HAZARDS OF RADIATION

THE committee on radiological hazards to patients, with Lord Adrian as chairman, has now published its second report*. The first, an interim report dealing only with mass miniature radiography, was issued in 1956 and has been reviewed previously (*Nature*, **178**, 453; 1956). The present report is devoted to considerations of the long-term genetic hazard to the population as a whole arising from the average radiation-dose received by the population in excess of that from natural sources. The statistical nature of the investigation and of its results is stressed; although doubling the average dose of 3 r. to the gonads during reproductive life might give reason for concern from a genetical point of view, a gonad-dose of 6 r. received by a single individual is not likely to cause abnormalities in the immediate progeny.

The conclusions of the committee are based on two nation-wide surveys. During one week in May 1957, a survey was made in Britain of the numbers and types of X-ray examinations carried out, of the number of films used, and of the apparatus available in all National Health Service hospitals and chest clinics, in dental surgeries and in a few other institutions. Including fluoroscopic examinations, this survey covered a total of 259,457 radiological examinations. The second survey, during one week in December 1957, was made in a random selection of about one quarter of the National Health Service hospitals and chest clinics, and totalled 55,065 radiological examinations. These surveys were supplemented by physical measurements (totalling about 14,000) of the radiation-dose received by patients undergoing different types of radiological procedures in a representative sample of 130 hospitals and chest clinics.

When account is taken of seasonal differences in the frequency of examinations, the data from both surveys agree in indicating a total of 13·0 million radiological examinations during 1957. This is somewhat more than the corresponding figure of 12·2 million used in the Medical Research Council's first report. In large part this may be due to the much more restricted sample that was available for the earlier estimate. More important, and possibly an indication that the recommendations of 1956 had already influenced radiological practice in 1957, was a difference in age distribution of patients examined in the two reports. While in 1956 it had been estimated that 31·9 per cent of all examinations had been given to the age group 0–14, and 25·9 per cent to the over-fifty age group, the corresponding figures in 1957 were 13·5 and 34·4 per cent. From a genetical point of view, this is a desirable development; for the potential effect of a given dose on future generations is greater in a young person having a high expectancy of parenthood than in an older person. In fact, the calculations of genetical hazards in the present report make use of fertility factors giving the average child expectancy at each age for arriving at the "genetic dose to the population". By this is meant the gonad-dose which, if given to every member of the population, would have the same effect as the sum of the individual doses actually received.

The results of the surveys are expressed as mr. (milliroentgens) annual genetic dose per head of the population. All medical radiology in 1957/58, both diagnostic and therapeutic, resulted in a genetic dose of 19·3 mr. This is less than the figure for diagnostic radiology alone (22 mr.) in the Medical Research Council's report of 1956. The main contributions to the total of 19·3 mr. are: diagnostic radiology 14·1 mr., radiotherapy of non-malignant conditions 4·5 mr., radiotherapy of malignant conditions 0·5 mr.; minor contributions are made by medical uses of radioactive isotopes (0·18 mr.), mass miniature radiography (0·01 mr.) and dental radiography (0·01 mr.). The dose to the gonads from any X-ray examination is small in comparison with that considered by the Medical Research Council to be acceptable to the individual without causing undue concern on behalf of himself or his offspring. The committee therefore concludes that there is no need for major restrictions in radiological practice, and that the number and types of examinations or treatments must be dictated by the clinical needs of the patient. Nevertheless, it considers that, whenever possible, the gonad-dose should be reduced even further, and it gives detailed recommendations how this can be done, especially in the case of pregnant women. It is satisfied that, if these recommendations are followed, the total annual genetic dose to the population from all forms of medical radiology can be reduced to a figure of 6 mr. or less. C. AUERBACH

* Medical Research Council. *The Hazards to Man of Nuclear and Allied Radiations—a Second Report to the Medical Research Council.* (Cmnd. 1225.) Pp. vii+154. (London: H.M. Stationery Office, 1960.) 7s.

PHYSIOLOGY OF SUGAR-CANE

R. L. BIELESKI (*Australian J. Biol. Sci.*, **13**, 203; 1960) has found that the sugar uptake by sugar-cane storage tissue takes place in two stages. In experiments in which slices of mature and immature storage tissue were used, the initial uptake reached an equilibrium within 1 hr., the level being proportional to the external sugar concentration: it was independent of the sugar, and was unaffected by anaerobic conditions. When the tissue was placed in water, this sugar diffused out rapidly, that is, it was contained in the apparent free space, 10–20 per cent of the tissue volume. The secondary uptake continued up to 60 hr. at a slow, constant rate, 1–5 mgm./gm./day, independent of sugar concentration above 2·0 per cent, dependent on the sugar, and inhibited by anaerobic conditions. This sugar did not diffuse out when the tissue was placed in water. The secondary uptake thus appears to involve an active accumulation process. The sucrose content of the tissue increased during accumulation, which occurred against a 10- to 200-fold concentration gradient. There was no starch synthesis, but accumulation was associated with a 30–40 per cent increase in respiration. Sucrose was not hydrolysed prior to accumulation, and when slices accumulated sugar from a mixed solution, sucrose uptake inhibited glucose uptake. Internodes which were most active in storing sugar in the field gave the most actively accumulating preparations in laboratory experiments. Mature tissue slices showed little or no ability to accumulate sugars.

