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 cæcal worms—these parasites having been detected in the fæcal droppings of the flock. There was much pecking and other signs of social adjustment for a week or so, but the birds soon sett'ed down.

The geese began making short flights within the pen early in September. The first flights out of the pen were seen 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 nenes 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

IN 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 cæsium-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 formulæ 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 fœtus, 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.

C. E. PURDOM

* 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