

that the taxonomy of these forms was based (at least in this case) on phenotypic rather than genotypic characters.

The excursion in the afternoon, led by Dr. McKerrow and Dr. H. G. Reading, visited first an exposure of the Great Oolite at Crawley Road Quarry, Witney, where members saw a Bradford Fossil Bed reef in the Forest Marble. The presence in this reef of remains of all animal groups except cephalopods suggests a shallow lagoon in which the water was too turbulent for cephalopods. The second quarry visited showed a 'Corallian' reef at Shelling-

ford Cross Roads Quarry, near Faringdon, where members saw patches of massive corals in early layers give way to mainly loosely-branching corals higher up, suggesting an increase in the depth of the water at this particular locality with time. The detrital Wheatley Limestone in this quarry was seen below the Coral Rag.

In the course of the symposium special thanks were expressed to Prof. J. W. S. Pringle for entertaining the meeting at Oxford.

D. V. AGER  
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## FOREST RESEARCH

MANY factors influence the growth of forest trees, and these factors cover a particularly wide range when the practice of forestry is largely concerned with afforestation and the use of exotic trees. Thus it is easy to understand why forest research in Britain is so comprehensive. This is certainly shown by the numerous projects described in the annual report of the Forestry Commission for the year ending March 1962\*.

Where so much dependence is placed on seed supply for ensuring the large planting programme, provenance and genetics are very important. Not only are vigorous trees wanted but also especial attention is being directed to those provenances which show resistance to frost. So that the forester may know where to obtain tree seed in Britain of the best of the existing varieties and cultivars, the *Register of Seed Sources* has been brought up to date and it now contains 535 classified seed sources totalling 8,833 acres. Associated with this has been the work of converting the best seed sources into seed stands and thus improving the genetic quality of seed collected in Britain.

Much attention is being directed to the study of soil moisture. Deep peat remains a problem with its poor drainage, the physical instability of the trees, the difficulties of timber extraction and not enough being known about the water and nutrient régimes of the trees. There is another drainage problem on heavy clay soils, but some hope is seen in improved types of mechanical drain diggers.

Exposure is a limiting factor to afforestation on many sites in Britain, and it is not easy of assessment. However, an inexpensive technique has been developed by using the rate of tatter of standard cotton flags set up for a period on the sites being studied. An account of this method is to be published soon. Wind damage is being examined from various aspects, and one project uses a

wind tunnel to determine the relationship between wind velocity and the forces acting on a tree. Another project utilizes the 'tree-pulling' technique to test the effect of direction of pull on tree resistance. Both series of experiments should bring out useful information, but they do not seem to take into consideration that trees in a forest are often subjected to gusts and turbulence and not to a steady force of wind.

The annual report for the New Zealand Forest Service †, covering the period January 1–December 31, 1962, shows an economic flavour. Emphasis is laid on the quality of the end-product so that utilization will be the most profitable possible. Hitherto, New Zealand's high-grade timber has largely come from its indigenous forests, but these resources are now approaching exhaustion. The tools at the disposal of the silviculturist in order to obtain a better proportion of good-grade timber from the exotic forests are pruning and thinning and, therefore, present investigations are attempting to relate pruning and its effect on grade enhancement and the relationship between green crown depth and the density of the stand. However, the importance of protection forestry is not being forgotten. More watershed surveys have been carried out, and some reveal conditions which are rather disturbing. Active erosion and the resulting outpourings of detritus into streams may be largely due to red deer, goats and opossums destroying the protective vegetation cover. In some of the more accessible areas, hunters appear to exert sufficient control on the deer numbers and so the vegetation cover is in reasonable condition to give adequate protection against soil erosion.

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\* Forestry Commission. Report on Forest Research for the year ended March, 1962. Pp. ix+194+12 plates. (London: H.M.S.O., 1963.) 13s. net.

† New Zealand Forest Service: Forest Research Institute. Report of the Forest Research Institute, Rotorua, for the period January 1 to December 31, 1962. Pp. 86+9 plates. (Wellington: Government Printers, 1963.)

## RETURN OF THE NENE TO HAWAII

FROM the beginning of the Wildfowl Trust's attempts to rear the Hawaiian geese, *Branta sandvicensis*, in 1950, it had been hoped that it would become possible to return the Hawaii geese reared at Slimbridge. The growth of the stock has been slow and some of the birds raised have been dispersed to other collections in Europe and North America in order to increase the chance of maintaining and developing flourishing stocks in captivity. By 1960, however, enough geese had been reared to allow the return of some of the nenes to Hawaii. It was not until the summer of 1962 that this somewhat complicated and expensive operation could actually be carried out\*.

The Division of Fish and Game, Department of Land and Natural Resources of the State of Hawaii, proposed that the Slimbridge-reared geese should be used in an attempt

to re-establish the species on the Island of Maui, where it had been extinct for many years. A survey of the existing habitat on Maui in June 1960 showed that there were 9,000 acres of excellent nene habitat and a further 30,000 acres likely to be of some value. A release site was selected near Paliku within the Haleakala National Park. There were strong reasons for this choice: the area at the upper end of the Kampo Gap provides excellent nene habitat with food throughout the year; it is remote, ensuring a minimum of disturbance to the birds in the release pen; suitable accommodation exists for the people needed to care for the birds.

In June 1962 thirty geese were despatched by air from Slimbridge to New York. They were taken to the U.S. Federal Quarantine Station at Clinton, New Jersey, where they were held for 21 days. They were then sent on by air freight to Honolulu. There they were kept in the Zoo for three days to recover from the journey and were

\* The Wildfowl Trust. Fourteenth Annual Report, 1961–62. Edited by Hugh Boyd. Illustrated by Peter Scott. Pp. 180+42 photographs. (Slimbridge: The Wildfowl Trust, 1963.) 17s. 6d. net.

given individually distinctive plastic leg bands. On the twenty-sixth day they travelled by air to Kahului, on Maui.

