The Preservation of Food.*

THE Report of the Food Investigation Board for 1930 is notable, as in previous years, for the great variety of the researches which have been carried out under the Board's auspices. They are concerned with the changes taking place in meat and fish, fruit and vegetables on storage, especially at low temperatures, with the commercial application of the results obtained, and with the engineering problems involved in the construction and running of large stores. The report notes that the work of the Board has already been effective, in that two commercial gas stores for the storage of apples are now in operation: in one, over a period of five months, the losses during storage of 'Bramley's Seedling' apples did not exceed 0·5 per cent. Close touch is kept with investigators in other parts of the Empire: co-operation will be facilitated by the appointment of assessors, representing the Dominions and Colonies, to the Board during the past year.

The model store chamber at the Ditton laboratory, designed to hold 120 tons of fruit, is now in operation. The problem is to secure uniformity of temperature, humidity, and gas content, at desired values, inside a stack of material which generates heat, evaporates water, consumes oxygen, and evolves carbon dioxide. Large scale storage involves special questions, since the heat, water vapour, and gases produced in the body of the stack have finally to be removed from its surfaces: the greater the ratio of volume to surface, the greater is the difficulty of effective removal without the establishment of gradients. The investigations must therefore be carried out in special chambers arranged for the continuous scientific control of the environment and the measurement of the changes occurring in it: all measurements can be made from outside—for example, temperatures by a 200-point resistance-thermometer outfit.

Some of the scientific problems to be met by the biological engineers have also been investigated: one of the most important is the rate of evaporation from stored materials. Investigations have been carried out by A. J. M. Smith, during the year, on eggs and cheese. In the case of the former, there is no close correlation between rate of evaporation and area of surface, nor does the rate of air-movement (at constant humidity) have any effect on the rate of evaporation. In fact, evaporation appears to depend chiefly on the shell, which acts as the limiting factor: the rate falls off with time, but this is apparently not due to the eggs containing less water but to an increase in the resistance to diffusion of one of the membranes. During the first ten days or so of the life of the eggs the loss of weight is also due in part to output of carbon dioxide. The initial movement of water from the white is not only outwards but also inwards to the yolk, since the osmotic pressure of the latter is the higher: later the yolk loses not only the additional water but also some of that originally present. Examination of the water content of cheese at different levels from the surface showed that the gradient of water content was very steep, the bulk of the evaporated water coming from the outer 2 cm.

Investigations on the canning of fruit and vegetables have been carried out by T. N. Morris and J. M. Bryan. Using a tin-iron couple, it was found that oxygen increases slightly the corrosion of the tin by acid, but depresses that of the iron: in the absence of oxygen the corrosion of tin is negligible. The detinning of tinplate is most severe at low hydrogen ion concentrations (pH 4–5) within the range encountered in canned fruits: thus, corrosion is greater with cherries than with gooseberries. On the other hand, at low acidity, oxygen accelerates instead of depressing the corrosion of iron. It was also found that a rough surface accelerates both corrosion and the formation of hydrogen; that at high acidities exposed portions of the metal are attacked, at low, the pits and seams, and that traces of tin in solution inhibit the corrosion of iron. Traces of sulphur dioxide accelerate the corrosion of iron at high acidity, but retard it at low; gelatin and other inhibitors of acid corrosion may exert a powerful influence at high acidity but little or none at low. It may be necessary to store the fruit or vegetables before they are canned: strawberries and cherries can be stored frozen in sugar syrup; peas require blanching by boiling water before being frozen. On subsequent thawing and canning, the latter have the appearance and flavour of fresh canned peas, provided the liquid drained off on thawing is used as a covering in the tin: the thawed peas themselves resemble fresh peas if cooked at once.

