of exhibitions of samples sent from various parts of the country, and valued by the Barley Valuation Committee of the Institute of Brewing. One of the most interesting facts gleaned is that the results of the experiments made by Rothamsted in the last ten years on the manuring of barley have passed into practice; these results indicated that barley is not a starvation crop, and that, provided the danger of lodging is kept in mind, the crop repays manuring.

The expanding acreage of vegetable crops grown in Great Britain is reflected in the increasing attention given them in the Rothamsted scheme of experiments. The expansion in this branch of work was made possible by the investigation into the value of dried poultry manure, put in hand by the Ministry of Agriculture and controlled from Rothamsted. Although the standard errors proved to be rather higher than the average of large-scale root-crop trials, a number of statistically significant fertilizer effects were found for some crops. More work was done on Brussels sprouts than on other crops. Comparing poultry manure with sulphate of ammonia providing the same amounts of nitrogen, the results indicate that, in the more favourable growing season of 1935, as compared with 1934, sulphate of ammonia proved more effective. Another interesting feature is that the manurial responses showed up more in the first pickings—an important consideration in the marketing of this crop.

The report has also something of interest for hill farmers. In the Bacteriological Department, the work on clover organisms continues, and it appears that the soils of certain hill districts contain harmful strains that do not themselves benefit the clover plant, and also prevent most beneficial strains from forming nodules. Some beneficial strains, however, can overcome the harmful effects of the bad strains, and enable the plant to make normal growth. Promising results have been obtained from experiments on the inoculation of these beneficial strains into soils containing the harmful ones.

The Report includes a review by Dr. W. Brenchley of thirty years' work of the Botanical Department (1906–36). The problems tackled by this Department have been many and varied. The work on boron in relation to plant growth is one of many interesting landmarks in this survey. A chance observation directed attention to the possibility that this element might be essential for plant growth, and it was established conclusively by later work that boron is essential for the growth of many plants, the meristematic tissues being affected in its absence. Dr. Brenchley is perhaps best known in the agricultural world for her researches on weed eradication, work that demanded a number of surveys to ascertain how far weed species, or groups of these, are associated with particular soils or crops.

The survey concludes with an account of the work on the Park grass plots, in which various aspects of grassland management have been studied, such as the influence of season and manuring upon the botanical composition of the herbage from year to year.

Separation of Isotopes

AN interesting report by G. Champetier (*Bull. Soc. Chim.*, (5), **3**, 1701; 1936) deals with the separation of the isotopic forms of elements.

The proportion of the isotopes in an isotopic mixture is very variable. In hydrogen, the atomic ratio is $^3H : ^2H : ^1H = 7 \times 10^{-10} : 1/5750 : 1$; bromine is a mixture of approximately equal parts of ^{79}Br and ^{81}Br. Apart from the well-known case of the isotopes of lead produced by the radioactive changes of uranium (^{206}Pb) and thorium (^{208}Pb), slight differences in the atomic weights of different specimens of natural elements have been found. A difference of 0·000108 in atomic weight between atmospheric oxygen and oxygen from the water of Lake Michigan has been reported. Small differences in density of water from the surface and from the depths of the sea in various localities are probably due to separation of light and heavy water by gravity. The first quantities of water collected in rain are heavier than the following, whilst snow and glacier water is lighter than ordinary water. These separations are due to differences in vapour pressure and melting point. Water from the wood or dry leaves of a tree is heavier than normal water. All these differences are very slight.

The artificial separation of isotopes has been achieved in various ways. Neon has been separated by fractional diffusion; mercury, zinc, potassium and chlorine (as hydrochloric acid) by distillation at very low pressure; minute quantities of the lithium isotopes, ^6Li and ^7Li, and more appreciable amounts of the potassium isotope, ^{39}K, by the mass-spectrograph; and neon, hydrogen, water, ammonia, carbon tetrachloride and oxygen by fractional distillation.

The diffusion method gives better results. If x_0 and y_0 are the volumes of the two constituents in the original mixture, and x and y the volumes remaining after diffusion, the enrichment coefficient $r = \frac{y}{y_0} \div \frac{x}{x_0}$ is related to the isotopic masses m_1 and m_2 by the equation

$$r = a\sqrt{V_0/V}$$

where $a = (m_1+m_2)/(m_1-m_2)$; $V_0 = x_0+y_0$; $V = x+y$. The values of a for HD and H_2 is 5, for neon 21, and for $^{18}O^{16}O$ and $^{16}O^{16}O$, 33. The diffusion method has been particularly used by Hertz, who has used batteries of porous clay tubes in series, and also by diffusion into mercury vapour of the pumps circulating the gas. In the first method, pure ^{20}Ne has been obtained, and in 8 hours 1 c.c. of pure D_2 from a mixture containing only 1 in 1000 of D_2. Recently, a partial separation of the carbon isotopes ^{12}C and ^{13}C has been achieved by diffusion of methane. Diffusion of hydrogen and deuterium through heated palladium has also been used.

The electrolytic method is the one most successfully used in the separation of hydrogen and deuterium from water. A slight separation of the oxygen isotopes is also effected, but it has been calculated that, to obtain 1 c.c. of $H_2{}^{18}O$ by this process, it would be necessary to electrolyse more water than is found on the surface of the earth. In an attempt to separate the tritium isotope, ^3H, from water, 75 tons of water

have been reduced to 0·5 c.c., when the ^3H content rose from 7×10^{-19} to 7×10^{-6}.

