In 1947 the Brookhaven National Laboratory, Upton, New York, after careful consideration of the scientific, economic and practical factors involved, concluded that the proton synchrotron was the best type of accelerator suitable for the purpose, and in 1948, with the financial assistance of the United States Atomic Energy Commission, the design and construction of the cosmotron was commenced. The assembly took nearly four years, and in May 1952 a proton beam of 1,000 MeV. energy was obtained. This was increased to 2,000 MeV. in the following month, and with suitable modifications to the pole windings it is confidently expected that 3,000 MeV. will finally be obtained. Machines capable of reaching higher energies are being constructed elsewhere ; but the cosmotron was the first high-energy accelerator to be constructed and to be operated.

The work was directed initially by M. Stanley Livingston (Massachusetts Institute of Technology), then by Milton G. White (Princeton University), and finally by G. B. Collins, who is the present chairman and who joined the project in April 1950. A detailed description of the principle, construction and operation of the cosmotron is given in a series of articles, edited by M. Hildred Blewett, a member of the cosmotron staff, in the special cosmotron issue of the *Review of Scientific Instruments* (24, No. 9 ; September 1953). L. J. Haworth, director of the Brookhaven Laboratory, contributes a short foreword, and this is followed by a general review, by the editor, of the cosmotron, discussed component by component and giving data concerning the personnel, cost and basic parameters.

A ring-shaped magnet guides the particles on a circular path of radius 30 ft., and a radiofrequency electric accelerating field provides increments of energy to the protons which are injected initially into the cosmotron, at about 3·5 MeV., from a Van de Graaff accelerator. The maximum magnetic field is 14,000 gauss. The vacuum is maintained by twelve 20-in. diffusion pumps at a minimum operating pressure of 5×10^{-6} mm. of mercury, and the volume evacuated is about 300 cu. ft. The other articles in the series are divided into sections dealing with the magnet, the pole-face windings, the radiofrequency system, the injection system, the vacuum system and the control system, respectively. Finally, three short papers deal with the cosmotron building, eddy-current phenomena and studies of injection phenomena in the cosmotron, respectively.

ALEURONE LAYER IN BARLEY

IN a comprehensive anatomical investigation of the aleurone layer in the cultivated barley, J. Sawicki (*Polska Akademia Umiejetnosci,* No. 66, 1–59, pub. Krakow, 1952, with English summary) has examined 103 varieties, representing all the sub-species of *Hordeum sativum* collected in different parts of the world.

In these materials, the number of cell rows in the aleurone layer and its thickness were observed. The range of variability of these characters was studied to see if they could be used in the classification of barleys. The hereditary transmission of these characters was also investigated over a period of several years. It has been ascertained that the varieties examined show distinct differences in regard to both the characteristics studied. The mean number of cell rows in the aleurone layer of the different barley varieties ranges from 1·64 to 3·11, and the mean thickness of the aleurone layer from 49·94 to 110·16 microns.

Observations of the two characteristics in question on material from several years and from different climatic conditions showed that they exhibit a comparatively small variability due to the environmental conditions. A detailed analysis of variance of material of forty varieties from 1937, 1938 and 1947 cultures showed that as regards the number of the cell rows the varietal differences are responsible for 93·00 per cent of the total variation and for 85·60 per cent as regards thickness of the aleurone layer. The variation due to seasonal differences is very small : in the first case 0·60 per cent, and in the second 0·40 per cent of the total variation. The remaining amounts of variation are due to unknown causes (environmental changes). Similar results were obtained by analysis of the variation of the pedigree lines from 1947, 1948 and 1949, indicating that there are no essential differences between the pedigree lines and the examined material of commercial varieties. The results obtained justify the view that the aleurone characters are comparatively constant and may therefore be used in classification.

It is held that the results of these investigations corroborate the earlier data of Orlow, who found that barleys endemic in the Asiatic centre of origin as a rule possess three rows, and those of the African centre two rows, of cells in the aleurone layer only. As the European varieties of cultivated barley show a similar differentiation, the possibility exists of explaining, in some cases, their primary origin.

FORESTRY COMMISSION IN SCOTLAND

IN a small illustrated pamphlet entitled "The Forestry Commission in Scotland" (recently published by the Forestry Commission) it is stated that the history of forestry in Scotland is a long one. Shakespeare in "Macbeth", for example, brought the Birnam Woods to Dunsinane, a difficult military position, and timber from the same Birnam Hill in Perthshire was used for helping the national effort during the Second World War. Great natural woods once covered most of Scotland ; but through the years, fire, disease and the axe took a great toll. Later, many of the remaining forests were exploited for charcoal for iron-smelting purposes, followed by the spread of sheep-raising at the end of the eighteenth century.

It was the great inroads into the woods of the country, almost entirely privately owned, during the First World War that brought the Forestry Commission under the Forestry Act of 1919. The Commission was reconstituted by the Forestry Acts of 1945 and 1951. Under the 1945 Act the Commission was made subject to direction from the Minister of Agriculture and Fisheries and the Secretary of State for Scotland. In Scotland all land acquired through the Forestry Fund is vested in the Secretary of State.

Between the World Wars a great deal of planting was done by the Forestry Commission, but the resultant plantations were still too young to provide any contribution of value to the timber requirements of the Second World War. Once again it was the privately owned woodlands which were subjected to over-felling, no less than 344,000 acres being felled. In Scotland this war-time felling amounted to 155,000 acres, with the result that many a glen and mountain-side are now no longer recognizable.

