200 yards to set up the telescope and from this position we both watched the bird make its way through the stones, stop, apparently turn an egg with the beak and settle down. This egg was later found to be infertile and has been sent to the Dominion Museum. I am indebted to Dr. R. A. Falla for a description of the egg as follows:— "Ground colour buffy white, closely and fairly uniformly mottled with purplish grey speckles and fine irregular pencilling. Dimensions: 28.83 mm x 21.21."

Juveniles are readily recognizable, being duller in plumage than the adults, and either partially or totally lacking the broad black "Y" marking on the chest which is such a distinguishing feature of the adults.

Further searching in the Ngaruroro river has led to the discovery of seven birds, all adults, only two of which appear to be mated. No young have yet been seen in this area.

The nesting colony has been under constant observation since found, a factor which has only been made possible through the help and assistance of B. D. Hankins and K. W. Varney. We expect by the end of the season to have a much fuller knowledge of the activities of this interesting new resident, although we have learnt the necessity for caution as shown by the following incident.

At what we call the 'Willow' nesting area, short, twice daily observations for ten days, disclosed only the two adults with two fledglings. However, on the 9/1/62 both B. D. Hankins and myself were present for over three hours; and it was not until the last few minutes that we discovered that there were four young. This fact in itself is apparently unusual in that Hindwood and Hoskin (Emu 54, 232), Sharland (Tasmanian Birds, p. 39) and Serventy and Whittell (Birds of Western Australia, p. 149) state that three eggs form a normal clutch.

We have so far located 13 adults and 9 juveniles, the latter belonging to three family groups and consider that at least two pairs are nesting again. It seems most likely that more will eventually be found.

HISTORY OF THE NEW ZEALAND LAND BIRD FAUNA

By C. A. FLEMING

The unique avifauna of New Zealand has left few clues to its history in the form of fossils, except for the very young deposits with moa bones, most of which date from the human period, i.e. the last thousand or so years. Speculation on the history of the fauna is thus perforce guided by indirect evidence. Dr. R. A. Falla (1953, *Emu*, 53: 36-46) has given a comprehensive account of the geographic relationships of the New Zealand avifauna, in which the Australian element is dominant. This paper, on much less secure evidence, seeks to explore the time factors in the history of the avifauna.

During the past century some seven species have successfully colonized New Zealand from Australia (Spurwinged Plover, White-faced Heron, Coot, Royal Spoonbill, Grey Teal, Welcome Swallow, Silver-eye),

This number may be too high, as some of these species may fail to persist (like the Avocet and White-eyed Duck last century); or it may be too low, if additional species (such as the Pied Stilt) are really young colonists. If, however, only two species colonized successfully each century, this would be a high rate when viewed in the perspective of geological time. During the Ice Ages of the Pleistocene (15,000 to 1,000,000 years ago) conditions were intermittently unfavourable for land-bird colonisation, but climatic conditions were as favourable as now during most of the 140 million years since birds evolved and, but for extinctions, a large fauna might have developed here.

The systematic differences which distinguish New Zealand birds from their relatives overseas give us a rough-and-ready yardstick to the time that has lapsed since their colonisation, unreliable in particular cases, but useful in default of other evidence. The critical time is not, of course, necessarily the first colonisation, but the last contact between colonist and parent stock. The non-marine birds of the main islands, including, for instance, the fresh-water gull and tern but not marine species, and including extinct species of moa-deposits, comprise some 116 species (data from the "*Checklist*" and from Oliver's *New Zealand Birds,* 1955).

In addition to the seven that colonized during the past century, eleven species cannot be distinguished from Australian subspecies, and are probably young colonists (e.g. Little Black Shag, Spotless Crake, Pukeko, White Heron, Grey Duck). Seventeen species are Australian (or other) species represented here by distinct subspecies (e.g. Crested Grebe, White-throated Shag, Black-fronted Tern, Banded Rail, Brown Duck and Shoveller, Pipit, Fantail, Kingfisher). How long have they been here? "Strong" subspecies have developed since Cook Strait last became a barrier, some 15,000 years ago, and since forest came to the formerly glaciated Auckland Islands, perhaps less than 10,000 years ago, so there seems no reason to assume that any of the seventeen New Zealand subspecies of Australian species is much older than late Pleistocene (say 20,000 years). Somewhat older, we may infer, are thirteen full spcies classed in overseas genera (including the two dotterels, Black-billed Gull, Paradise Duck and Scaup, Warbler, Tits, Long-tailed Cuckoo, and the New Zealand Swan and Merganser, now extinct). Using the yardstick of "strong subspeciation in about 15,000 years," I see no need to push their origin further back than Early Pleistocene, a million years or so. Some of the full species *(Larus bulleri,* Scaup, *Mergus)* are a long way, geographically, from their closest known relatives, but the Pleistocene saw many dramatic changes of range and extinctions which could account for such relicts.

