The annual report is divided into three main sections, dealing with research and development, reactor design and construction, and administration, respectively. In general, the technical predictions on which the project was originally based continue to be confirmed by experience. No significant changes in the basic concept have been necessary, though an important change in the safety principles has been decided on. The inner containment, which consists of a steel shell containing the reactor core, is to be filled with air instead of nitrogen, but the design is such that a return to nitrogen filling, if required, can still be made. The reactor pressure vessel has been successfully pressure and leak tested and delivered to the site. Its erection within the reactor building is proceeding. Steady progress has been made in the design of the fission product and helium purification systems, and a contract for the purification plant is expected to be placed shortly. Construction of the reactor building has advanced rapidly and the control building has been completed.

Theoretical studies during the year have been concentrated on 'burn-up calculations' and power and temperature distributions. The distribution of radioactivity in the *Dragon* system has been estimated. The experimental reactor physics investigations carried out in the *Zenith* reactor continued until July, when the exclusive use of the *Zenith* reactor for the *Dragon* programme came to an end. Several measurements have been made and evaluated. Heat-transfer channel experiments simulating *Dragon* reactor conditions have been carried out at Risø, Denmark. Carbon transfer experiments have emphasized the importance of extremely pure graphite in the core. Barium has been found to have a strong catalytic influence on graphite corrosion while silica acts as an inhibitor. The graphite for the main reactor components other than the fuel elements has been delivered and is in the process of being machined. No firm decision has yet been taken as to whether a fission product emitting fuel or a fission product retaining fuel will be used for the first charge in the *Dragon* reactor, but development work has proceeded on both types and plans for manufacturing either type are in hand.

The report contains many other details of the core and graphite assemblies and control mechanisms together with numerous dimensional diagrams and photographs of the various components. Annexed to the report are charts showing the composition of the staff of the Project; the members of the Board of Management and the General Purposes Committee—the two international committees responsible for the direction of the Project; and a list of all major contracts placed up to March 31, 1962.

S. Weintroub

RADIOACTIVITY IN HUMAN DIET

EACH year, as a reminder of the hazards of the atomic age, reports are issued by the Agricultural Research Council Radiobiological Laboratory of levels of radioactivity in human diet. The annual report, 1961–62*, includes a review of research designed to give better understanding of factors which influence the passage of radioactive material from fall-out into plants and animals, both by direct contamination of foliage and via the soil, finally appearing in the mixed diet of the human population. The results of this work range from a demonstration that deposition of strontium-90 in soils may be reliably predicted from figures for annual rainfall, to a final indictment of the Brazil-nut as a concentrator of radium and thorium from the soil on which it is grown; about 1,000 times as much of these isotopes are found in Brazil-nuts as in other nuts and fruits.

The report gives the mean ratio of strontium-90 to calcium in the total mixed diet as 6·2 picocuries per gram of calcium during 1961 as compared with 6·4 in 1960 and 9·0 in 1959, the corresponding values for milk being 5·9, 6·4 and 9·7. It is stressed, however, that the figures obtained so far do not as yet reflect the full effects of the resumption of nuclear testing in 1961, and the most recent measurements support the forecast that the situation in 1962 will not differ greatly from that in 1959 after the tests in 1958.

Reference is made in the report to a 'working level', which is defined as 130 picocuries of strontium-90 per gramme of calcium. Indefinite exposure at this level would induce in bone amounts of strontium-90 of approximately half the maximum permissible specified by the Medical Research Council. In fact, the recommendation of the Medical Research Council's second report, *The Hazards to Man of Nuclear and Allied Radiations* (Cmnd. 1225, December 1960), was that "if the concentration of strontium-90 in bone calculated as an average for any age group, including the groups of infants and young children, was found to be rising continuously and to have reached the level of one-half that recommended as the maximum permissible level for the population as a whole, a re-assessment of the situation would be required". The derivation of a 'working level' in the diet, from a maximum permissible level in bone, is not explained in the report from the Agricultural Research Council, and the size of the margin of safety adopted is not given.

