or in argon up to 2,700° C. and then quenched. The apparatus has been used in work on molybdenum base alloys. A. Hellawell (University of Oxford) directed attention to the face-centred cubic/body-centred cubic transition found in the metals of the first three transition series, and described apparatus which has been used in the thermal analysis of these phase transitions. The influence of various solute elements upon the transition in manganese and iron was shown to be related to the structures of the elements concerned.

The last paper of the session, by P. Gross, D. L. Levi and G. Wilson (Fulmer Research Institute), discussed methods for determining the thermodynamic activities of alloy constituents at high temperatures. Two methods for measuring vapour or reaction pressures have been used—an effusion method (restricted to systems in which the pressure of any constituent does not exceed about 0·1 mm. mercury) applied to alloys containing iron and aluminium at 1,300° C., and also a capillary vessel method where the reaction pressures are beyond the range of the effusion method.

Mechanical Properties at High Temperatures

In a paper on high-temperature mechanical working of molybdenum, E. W. Ward (Woolwich) discussed the factors affecting the breakdown of the arc-cast structure. The microstructures produced by rolling and extruding at temperatures up to 1,800° C. showed that true hot working had been achieved.

Two papers concerned with the measurement of mechanical properties followed. L. M. T. Hopkins (National Physical Laboratory) described determinations of the creep properties of ceramics and high melting-point metals in air and *in vacuo*, respectively. B. L. Mordike and L. M. Fitzgerald (University of Cambridge) are investigating the properties of the refractory metals tantalum, tungsten, niobium and molybdenum, and the carbides of tantalum, tungsten, niobium, titanium, zirconium, vanadium and boron up to their melting points, which lie in the range 2,500–3,500° C. Apparatus to measure the tensile strength of metals, friction of carbides and hardness determinations of metals and carbides were described.

D. M. Gilbey (Farnborough) presented an extension of the simple theory of the thermal stresses in flat plates, so that variations with temperature and stress of the thermal and elastic properties of the material can be taken into account. The stresses calculated by this method for a manufactured graphite were compared with those obtained from the simple theory using constant 'effective values' of the 'constants'.

The session concluded with a paper by D. T. Livey (Harwell) on the high-temperature stability of oxides and sulphides. The behaviour of the stable refractory oxides *in vacuo*, oxidizing and reducing atmospheres was considered; the refractory sulphides are thermodynamically less stable, in general, than the oxides, although the sulphides of cerium and thorium have been used for reactive metals. Kinetic factors, rathet than thermodynamic stability, control the degree of reaction between metals and oxides or sulphides, ar least for the more reactive metals.

During the symposium, an exhibition of apparatus, refractories, etc., was held at the University Department of Metallurgy. Exhibits were lent by a number of industrial firms, research establishments, and university departments.

J. W. MARTIN

INVASIVENESS AND SURFACE PROPERTIES OF CANCER CELLS

AN informal symposium on the surface properties of cells and their possible bearing on the invasive movements of cancer cells was held at the Chester Beatty Research Institute on July 4. The chair at the morning session was taken by Prof. A. Haddow and in later sessions by Dr. B. Sylvén (Stockholm) and Prof. G. Klein (Stockholm).

Prof. Haddow pointed out in his introductory remarks that the bearing of the surface properties of cancer cells on their invasiveness has received little attention, apart from the microhistological studies of Dr. Coman and his collaborators in the United States. But interest in the surface properties of cancer cells has developed during the past few years, stimulated largely by Dr. M. Abercrombie's studies of cell movements in tissue culture. It had, therefore, been decided to bring together some of those specialists most directly concerned with this largely unexplored field.

Dr. M. Abercrombie (London) then described the conditions for the invasion of normal cell explants by tumour cells in culture. Whether or not invasion occurs appears to be determined largely by the effect that contact between interacting cells has on their