During the year a survey of the freezing, storage, and transport of New Zealand lamb was carried out by E. Griffiths, J. R. Vickery, and N. E. Holmes: it was concerned chiefly with the measurement of the temperature, relative humidity, and movement of air surrounding the carcasses, as well as with the temperatures of the latter themselves, in the various stages of storage and transport. It was noticed that the 'bloom' or general appearance of the carcasses depended on breed, age, and nutrition of the sheep as well as on the treatment accorded after death. The value of beef is greater when it is imported chilled and not frozen, since it is ready for immediate sale, is well conditioned and tender, and little different in appearance from home-killed beef. The drawbacks of chilled, instead of frozen carriage, are microbial growth and rancidity. T. Moran, R. B. Haines, and C. H. Lea have shown that air movement delays the growth of moulds and the development of rancidity when meat is stored at 0° C.

Rancidity cannot be measured by chemical tests, as the products responsible for the taste and odour vary in different cases: it can be prevented by storage below − 10° C., when the meat is, of course, frozen: at − 5° C. the growth of moulds and yeasts is not completely inhibited. Light favours the development of rancidity, by hastening oxidation in the superficial layers of the fat: the process is autocatalytic and continues after subsequent removal to the dark. On the other hand, an unpleasant flavour develops in the dark, which is not due to atmospheric oxidation of the fat. It has also been found that an *Actinomyces* is responsible for the development of a musty odour in meat: it finds its way into the store with straw.

Work has also been carried out on the theoretical aspects of the subject of chilling and freezing: thus, muscle is irreversibly damaged when frozen below about − 2° C.: it can still form lactic acid, which can be removed by oxidation; but the resynthesis of the acid to glycogen can no longer take place. J. Brooks has shown that the discoloration of meat is due to the formation of methæmoglobin from hæmoglobin in the superficial layers: this process is inhibited by continuous storage at below − 10° C.

In the case of pig products, E. H. Callow has shown that carcasses of pork can be frozen, transported, and then made into bacon, provided that the fat is hard, otherwise rancidity develops: the nature of the fat

* Department of Scientific and Industrial Research. Report of the Food Investigation Board for the year 1930. (London: H.M. Stationery Office, 1931.) 3*s*. net.

depends on the diet of the pig. More lately it has been found that mild-cured or tank-cured bacon, frozen at − 35° C. and stored at − 10° C. or − 15° C., after slow thawing, and smoking in the case of the latter, tasted for the greater part like ordinary bacon after cooking, but in each case slight rancidity had developed in small areas of the fat. Work has also been carried out on the swelling of gelatin and pork muscle in solutions of sodium chloride.

The Torry Fish Research Station acquired the steam-drifter *City of Edinburgh* during the year. C. A. Reay has carried out further experiments on the freezing and cold storage of haddock. Under certain conditions an irreversible change in the muscle occurs which may not be very obvious on thawing but is evident after curing, since the glossy pellicle of the surface is absent and the tissue is friable, inelastic, and opaque instead of elastic and translucent. The rate of change is slowest at 29°–25° F. and − 9° to − 13° F., and quicker at the intermediate temperatures; at the higher, bacterial growth occurs, the lower involves greater expense in refrigeration.

Research work on fruit and vegetables has been continued. J. Barker has found that cyanide at first accelerates the respiration of the potato instead of inhibiting it as in the case of many animal tissues. The effect appears to be due to an activation of the starch-hydrolysing mechanism, so that more respirable material is available: later inactivation occurs. A. S. Horne has found that East Malling apples, which have a reputation for good keeping qualities, owe their freedom from wastage to absence of infection in the orchard: when infected they are less resistant than fruit from other areas. Resistance to fungal attack depends in part on the acid content of the apples, which decreases with age.

The Idu (Japan) Earthquake of Nov. 26, 1930.

SINCE the great disaster of 1923, Japan has been visited by three destructive earthquakes, in the Tazima province on May 23, 1925, when 428 lives were lost; in the adjoining Tango province on March 7, 1927, when 3017 persons were killed, and in the Idu peninsula on Nov. 26, 1930. Prof. A. Imamura has written two interesting papers on the last-named earthquake while a valuable memoir has recently been contributed by Mr. S. I. Kunitomi of the Central Meteorological Observatory.*