The Slimbridge birds consisted of 10 juveniles, 7 one year old, 10 two years old, 2 three years old and 1 four years old. 17 were females and 13 males. At Kahului they were joined by five juvenile females reared by the State's Pohakuloa propagation project on Hawaii. The 35 birds were put in light-weight cardboard boxes and taken by lorry up to the rim of Haleakala Crater. Here the boxes were loaded on pack boards and were carried on the backs of 23 Boy Scout volunteers 8.5 miles down into the Crater and across to the release pen at Paliku on the other side.

The release pen at Paliku encloses about an acre of good grass, on the edge of an ancient 'aa' lava flow. The geese were released in the late afternoon of July 26. As they were removed from the boxes, their clipped primaries were extracted so that new feathers would start to grow immediately. The birds were given constant care and supplied with native berries and scratch food

daily. They were also treated for coccidiosis and caecal worms—these parasites having been detected in the faecal droppings of the flock. There was much pecking and other signs of social adjustment for a week or so, but the birds soon settled down.

The geese began making short flights within the pen early in September. The first flights out of the pen were soon on September 12, two Hawaiian-reared birds being the pioneers. The first Slimbridge bird did not fly out until September 17. By the end of the month, 27 out of the 35 were flying a few hundred yards out of the pen, returning at dusk. The Hawaiian and English birds, though remaining in distinct flocks within the pen, mixed very well outside it.

Earlier experience with four separate releases, of 87 birds in all, on the Island of Hawaii, made with similar release pens, has shown that the geese will generally remain in the vicinity of the pen for several months. It is planned to make annual releases of flocks from the same pen in Haleakala Crater for at least two more years, a total of 100 birds being the aim.

## DAMAGE TO LIVESTOCK FROM RADIOACTIVE FALL-OUT

**I**N the event of nuclear war, one major problem for civil defence authorities would be the availability and maintenance of food supplies. One aspect of this problem, the effect of fall-out on domestic animals, is considered in a report, entitled, *Damage to Livestock from Radioactive Fallout in Event of Nuclear War*, prepared by the Subcommittee on Livestock Damage of the Advisory Committee on Civil Defence, National Academy of Sciences—National Research Council, Washington\*.

The object of the report is to present estimates of the biological effects of various levels of radiation exposure. These estimates could be used by civil defence planners, whose responsibility would be, first, to feed a population during emergency conditions immediately following a nuclear attack; secondly, to sustain a population during the subsequent recovery period; and, thirdly, to ensure an adequate maintenance of animal populations. No attempt is made to present maximum permissible levels of exposure, since this concept is considered irrelevant under conditions of national emergency where famine and other hazards would far exceed those normally found in peacetime. The report therefore deals mainly with the lethal effects of radiations received from external sources or from radioisotopes within, or on, the bodies of animals. On the effect of external radiation, animals investigated include cattle, pigs and poultry, and details are given of the clinical responses of these animals following radiation exposure. Estimates are also presented of the mortality and possible utilization of food animals at different times after brief exposures to various doses of radiation. For mammals, it is estimated that a dose of 350 rads would have only a negligible effect on salvageability; following a dose of 750 rads, most animals could be salvaged during the first three days after exposure, but by the fourteenth day all animals would be unfit for use. Estimates for poultry suggest that these animals are able to withstand slightly higher radiation doses than mammals.

The ingestion of radioisotopes may damage the health of food animals, but may also render them unfit for

human use because of the radioactive contamination. The report suggests that contamination should not be significant immediately after a nuclear attack but may become serious if food animals receive protracted exposure to contamination. This factor might be more important for isotopes like caesium-137, with a general distribution in the body, than for iodine-131 and strontium-90 which are concentrated in specific sites. Iodine-131 in milk, however, may represent a hazard, particularly to young children. An assessment of the suitability of contaminated animals for human consumption would require knowledge of the amount and distribution of fall-out. The report describes formulae which could be used to estimate the probable human hazard on the basis of radioactive contamination of the food intake of animals; it also suggests the use of certain foods, such as poultry, eggs and some marine animals, which would not be highly contaminated.

On the problem of stock maintenance, the report considers that radiation exposure would not be seriously harmful. Data from a wide variety of adult animals showed no effect on fecundity from radiation exposures of 400 rads. One gap in the data, however, concerns the radiation sensitivity of young animals. Irradiation of pregnant animals produces abnormalities in the foetus, but this would be of minor importance in stock maintenance. Similarly, gene mutations would be unimportant, particularly in view of the high level of selection normal to animal husbandry.

Final chapters in the report contain recommendations on methods for handling animals which have been exposed to fall-out and suggestions on areas of investigations in which research is urgently needed. A series of appendixes present the basis on which estimates are made throughout the report and a comprehensive list of references is also included.

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\* National Academy of Sciences—National Research Council, Washington, Publication 1078: *Damage to Livestock from Radioactive Fallout in Event of Nuclear War*. Pp. vi+93. (Washington, D.C.: National Academy of Sciences—National Research Council, 1963.) 2 dollars.

## MUCUS IN INVERTEBRATES

**A** GROUP of scientists interested in investigations on "Mucus in Invertebrates" met on August 27, 1963, in Washington, D.C., during the sixteenth International Congress of Zoology. The session was organized for the Division of Invertebrate Zoology of the American Society

of Zoologists by Dr. Sophie Jakowska, Food and Drug Research Laboratories, Inc., Maspeth, New York.

Twelve speakers, representing Australia, Brazil, Canada, Denmark, Sweden and the United States, discussed various aspects of slimy secretions of lower animals. The subjects