

Irrigation and subsequent agriculture in California brought changes in the flora and fauna which were responsible for epidemics of encephalitis, and increased agricultural activity in Tongaland appears to have led to greatly increased arbovirus activity there.

With the widespread use of insecticides, resistant arthropod strains emerge, and it is unlikely that they do not also differ from the parent form in other respects, such as vector efficiency for arboviruses. Arthropods do not appear to be adversely affected by arbovirus infection and it is not known whether their defence mechanisms interact with the viruses. In vertebrates the specific defence is antibody formation, but there are also the non-specific processes of inflammation and fever. Inflamed tissue is acid, thus a strain of virus with greater resistance to acid and which multiplies better over 100° F. may prevail. In the arthropod, the length of the extrinsic incubation period is dependent upon temperature; thus, on the other hand, viruses which multiply better at, say, 70° F., might have an advantage.

A strain of virus capable of remaining latent in vertebrates for long periods might be maintained through periods when arthropods are not sufficiently numerous. Such latent infections with western equine virus have been demonstrated in birds and the stress of migration or ovulation might permit the virus to circulate when mosquito populations are becoming active in a temperate climate.

Opening the discussion, Dr. C. H. Andrewes suggested that there are two kinds of evolution to con-

sider: the short-term with changes such as have been best seen in influenza, and the long-term, in which viruses as a whole may be very old and relatively stable. Viruses have a unique form of replication, which does not suggest that they are derived from host components. The ticks being probably more primitive than the mosquitoes might be more likely to have been the original hosts.

Several other speakers suggested pointers to the ticks as original hosts. Prof. D. S. Bertram pointed out that the one-layer covering of tick eggs may make them more susceptible to transovarial infection than mosquito eggs. Dr. M. G. R. Varma said that it appeared that while mosquito-borne viruses could multiply in ticks, tick viruses could not in mosquitoes. Dr. P. B. Stones suggested that if mosquitoes were the origin, then viruses ought to have been isolated from male mosquitoes: he reported an isolation of Semliki forest virus from a male *Eretmapodites* in Lagos.

Dr. J. S. Porterfield suggested that Semliki Forest virus may be the most primitive member of group A of arboviruses—a number of very closely related forms have now been isolated in Africa. He thought that Israel turkey virus may be a recent derivative of West Nile virus possibly resulting from man-made ecological changes.

On an analogy with transduction in bacteriophage, Dr. P. H. A. Sneath suggested that viruses are not true parasites, but may be partially derived from the reproductive mechanisms of their hosts.

C. E. GORDON SMITH

RED DEER AND VEGETATION IN NEW ZEALAND

AN expedition visited Lake Monk in the Cameron Mountains of Southern Fiordland, New Zealand, during March 26–April 5, 1957, to study the interrelations of birds and mammals, particularly deer, with the vegetation (New Zealand Department of Scientific and Industrial Research, Bull. 135).

The vegetation was classed broadly into forest, scrubland, grassland and bogs. Mice and stoats are the only small animals in the area; the former are scarce and the latter are probably more widely distributed; from an examination of droppings they appear to be feeding mainly on birds. Red deer (*Cervus elaphus*) are thought to have reached the area about 1920, and to have built up a peak population between 1943 and 1950. They have since declined in numbers and are probably still declining. The population was composed of 50 stags to 35 fawns to 100 hinds, which are unusually low ratios; the deer were all in very poor condition.

The amount of grazing on the fern *Polystichum vestitum* was strongly correlated with the density of deer faeces, and could be used to provide an alternative index to deer abundance.

Counts of deer faeces showed that the animals in this area were spending more time in the forest than in the open grassland, although their preferred food at the time of year studied is grasses and forbs, but storms probably prevent the deer from spending as much time in the open as they would otherwise do. In the forest the beech seedlings are heavily grazed, but once established they continue to grow slowly. The saplings are hedged by deer; but the full amount of each year's growth is not removed and

eventually a shoot grows above the browse-level. There are sufficient pole-stage beech to replace the present generation of mature trees, and enough of the younger stage to ensure the continuance of the forest, although possibly with a lower density of trees.

The second-tier species in the forest, such as *Nothofagus colensoi*, *Griselinia littoralis*, and *Coprosma foetidissima*, have little resistance to browsing and the young stages of these species are only found in places inaccessible to deer. In the sub-alpine scrub there has been a widespread destruction of *Olearia colensoi*: grassland areas have been heavily used but show signs of recovery. On boggy areas the trampling of hooves has bared the ground around wallow holes.

The investigators concluded that red deer provide the dominant animal influence on the vegetation; but it is an influence superimposed on long-term trends due to climate and on short-term successional changes. The composition of the vegetation has been and is being altered by them in such a way that there is a marked increase in unpalatable plants, and a corresponding decrease in palatable plants. The resulting environment is relatively unfavourable to deer. In spite of these changes in the composition of the vegetation the forest, as a protective forest, is in no danger of being eliminated by deer; the total vegetative cover is not decreasing, and soil erosion in the area is negligible.

In the light of these findings an attempt is being made to define and clarify the wild-life problems arising from the use of this area as a national park.