The next systematic category is the endemic genus in an overseas family. There are 29 species in this group (eight extinct since the Maori period) ranging from forms with clear relationship to parent genus *(Gallirallus* to *Rallus, Notornis* to *Porphyrio, Anthornis* to *Meliphaga, Notiomystis* to *Meliornis, Cnemiornis* to *Cereopsis)* to well differentiated genera of obscure affinity (Wrybill, Blue Duck, Bush Canaries, Tui). They represent 24 colonisations. The date of probable colonisation ranges over a long period, here equated with the 25 million years of the Neogene (Late Tertiary) but perhaps reaching back into the Eogene for some genera.

Eight species, in six genera, are grouped in three endemic families, representing at least three original colonisations: the N.Z. Wrens, Wattle Birds and N.Z. Thrushes. Their distinctness implies an ancient origin, certainly Tertiary and probably in part Eogene (early Tertiary). I personally think it most unlikely that any of the colonisations so far mentioned was as old as Upper Cretaceous. Finally, two endemic orders of Ratites, the Kiwis and the Moas, represent one or more probably two original colonisations, the three Kiwis in a single family and genus, the 20 to 30 species of Moas in two families and seven genera. Irrespective of the question whether the "Ratites" are polyphylletic, we are probably on safe ground in attributing these two colonisations to the Upper Cretaceous.

Taking courage in both hands, I have used the data discussed above in two diagrams, the first showing the number of *species* in the Holocene fauna dating from the different periods of colonisation, the second showing the number of inferred *colonisations* plotted against time. From these, a number of generalisations arise.

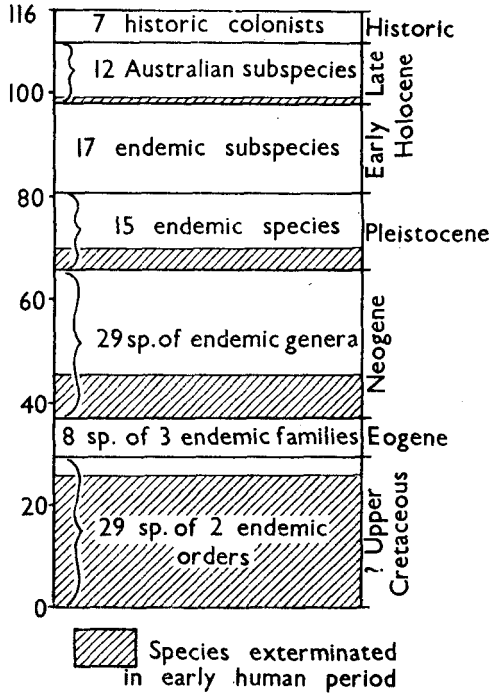

Figure 1 — Diagram showing numbers of species of New Zealand land birds classed under the geological age attributed to their ancestors, judged by their degree of endemism.

