

used were those of scalp pressure bandages, temporary bilateral ligation of external carotid arteries, and boron-10 infusion into the internal carotid artery on the same side as the tumour. These methods were not adequate in preventing severe reaction since a large neutron dose was required to treat a deep-lying tumour because the thermal neutrons attenuate rapidly in tissue.

A research project has therefore been undertaken to determine the minimal dose of thermal neutrons and of the heavy particles from $^{10}\text{B}(n,\alpha)^7\text{Li}$ reaction to produce radiodermatitis on the ear of the rabbits, and to investigate the details and characteristics of skin reaction and their prevention, especially by the employment of neutron-shielding materials for medical use.

The findings show that the safe skin dose (no more than grade-2 skin reaction) of thermal neutrons and of the heavy particles from the $^{10}\text{B}(n,\alpha)^7\text{Li}$ reaction on rabbits' ears are established to be less than

10×10^{12} n/cm.² with thermal neutrons exposure alone and 1.5×10^{12} n/cm.² with 35 mgm. ^{10}B per kgm. body-weight. A review of clinical data shows the maximum safe skin dose to be roughly 0.5×10^{12} n/cm.² with 25–50 mgm. ^{10}B per kgm. body-weight. These clinical data have been correlated with work on the differences of radiosensitivity between human beings and rabbits' ears by Ellinger.

The medical uses of neutron-shielding materials from both physical and biological points of view have been considered, and the utilization of the above data to avoid skin complications in neutron-capture therapy for human brain tumours is indicated by Yamamoto. The use of the temporary skin flap and lithium metal shielding has been successful in avoiding skin complications. The value of relative biological effectiveness is calculated to be 3.9 from thermal neutron exposure alone and to be 1.87 from neutron-capture therapy from the $^{10}\text{B}(n,\alpha)^7\text{Li}$ reaction with 35 mgm. per kgm. body-weight.

LAND-USE SURVEY: NICARAGUA

IT is now well recognized that the world's agriculture must become more intensive if it is to keep pace with the increasing population of this planet. Earlier warnings by Lord Boyd-Orr can now only be accepted as fundamentally real, and have been placed in perspective by Dr. Norman Wright, deputy director of the Food and Agriculture Organization of the United Nations. He estimates that if agriculture makes use of all the technical assistance available, there is no reason why it cannot keep pace with the increasing demands for food, at least to the turn of this century. One of the first technical contributions to agricultural intensification of a country is a survey of the optimum uses of land, and the first parts of such a survey in Nicaragua have been published recently.

Nicaraguan agriculture is at present not very intensively developed. The latest returns (for 1952, in the Food and Agriculture Organization's *Yearbook 13*, 1959) show it to have a total area of 14,800,000 hectares of which more than 26 per cent is built on or otherwise unusable. Of the productive area the largest proportion is forest (57.5 per cent). Pastures account for nearly 6 per cent and arable crops nearly 8 per cent, while 29 per cent is potentially productive, though not used at present. This should be a most rewarding setting for a land-use survey, shows particular foresight of the originators, and Dr. Taylor has indeed produced a report which demonstrates how Nicaragua could not only feed more than her own rapidly expanding population for some time to come but also maintain and increase the forestry assets*.

Grassland improvement is perhaps the most basic, for stock depends on it more than on arable crops. Enhanced grazing value of the savannah is possible by mowing or controlled burning, and on more fertile ground, the wasteful bush fallow should be replaced by a period of from four to six years of rotation pasture with controlled grazing by stock. There is,

however, urgent need to introduce more productive grasses and legumes.

Perhaps the greatest need for the survey is shown in forestry organization. In the Puerto Cabezas-Rio Coco area, the pine forests are only sufficient for a further seven years supply, yet the industry could be built up to have a perpetual annual income of at least 23,000,000 dollars (U.S.), and measures to effect the transition are discussed. On the other hand, in an area to the north of Santo Domingo, standing timber valued at approximately 100,000,000 dollars (U.S.) is likely to be destroyed in the gradual clearing of land for agriculture and grazing. A project to utilize it is described. It is recommended that a small forest service concentrating on fire control be established, pasture and plant introduction officers be appointed and that there should be a small service for crop protection, for diseases and pests are severe in the condition of high rainfall.

Climate and soils in Nicaragua are very suitable for a considerable expansion of cash crops. Large areas would, for example, be suitable for growing rice, with or without low-lift irrigation, which could cover immense areas at low cost. The survey indeed leads to the conclusion that Nicaragua might well export rice, meat, milk, cheese, sugar, citrus products, peanuts, beans and cacao. This raises one of the main difficulties of expanding world food production, namely, of adjusting increased production to new markets. Unplanned flooding of world markets would destroy the whole economics of production, and Dr. Taylor very rightly considers this aspect in addition to the detailed ecology of his valuable report. The population of Nicaragua, however, has increased from 765,000 in 1937 to 1,378,000 in 1958, so if this very rapid increase persists, the internal market alone will demand considerable expansion of food supply and resources.

The classic instances of Israel and Taiwan show what can be achieved by the planned use of land, and, in complimenting Nicaragua and the Food and Agriculture Organization on this progress, we look forward to the remaining parts of the survey and to the implementation of its recommendations.

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* Republica de Nicaragua, C.A. Ministerio de Economia, Instituto de Fomento Nacional, y Organizacion de las Naciones Unidas para la Agricultura y Alimentacion. *Estudios Ecologicos*, Volumen No. 1 (1959). *Estudios Ecologicos para el Aprovechamiento de la Tierra en Nicaragua* (Ecological Land Use Surveys in Nicaragua). Pp. xv + 338. By Dr. E. W. Taylor. (Managua, D.N.: Ministerio de Economia, Instituto de Fomento Nacional y Organizacion de las Naciones Unidas para la Agricultura y Alimentacion (F.A.O.), 1959.)