In view of this the implications of the term 'working level' are difficult to assess and at best this seems a most unfortunate choice of words.

* Agricultural Research Council: Radiobiological Laboratory. Annual Report, 1961–62. Pp. xv+96. (London: H.M. Stationery Office, 1962.) 6*s*. 6*d*.

PETROLEUM MULCH

IN arboriculture the word 'mulch' is usually associated with the compost of wet leaves, straw, etc., laid as a protection to the roots of newly planted or young trees, especially on inherently dry soils. Petroleum mulch, however, is a relatively recent product of research in the industry and although in some respects its behaviour and purpose are similar to traditional soil-dressings, its potentialities are probably more far-reaching and durable. In the autumn number of the *Esso Magazine* (1962), an informative and well-illustrated account of a petroleum mulch evolved by Esso Research is given. The efficacy of this product is now being tested and proved on a large number of sites in many different countries. Already results are most encouraging and augur well for yet another application of petroleum to the well-being of mankind.

Briefly, this type of mulch is in fact an inexpensive emulsion of petroleum resins, used as an agricultural spray for improving the growth and yield of crops of all kinds. Its function is four-fold: to warm the soil, to reduce evaporation, to protect against soil-erosion, and to retard the dispersal by rain-wash and other agents of vital mineral and chemical constituents in the soil growth-zones wherever it is used. Most crops are planted in rows and when seeded can be sprayed with this petroleum mulch. The width of these bands may vary from three to ten inches or more, according to the nature of the crops, spacing, and soil conditions. In this way a thin, continuous protective film of the emulsion is formed on the top of the soil, adherent but not deeply penetrating. This film is rain- and wind-proof and remains intact for up to ten weeks. The effect is drastically to reduce the rate of moisture evaporation from the soil involved; also, because of its dark colour, sunlight is absorbed and heat trapped, so that in favourable circumstances soil temperatures can be raised by as much as 20° above normal.

Some significant results are quoted. Tests on cotton plants in Arizona in 1960 revealed that where this mulch was used, twelve days after planting, 121,900 plants per acre had emerged as against 8,710 per acre on the control area. The final yield in bales per acre was 2·2 with mulch and 1·65 without, an increase of 34 per cent. In comparable tests with melons, an increase of 17 per cent was attained, while with vegetables such as carrots, onions, lettuces, turnips and radishes, the increase ranged from 22 per cent to 67 per cent. Similar tests of the reaction of different plants to petroleum mulch under a great variety of climatic conditions, have been carried out in the United States, Europe, and arid and semi-arid areas in North Africa, with equally beneficial results. H. B. MILNER

METALLOGRAPHIC EXAMINATION OF THE PHASE DIAGRAM OF THE GALLIUM–TELLURIUM SYSTEM

By J. R. DALE

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KLEMM and von Vogel[1] obtained a phase diagram for the gallium–tellurium system by means of thermal and qualitative X-ray analysis. Newman, Brice and Wright[2] modified this by investigating the system by differential thermal analysis and by direct observation of the melting-points under controlled tellurium pressures. Since no attempt appears to have been made to check the phase diagram metallographically and no data on the microscopy of the system appear to have been published, a metallographic analysis of the system between 50 and 85 per cent tellurium (all compositions are quoted in atomic percentages) was undertaken.

The samples for microscopic analysis were prepared from 99·999 per cent gallium (from Aluminium Industrie Aktien Gesellschaft) and 99·999 per cent tellurium (from Mining and Chemical Products, Ltd.). The gallium was cleaned by etching in dilute hydrochloric acid before weighing and the tellurium in concentrated hydrochloric acid. After weighing the materials (total weight approximately 2 g) were placed in silica crucibles which were sealed under high vacuum to eliminate loss of tellurium. In general, the samples were reacted for 8 h at 840°–860° C followed by furnace cooling to give a cooling rate of approximately 4°–5° C/min. Some of the samples were vibrated at 50 cycles/sec at low amplitude to give better mixing and more rapid reaction.