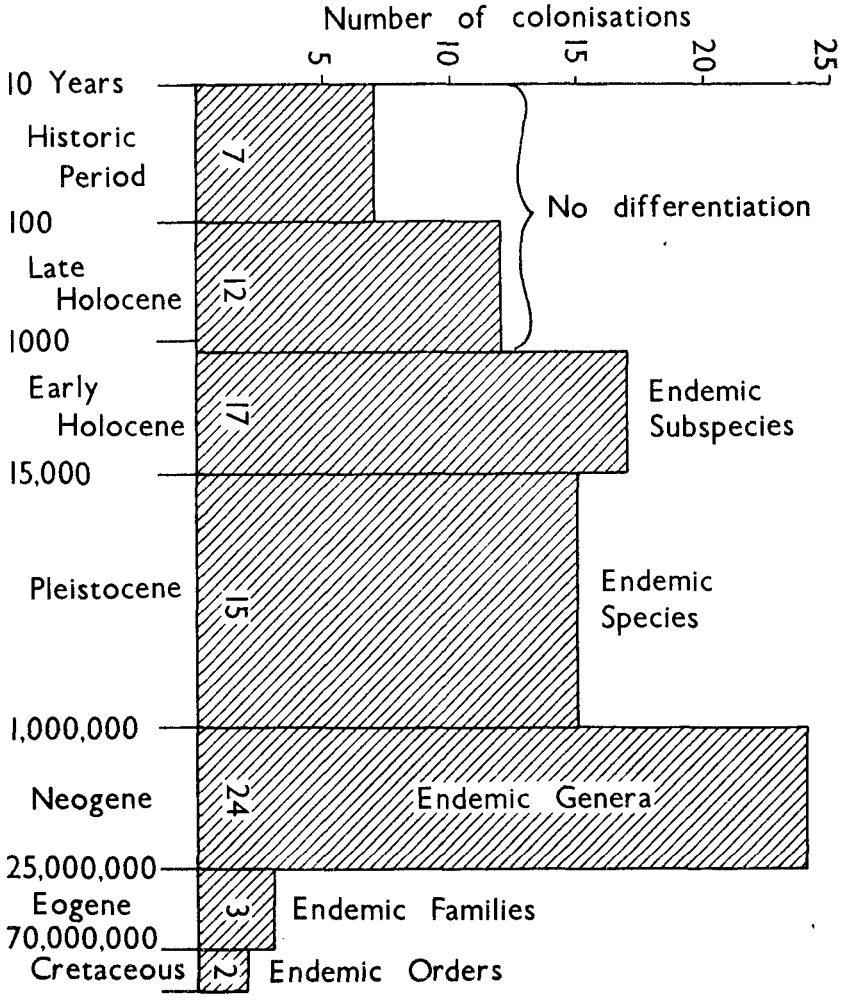

Figure 2 — Histogram showing numbers of bird colonisations plotted against inferred date of colonisation. Absolute age is shown on a logarithmic scale of years before the present.

1. The present rate of apparently successful colonisations (about seven per century) is abnormally high, suggesting that only a fraction of such colonists becomes firmly established in the long run, or that the present (European) period is exceptionally favourable for their establishment.

2. Post-Pleistocene colonisation has been steady, perhaps at an increasing rate. Most colonists were from Australia, and the one subspecies that has no relatives breeding in Australia *(Haematopus ostralegus finschi)* may have been there in the Pleistocene, or may be a slow-evolving form of Holarctic origin and older date of colonisation.

3. Pleistocene colonisation may have been at a low rate, judged by the small number of endemic species (of overseas genera) attributed to colonisation during this period. They include five species of perhaps Holarctic (north temperate) affinity not represented in Australia (dotterels, *Larus bulleri,* Scaup, *Mergus;* compare also *Haematopus ostralegus,* above).

4. The late Tertiary (Neogene) seems to have been an important period of immigration, judged by the relatively large number (25) of endemic genera (of overseas families) that survived into the Holocene.

5. As the Tertiary colonisation rate was probably as high as in the Pleistocene a very large number of Tertiary colonists must have failed to survive till post-Pleistocene time. If we are ever fortunate enough to find a Tertiary deposit of fossil land birds, we must expect many extinct forms not represented in the Holocene fauna.

6. Only very few colonists of Early Tertiary date have persisted through to the Holocene as the three endemic families (N.Z. wrens, thrushes and wattle-birds). The wattle-birds (Huia, Saddlebacks, Kokako), perhaps survivors of a larger group, developed by adaptive radiation in New Zealand during the Tertiary.

7. Of the two endemic orders, attributed to Late Cretaceous colonisation, the Kiwis became specialised for nocturnal life in the forest, an evolutionary blind-alley, whereas the Moas radiated adaptively to exploit a large number of ecological niches in primitive New Zealand.

8. The early human (Polynesian) period robbed the fauna of many of its older elements, probably more than we know, but judged by the fossil record of other groups of animals and plants, the Pleistocene was even more destructive, a conclusion emphasised on the one hand by the high rate of post-Pleistocene colonisation, and on the other, by the relatively small number of pre-Pleistocene colonists that survived.

There are, of course, many pit-falls in this kind of "educated guessing." The data can change with changes in the systematic ranking given to an endemic group, and difference in the speed of evolution will confuse the issue. But the attempt seems worth while in order to provide a hypothesis to test, and is made in the belief (recently expressed by Robert Ardrey) that a scientist has the right, approximating an obligation, to be wrong, in expressing his conclusions, which are always subject to revision.