

## Discussion

The Chairman (DR. FALLA), in initiating the discussion, expressed regret that there had not been further contributions to the symposium dealing in particular with the inter-relationships between flora and fauna of both terrestrial and littoral regions.

R. M. CASSIE supported Mr. Dawbin in his remarks concerning the deficiencies of standard methods of plankton sampling. Apart from the difficulty in sampling highly mobile organisms, contagious or "patchy" distributions were very common in marine and perhaps also in terrestrial ecology. He illustrated on the blackboard the highly asymmetrical distribution curves found in toheroa sampling and pointed out the need not only for new methods of sampling, but also for better statistical methods for evaluating the data.

MISS L. B. MOORE said that, until recently, biological interest in the subantarctic islands had been focussed mainly on taxonomy and biogeography. More recent work by the "Cape Expedition" members and their post-war counterparts had contributed particularly to the non-vascular plant groups. Among bryophytes, 120 species of liverworts and 55 species of mosses had been described, of which 20 and 27 respectively had not been previously recorded. Of the 175 species of marine algae 27 had been collected only recently, and 12 per cent. of the total were not known elsewhere in the New Zealand region. Most of this 12 per cent are small obscure forms which may have escaped detection on the mainland. It is significant that of the marine algae only 16 per cent. (28 species including 5 local endemics) are endemic to the New Zealand region, while 41 per cent. of the mainland species are endemic. The high humidities produced by frequent soft rain might induce higher upper limits in the intertidal algal zonation. This rain might also have a selective effect on the distribution of rain-pollinated plants as against those pollinated by insects. Further study might add valuable information to the work of Dr. Hagerup on this topic, as well as helping to explain some problems of distribution. It would be interesting to know whether changes in vegetation, notably the disappearance of snow tussock (*Danthonia flavescens*) has been influenced not only by sheep, but also by climatic change. A general ecological factor of some significance might be present in that most of the indigenous mammals and birds obtained

their food supplies not from the land but from the sea. As a result the organic and mineral matter contributed to the island in the form of excreta, food debris, and dead bodies, would tend to balance that removed by feeding and erosion.

DR. K. A. WODZICKI pointed out some of the gaps still existing in our knowledge of the islands. For instance, no one had studied the soil or the fish. The way had been paved to proceed from taxonomy to ecology proper. Before an effort were made to exterminate rabbits, hares and sheep it would be useful to make some study of the population dynamics of these introduced species.

DR. W. R. B. OLIVER said that in 1927 shepherds had told him that snow tussock generally did not recover from grazing by sheep. He asked Mr. Sorensen if the absence of trees on Campbell Island might be correlated with loss of light owing to fog as in V. D. Zotov's work in the Tararuas. MR. SORENSEN replied that there seemed to be no absence of light and little fog, though meteorological records were of direct sunshine, not sunlight. *Dracophyllum* grew only in sheltered regions, but under favourable conditions it might form trees up to 12 inches diameter.

D. R. McQUEEN asked whether the presence of rata on Auckland Island and its absence on Campbell Island could be related to meteorological conditions. MR. SORENSEN said that he had no comparative meteorological data to explain this point. MR. DAWBIN said that Carnley Harbour had rata forest, but owing to fog would have less sunlight than Campbell Island. DR. FALLA considered shelter to be significant and said that Campbell Island was more exposed.

P. C. BULL, who said he had had only four days on Enderby Island, indicated that Campbell and the various Auckland Islands differed in their introduced mammals, making them an ideal experimental ground to study introduced populations where they were not subject to man's control. Though he was unable to study the breeding of rabbits he found a marked difference in age structure from the mainland populations: 50 per cent. yearlings as against 80 per cent. on the mainland. The parasite fauna was almost identical with the mainland, the only species absent being discontinuously distributed in the New Zealand area. This suggested that environ-

ment during transportation was responsible for the distribution, since historical records have established that the rabbit was introduced from Europe to the subantarctic islands by channels independent of the New Zealand stock.

G. R. WILLIAMS referred to the presence of most of the European passerine birds present in New Zealand and asked if there were any record of their introduction to the subantarctic islands. DR. FALLA said that there were a number of introduced species, including the redpoll, on Macquarrie Island. The house sparrow still bred on three islands, particularly the Snares, in spite of the absence of human habitation, although it was alleged to have left Campbell Island when the sheep station was abandoned. There were no reliable records of its introduction. MR. SORENSEN said he had not seen the house sparrow on Campbell Island in six and a half years. He had a number of records both published and unpublished of introduced passerines which he would make available to any person interested.

R. I. KEAN pointed out that pigs have established themselves on Auckland Island under conditions generally considered unsuitable on the mainland. Suggested reasons were: the shelter provided by rata roots and rocks; food supplied by beach debris or bird colonies; protection by man while becoming established. MR. DAWBIN said that he had seen pigs feeding in the kelp zone and remarked on their small size and the fact that litters apparently seldom exceeded two. Regarding the lack of comments on fish he mentioned the difficulty of catching fish other than rock cod with lines. However, gulls and shags probably fed on clupeid species. All fish caught were heavily parasitised. MR. SORENSEN confirmed the suggestion that pigs fed on birds.

R. W. ROACH mentioned a boar brought from Auckland Island in 1942 which had now reached considerable size in the Auckland Zoo and produced litters up to nine when crossed with a wild sow. He enquired whether sea-lions fed on fish as do fur seals. MR. DAWBIN replied that he had examined sea-lion regurgitations but had found no fish remains though squids and crabs were present. This may have been due to the scarcity of fish. MR. SORENSEN confirmed this, saying that sea-lions would take fish if they could get it. Fur seals and sea elephants preferred birds when they were available. He had seen sea

elephants playing with flounder but thought sea lions had caught them.

DR. G. B. CONE suggested that the difficulties mentioned by Mr. Dawbin and Mr. Cassie in sampling plankton and fish might be due to deficiencies in the sampling method and that the true unit might be the shoal, not the individual. This might be overcome by aerial surveys in some cases. MR. CASSIE suggested a system of underwater photographic quadrats for sampling bottom fish.

L. V. SIMPSON remarked on the lack of mention of parakeets of which there are two species in the subantarctic islands, indicating some tropical affinity in the fauna. He asked if there were any geological evidence of a warmer climate or of land bridges in the past. MR. MCQUEEN said there was evidence in the mollusca and microflora of warmer conditions in the New Zealand area during the Miocene. DR. OLIVER said that the distribution of the parakeet in the Western Pacific suggested that land bridges were not necessary for its dispersal over distances up to 600 miles of sea.

MR. SORENSEN suggested that some of the introduced avifauna might have arrived from elsewhere than New Zealand; e.g. the hedge sparrow from Australia. MR. WILLIAMS said he thought redpolls and yellowhammers might have come from New Zealand. The two parakeets on the Enderby Islands were an interesting case of habitat exclusion, occupying different niches through necessity, though they both had similar requirements.

DR. FALLA, in summing up, complimented the authors of papers on their field work which was done under difficult circumstances without the equipment and facilities necessary for intensive research. The pioneer work of short-term visitors had been advanced by the voluntary work of those associated with the "Cape Expedition" (which was the code name for the wartime coast-watching service on Auckland and Campbell Islands) and by the post-war meteorological observers who continued to man the station. This work had paved the way for future investigation which is an obvious responsibility for New Zealand scientists. The Ecological Society might well concern itself with the preparation of a plan for continuing this work, some of which was within the resources even of individuals or small groups.