In further work on the effects of inhibitors on sugar accumulation, the author (*ibid*., p. 221) has noted that various metabolic inhibitors, at *p*H 5·5, affect sugar accumulation in immature sugar-cane storage tissues. The rate of accumulation was reduced by 10^{-5} *M* mercuric ion, 10^{-5} *M* *p*-chloromercuribenzoate, cyanide, and cupric ion, and 2×10^{-3} *M* phloridzin. Accumulation was completely inhibited and sugar leakage induced by 10^{-5} *M* dinitrophenol, 10^{-4} *M* mercuric ion, and 10^{-3} *M* *p*-chloromercuribenzoate, cyanide, cupric ion, azide, arsenate, and iodoacetate. The effects of 10^{-5} *M* dinitrophenol and 10^{-4} *M* cyanide were reversible, but that of 10^{-3} *M* cyanide was irreversible. Only slight effects were produced by borate, phosphate and magnesium ions. The behaviour of sugar-cane sugar accumulation towards inhibitors is apparently similar to that of other transport mechanisms, being somewhat more sensitive than most plant processes and less so than animal ones. It differed from sugar accumulation in animal tissues in showing no specific sensitivity to phloridzin. The results suggest that sugars are contained within the immature storage cell by the continuous operation of a metabolic storage mechanism rather than by an impenetrable barrier to sugar diffusion.

VIRUSES AND PLANT DISEASES

THE investigations of Dr. L. O. Kunkel into the relationships between viruses and plant diseases are described in the *Rockefeller Institute Quarterly* (4, No. 2; Summer, 1960).

Kunkel discovered that the aster yellows disease is carried by a leafhopper and is caused by one of the few viruses that is equally at home in hosts of the plant and animal worlds. First, he observed that during the hot summer months the aster yellows disease diminishes in plants, and showed that the causative virus is sensitive to heat. Dr. Kunkel was able to cure infected plants of several virus diseases by growing them at temperatures which destroyed the virus without destroying the plants. Peach yellows is one of the diseases which responded to heat treatment. The heat-treatment technique also enabled Dr. Kunkel to deduce that the aster yellows virus multiplies in its leafhopper carrier as well as in the plant it infects. To do this, he subjected the insects to heat and noted how they regained their infectivity. He concluded that the virus must multiply in the insects, reaching a level of maximum infectivity in about two weeks. Direct evidence for this was found by L. M. Black, using a technique developed in Africa by the English scientist, H. H. Storey, to inoculate minute leafhoppers with measured amounts of virus.

Secondly, in his work on the transmission of yellows viruses, Dr. Kunkel discovered two related strains of aster yellows virus, each of which will protect plants against infection by the other, a phenomenon known as cross-protection. He also found cross-protection between viruses in the leafhoppers as well. Dr. Karl Maramorosch, who began work at the Institute with Dr. Kunkel, has continued his studies of plant viruses. He confirmed the complex relationships existing between two strains of the corn stunt virus and the leafhopper that transmits them from plant to plant. Of the two strains of the virus, plants infected by one are protected against infection by the other, but the second will not protect a plant against the first. Similarly, infection of a leafhopper by the first will prevent it from becoming infected afterwards with and transmitting the second. In the insect also, the second virus strain will not protect against the first. These findings regarding corn stunt virus confirmed Kunkel's discovery that two related strains of aster yellows virus would protect leafhoppers against each other, but Dr. Maramorosch was the first to find unilateral protection.

Maramorosch has also found that a leafhopper which normally feeds on corn can live on aster plants only if the asters are infected with the aster yellows virus. After they feed on diseased asters, the corn leafhoppers are then able to survive on uninfected aster plants. They are then also able to survive on healthy carrot plants, which they could not do before their diet of diseased aster plants. It would appear that the virus infection may actually benefit the insect by widening its potential food plants. The explanation of these phenomena is not yet clear, but Dr. Maramorosch is pursuing his investigations.

DISTILLATION OF ALKALI ELEMENTS DURING FORMATION OF AUSTRALITE FLANGES

By Dr. S. R. TAYLOR*
Department of Geochemistry, University of Cape Town

THE flanged australites (Figs. 1 and 2) are the most distinctive members of this well-preserved group of tektites. The common australite forms are distinguished by Fenner[1] as round (buttons and lenses), oval (ovals, boats and canoes), dumbbells and teardrops. 'Cores' may be round, oval or dumbbell shapes. The flanges, which occur most commonly on the round forms, but occasionally on the other types as well, display the often quoted evidence for two periods of melting of tektites. Sections

* Now at Department of Geophysics, Australian National University, Canberra.