To prevent deformation of the relatively soft GaTe and to facilitate sectioning, ingots were mounted in cold setting low-shrinkage epoxide resin blocks ('Bakelite Resin 19019, Hardener Q18814'). In most cases the whole ingot was potted so that a full macroscopic examination could be carried out to determine if any segregation or other inhomogeneities had occurred during the reaction and cooling procedure.

The ingots were prepared for metallographic examination by first lapping successively on 400 mesh, 600 mesh and precision grades of silicon carbide emery polishing papers (Union Glue and Gelatine Co., Ltd.) using paraffin as a lubricant. Intermediate polishing was carried out by lapping on successive grades of diamond paste (L. M. Van Moppes) from 16μ particle size to 0·25μ held on photographic paper pads. A final polish was carried out using a 'Selvyt' cloth pad rotating at 750 r.p.m. and impregnated with a dilute solution of gamma polishing alumina. This long lapping and polishing procedure was found necessary to prevent flowing and deformation of alloys containing less than 58 per cent tellurium, for those having a higher tellurium content the intermediate polishing procedure could be omitted.

Two etches were selected for the determination of the phase diagram by microscopical analysis. The compositions of these etches were:

No. 1 etch: 50 parts glacial acetic acid; 5 parts hydrofluoric acid (40 per cent); 5 parts nitric acid (sp.gr. 1·42).

Samples were etched for 1–2 sec, rapidly transferred to a water bath or quenched and then dipped in concentrated ammonia for a few seconds to remove any slight film formed. The samples were finally washed in de-ionized water and rinsed in ethyl alcohol to prevent staining. No. 1 etch attacked GaTe more rapidly than Ga_2Te_3.

No. 2 etch: 50 parts glacial acetic acid; 5 parts nitric acid (sp.gr. 1·42); 2 parts hydrofluoric acid (40 per cent); 2 parts hydrogen peroxide (100 vol.). This was used as a stain etch to identify the gallium–tellurium compounds in conjunction with No. 1 etch; this caused Ga_2Te_3 to be stained light brown but had very little effect on GaTe.

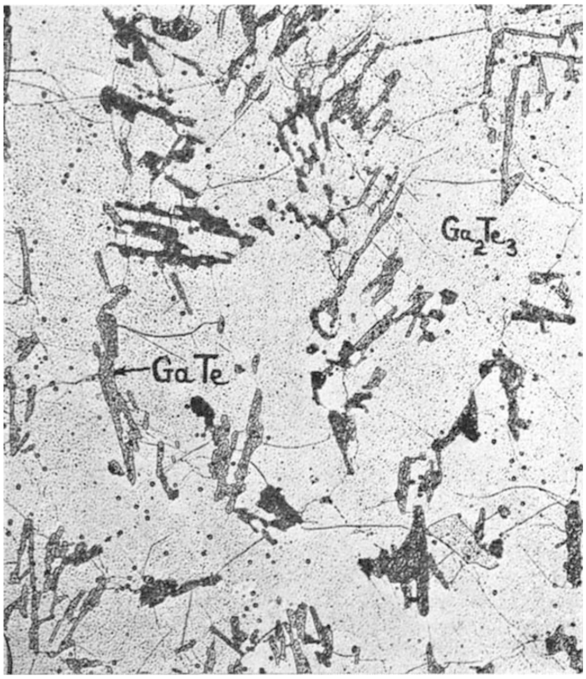

Fig. 1. Photomicrograph of an alloy, composition 57·8 atomic per cent tellurium, after etching in No. 1 etch. This shows island of GaTe (dark) in a matrix of Ga_2Te_3 (light). (× 350)