Separation of isotopes has also been achieved by chemical means. These generally make use of the so-called exchange reactions, of which the following are typical:

$$NH_3 + HOD \rightleftharpoons NH_2D + H_2O;$$
$$2H_2{}^{18}O + C^{16}O_2 \rightleftharpoons 2H_2{}^{16}O + C^{18}O_2.$$

The photochemical method is probably capable of extension. Phosgene, $COCl_2$, containing the chlorine isotopes 35 and 37, is exposed to light, when the molecules containing only ^{35}Cl are preferentially decomposed (in presence of a trace of iodine). The free chlorine is absorbed by mercury and has an atomic weight lower than normal. Preferential photochemical oxidation of the mercury isotopes has also been achieved.

University Events

BIRMINGHAM.—The degree of D.Sc. has been conferred on the following: Donald Parkinson (geology) for papers on "The Faunal Succession in the Carboniferous Limestone and Bowland Shales at Clitheroe and Pendle Hill", "The Carboniferous Succession in the Slaidburn District of Yorkshire", and other papers published in the *Quarterly Journal of the Geological Society* and elsewhere; Robert Anthony Robinson (chemistry) for "Investigations on the Thermodynamic Properties of Aqueous Solutions of Electrolytes" published in the *Transactions of the Faraday Society* and for other papers; Horace Augustus Thomas (electrical engineering) for papers on the "Frequency Stabilisation of Valve Oscillators" and "Developments in Rotating Radio Beacon Transmitters and Receivers", published in the *Journal of the Institution of Electrical Engineers*.

CAMBRIDGE.—The Clerk Maxwell scholarship has been awarded to E. Bretscher of Fitzwilliam House.

DR. SIMON FLEXNER, emeritus director of the Rockefeller Institute of Medical Research, has been appointed Eastman visiting professor in the University of Oxford for the academic year 1937–38. The professorship was founded by the late George Eastman of Rochester, U.S.A., to provide for scholars in American universities to go to Oxford as visiting professors for terms of one to five years.

THE Rhodes Trust has issued a statement for 1935–36 showing the distribution of the Rhodes scholars (95 from the British Empire, 90 from the United States and 5 from Germany) among the various subjects (either in the final honour schools or for research degrees) chosen by them. It shows a large majority under the headings natural science and medicine (62), philosophy, politics and economics (41), and jurisprudence and B.C.L. (32). Next come modern history (14), English (13), mathematics (8), Litt. Hum. (7), economics (6), geography (3), modern languages (2), theology (1) and education (1). Of the 16 who obtained honours in philosophy, politics, and economics, 12 were from the United States, 2 from Canada and 2 from Africa.

Science News a Century Ago

J. D. Forbes's Work on Terrestrial Magnetism

ON January 3, 1837, in a letter to Arago, J. D. Forbes said: "I write to mention some results respecting terrestrial magnetism at which I have lately arrived. In 1832 I made an extensive series of experiments with Hansteen's Intensity Apparatus in the Alps, and in 1835 in the Pyrenees. One principal object was to ascertain the influence of heights. I doubt extremely whether any decided result can be drawn from preceding observations. . . . Those of M. Kuppfer seem to be of little value. They were not made at the summit of the Caucasus. . . . I have referred the positions of my stations in the Alps and Pyrenees to the three co-ordinates of latitude, longitude, and height, and deduced the influence of each. . . . I have in the first instance confined my calculation to horizontal intensities. From three different series of observations, made with two needles, I find always a negative co-efficient of the height, indicating, at a mean, a diminution of ·001 of horizontal intensity for 3,000 feet of vertical ascent. If, as Humboldt states, the dip diminishes in ascending, the diminution of total intensity will be somewhat greater. You will judge of the extent of the inductions upon which this is founded when I mention that the sum of the heights to which I have carried Hansteen's apparatus exceeds 160,000 feet, or thirty vertical miles, twelve *lieues*".

Airy at Greenwich Observatory

IN his review of the events of 1837, Airy in his autobiography said: "My connection with Cambridge Observatory was not yet finished. I had determined that I would not leave a figure to be computed by my successor. In October [1836] I had (at my private expense) set Mr. Glaisher to work on reducing the observations of Sun, Moon, and Planets made in 1833, 1834 and 1835; and subsequently had the calculations examined by M. Hartnup. This employed me at times through 1837. I state here, once for all, that every calculation or other work in reference to the Cambridge Observatory, in this and subsequent years, was done at my private expense".

"On Jan. 3rd," Airy wrote, "I gave notice to the Admiralty that I had finished the computations of Groombridge's Catalogue, and was ready to print. The printing was authorized and proceeded (the introduction was finished on Nov. 22nd) but the book was not quite ready till the beginning of 1838". For furthering the magnetical work at Greenwich more ground was necessary. When the Visitors met in 1836, a suitable site was chosen and in 1837 "on Jan. 3 I was informed unofficially by Mr. Wood (Admiralty Secretary) that the addition of the Magnetic Ground was sanctioned".

Among other entries relating to 1837 is that in which Airy says "In the month of July the Admiralty wished for my political assistance in a Greenwich election, but I refused to give any".

Botany of Battersea Fields

AT a meeting of the Botanical Society held on January 5, 1837, a communication was read by the curator, Mr. Daniel Cooper, author of "Botanical Rambles within Thirty Miles of London", on the distribution of the localities of wild plants in Battersea Fields. It was accompanied by a map of the