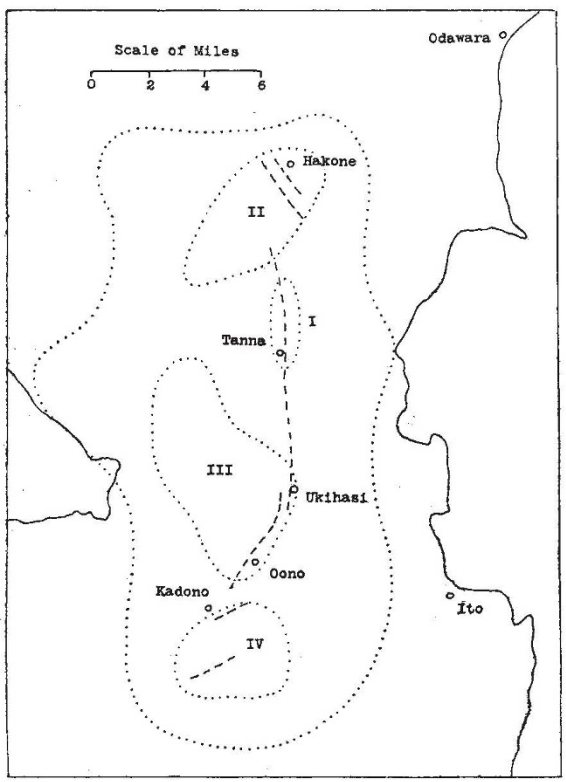

FIG. 1.

According to Mr. Kunitomi, the earthquake was felt over a land-area of 133,000 sq. miles, including the greater part of Japan. The series of Ito earthquakes, more than 4000 in number, closed at the end of May (NATURE, vol. 126, pp. 326, 971). Then followed a pause of about five months until Nov. 7, when a slight earthquake occurred with its epicentre near the Tanna basin. Every day after this, the fore-shocks of the Idu earthquake increased in number until, on Nov. 25, 734 shocks were recorded at the Misima Observatory near the north end of the peninsula. Up to 4 A.M. on Nov. 26, the total number of fore-shocks was 2165, of which 184 were felt at the observatory. Mr. Kunitomi's map representing the distribution of the fore-shock and after-shock epicentres shows that the former were as a rule clustered along the Tanna fault, while the latter were widely scattered over the epicentral region and especially at the bases of Mounts Huzi, Asitake, and Hakone, and off Cape Ooze.

One of the most useful sections of Mr. Kunitomi's paper is that which deals with the origin of the Ito and Idu earthquakes. He has studied the distribution of the directions of initial motion in the Idu earthquake and the stronger Ito earthquakes, especially that of March 22. In all of these earthquakes the distribution is the same, and implies in each a horizontal movement of the crust-blocks along a N.N.W. and S.S.E. line, or nearly along the course of the Tanna fault, the eastern block moving to the north and the western to the south.

The Idu peninsula lies on the west side of Sagami Bay, the bed of which and the surrounding shores formed the epicentral area of the Kwanto earthquake of Sept. 1, 1923. Prof. Imamura points out that there have been three epochs of seismic activity in this region, in 818, 1703 and 1923, and that the first and third were followed, after 23 and 7 years respectively, by destructive earthquakes in the Idu peninsula. The recent Idu earthquake may thus, he suggests, be regarded as an after-shock of the earthquake of 1923.

The earthquake occurred on Nov. 26, at 4 h. 3 m. A.M. (Nov. 25, 7 h. 3 m. P.M., G.M.T.). In a sketch-map, the essential features of which are here reproduced (Fig. 1), the broken lines represent the faults along which dislocations occurred during the earthquake, the outer dotted line bounds the area in which at least 1 per cent of the houses collapsed, the inner dotted lines I-IV, the areas in which the percentage was not less than 25. It was in the areas II-IV that the greatest losses of life and property occurred, 259 persons being killed and 2142 houses destroyed.

Of the faults that appeared during the earthquake, four are especially noteworthy. (i) The Tanna fault

* *Tokyo Imp. Acad. Proc.*, vol. 6, pp. 419-422; 1930, and *Japan. Jour. Astr. Geoph.*, vol. 8, pp. 51-65; 1931. *Tokyo Geoph. Mag.*, vol. 4, pp. 73-102; 1931.