In 1946 the Commission embarked on a big post-war programme, the aim of which is to produce five million acres of productive forests in Great Britain. This involves the development of three million acres of new forest mainly on moorland and mountain-side and other land of low agricultural value, and the restoration to full production by private owners and the Commission of two million acres of existing woodlands. It is proposed that not less than half the new planting will be carried out in Scotland, where there is a great deal of land eminently suitable to afforestation, this being done without any interference with land which can be utilized for agriculture, for agriculture has the first call on all land.

Planting is proceeding all over Scotland at a steadily increasing rate. During the 1951–52 season nearly 31,000 acres were planted by the Commission, whereas five years before only about 12,300 were planted. By 1956 it is hoped to increase the annual rate to forty thousand acres, about 40 per cent being in the Highland counties. The Commission has one million acres of land in Scotland, three hundred thousand acres of which is planted; the balance of the land is made up of areas still being grazed and awaiting afforestation, land given up to forest nurseries, unplantable land and mountain tops the forests of which come into the national forest parks, and lastly a considerable area which will remain permanent agricultural land. Among the species of tree used, Scots pine ranks high; but on the peaty slopes of the western hills, with their high annual rainfall, Sitka and Norway spruces are more satisfactory. Other conifers used are the three larches, European, Japanese and hybrid, the Corsican pine and the Douglas fir, the latter first introduced in 1826 from British Columbia by David Douglas. The area suitable for hardwoods is limited. Already the work entailed has resulted in an increase of population, and forest villages are in the process of being built. The afforestation campaign will add in the future very considerably to the wealth of Scotland, apart from the increase in employment provided by the forests and the connected wood industries.

E. P. Stebbing

DETERMINATION OF ATOMIC MASSES BY THE PYKNO-X-RAY METHOD

By Prof. T. BATUECAS

Laboratory of Physical Chemistry, University of Santiago de Compostela, Spain

In a previous communication[1] it was shown that the atomic masses of various chemical elements can be calculated with precision by means of the pykno-X-ray method, when the density and X-ray data of the crystalline solid have been measured at the same temperature.

It is to be noted, however, that the method as described was not capable of the highest accuracy because the data used were slightly uncertain. In order to remedy this and at the same time to check the accuracy of the new method, researches have been in progress since 1950 in this laboratory with the object of measuring the densities of several crystalline solids at the same temperature at which their grating spaces had been determined. It seemed useful to report the first results obtained for sodium chloride, arsenic trioxide (As_4O_6, octahedral form), and silica (α-quartz), as well as the atomic masses deduced for sodium, arsenic and silicon. Further, we can add (1) another result for the atomic mass of silicon from the very precise data obtained at 20° C. by M. E. Straumanis and E. Z. Aka[2] for octahedral silicon, and (2) the value for the atomic mass of calcium calculated from the excellent measurements made on calcite also at 20° C. by J. A. Bearden[3].

In our calculations of 1950, we adopted calcite as reference standard "because in our opinion its density, grating space and structural geometric constant have been determined with greater accuracy than any other crystalline solid". This was qualified by the remark that "Finally, it would be better to take as reference standard instead of calcite another such as diamond. Then, of course, the value used for the Avogadro number would be that deduced from diamond". In view of the recent beautiful work on diamond of M. E. Straumanis and E. Z. Aka[4], it seems that the time has now come for adopting as standard this latter substance instead of calcite.

Actually, using the 'methode asymetrique' (probably the most exact method available at the present time for determining the grating spaces), Straumanis and Aka have succeeded in making highly accurate measurements on three specimens of very pure diamond between 10° and 50° C. From these data the grating space at 23·5° C. (all corrections made) $d^{23\cdot5} = (3\cdot55961 \pm 0\cdot00001_6)$ A., $d'^{23\cdot5} = (3\cdot56682 \pm 0\cdot00006_8) \times 10^{-8}$ cm., taking into account that to convert to absolute values the values expressed in the Siegbahn scale, multiplication by the factor $(1\cdot00202_5 \pm 0\cdot000015)$ is necessary. The temperature of 23·5° C. is that at which J. A. Bearden[5] determined the density of diamond which seemed then to be the most probable value, namely, $\rho^{23\cdot5}_{\text{diamond}}$ $(3\cdot51836 \pm 0\cdot00004)$ gm./cm.^{3}.

In our opinion, the diamond is much better than calcite as a reference standard because the uncertainty in the molecular weight of the latter is much greater than that of the atomic weight of carbon. As already stated, in taking diamond as the reference standard the value for the Avogadro number used in the calculations must necessarily be that referred to diamond. Now the unit cell of the latter contains eight atoms of carbon and the formula to be used will be:

$$8\, M_{\text{diam.}} = N_A \cdot \rho_{\text{diam.}} \cdot (d'_{\text{diam.}})^3, \qquad (1)$$

in which the symbols $\rho_{\text{diam.}}$ and $d'_{\text{diam.}}$ represent in our case the density and the grating space of diamond at 23·5° C. For the atomic weight of carbon we assume $C = (12\cdot011 \pm 0\cdot0005)$ in agreement with that recently found in this laboratory[6] by means of the gas dimethyl ether $(CH_3)_2O$, namely, $C = (12\cdot011_5 \pm 0\cdot001_7)$ and identical with the value now considered as most probable by E. Wichers[7]. On substituting the appropriate data in formula (1), the value of the Avogadro number is found to be:

$$N_A = (6\cdot0236 \pm 0\cdot0006_6) \times 10^{23},$$