# MOA'S ARK

## the natural world of the Moa

by Barney Brewster

Long before Polynesian seafarers discovered and settled New Zealand, this ancient archipelago was inhabited by a race of giant birds — the moa.

When our primaeval islands first drifted off from the Gondwana supercontinent, around 80 million years ago, the ancestral moa had already embarked for the long ocean journey. Moas were the original New Zealanders — a feathered family remarkable for their size, their lack of wings and their uniqueness to New Zealand.

Because the moa is extinct, scientific study of the bird has been made particularly difficult. The dodo of Mauritius, that epitome of extinction, left something for science in the way of travellers' descriptions, paintings and preserved parts; but of the moa? Bones, and more bones, and few other traces.

Over the last century moa bones have turned up in their thousands in caves, swamps, river beds and sand dunes, as well as early Polynesian middens. But complete moa skeletons, with bones still articulated, are quite rare, although vital for species identification. This is important because definite knowledge of an animal's biological status forms the basis of all further scientific enquiry.

Since the mid-19th century, many zoological systematists have laboured over the moa's family tree, suggesting over 60 names. W.H. Oliver, the author of the most recent scientific monograph on the moa (1949), considered there were 28 species. Since then, the number of species has been whittled down to 12. Such an array is surprising when contrasted with the limited number of types of New Zealand's other ancient bird lineages — the wrens, wattle birds, thrushes and kiwis. The number of moa species, and especially the absence of sub-species, has also been criticised from an ecological perspective.

### The ultimate answer

Because our moa heritage remains mostly in the form of bones, the reconstruction of species can only really be assessed from variations in bones, principally the skull, pelvis or the leg bones (the most commonly found). But, then, today's scientists have serious difficulties in differentiating between the bones of different kiwi species, and between keas and kakas — birds readily distinguished in real life. 'Scientists are no closer to being certain about how many species of moa existed in New Zealand than they were 150 years ago', according to Dr Phil Millener, an avian paleontologist now with the Smithsonian Institute. He believes that biochemistry is the ultimate answer. You can't argue with biochemical labels, he told the 1983 Pacific Science Congress.

Fortunately, there is at least general agreement on moa generics, although the lack of common names for the six broader categories of moas makes for a forbidding list: *Anomalopteryx, Megalapteryx, Pachyornis, Emeus, Euryapteryx* and *Dinornis*. This catalogue of scientific tongue-stoppers must be very off-putting to the average museum visitor!

Moas came in a great range of sizes. The *Dinornis* species were the largest. Recent scientific estimates of their maximum height vary from 2.7m to around 4m, but they are regarded as the tallest of modern birds. Other moas graduated in size down to about 1m high, but there were some notable variations in build. Some were slender and probably graceful, others were very squat and heavy birds, and would have waddled about in a most ungainly fashion. All were entirely wingless. It is this which makes the moa truly unique among birds. Even the kiwi has vestigial wings, 5cm long, with a reptilian claw at the end, but the shoulder girdle of the moas lacked even a socket for a wingbone to fit into.

This extraordinary devolution of the forelimbs must be linked to the very favourable circumstances that the original moa bird inherited millions of years ago, when this capacious ark set sail from the rest of Gondwanaland. The ancestral moa occupied a tract of country larger than the New Zealand of today, with little or no competition, or danger from serious predators. We can presume this from the success of the moa's radiation into many species.

### Massive penguin

From the immense numbers of subfossil bones, still being found in caves, swamps and mudsprings to this day, we can be confident that moas were flourishing only a few thousand years ago.

Flightlessness and giantism are hallmarks of isolated populations of birds, and there have been other examples in New Zealand. The kakapo survives (just) as the world's largest parrot, whereas the flightless NZ goose (*Cnemiornis*) and the giant flightless rail *Aptornis* do not appear to have lingered long after the arrival of people. Our islands were once home to another giant bird, the penguin *Pachydyptes*. This massive bird, around 1.6m in height and weighing about 100kg, is known from 40 million-year-old marine sediments at Oamaru. On the basis of the huge size of the kiwi egg, relative to bodyweight, it has also been suggested that the kiwi was once a much larger bird. Its present size might be a specific adaptation to nocturnal life in the deep forest.

Moas and kiwis are grouped with other large flightless birds — the Australian emu, the cassowary of New Guinea and Queensland, the African ostrich and the rhea of South America — under the name 'ratites'. The Latin-derived term refers to the ridgeless breastbone of these birds; flighted birds retain the ridge for the attachment of flight muscles.

Many scientists believed that all these birds had a common ancestor, and until the theories of continental drift gained wide currency in the 1960s, the natural tendency of northern hemisphere scientists was to locate the origins of these birds close to home. Contemporary wisdom now focuses on the forests of South America as the ratite family seat, and on Antarctica as the bridge for their wide dispersal.

### Flying ancestor

Some scientists have regarded the anatomical and structural similarities among the ratites as only a good example of the converging forces of evolution, but studies of chromosome material from the living ratites now suggest a common origin from a flying ancestor, at an early stage in the age of birds.

The kiwi and the moa have been paired in the popular mind from the earliest days of their scientific discovery. The curiosity of the British and European public was considerably aroused by reports of the strange tailless, 'wingless' kiwi, while the moa became famous by an astute diagnosis from a single bone, brought to London in 1839. Biochemical studies of kiwi genetic material suggest a split with other birds of the Australasian region only 40-45 million years ago. However this conflicts with the geological evidence, as a split from emu/cassowary stock at this time would postdate the oceanic separation of that continent and New Zealand.

It is generally thought that moas came to this country on foot, around 150-140 million years ago, before the development of mammals and the break-up of Gondwanaland. Unfortunately the fossil record has nothing to add to this, nor does it give any clues to the subsequent evolution of moas in New Zealand. Terrestrial vertebrate fossils are in fact completely lacking fot this extended period, with not even that most ancient of animals, the tuatara, making an appearance. However, we can be sure that moas were witness to the long series of changes as this primordial land rose and weathered over the aeons. Climatic change accompanied the purely topogragraphic. Twenty million years ago, coconut palms grew in Northland, kauris prospered in Southland, and moas saw it all.

The ratite connection gives us good reason to look at the moa's living cousins, es-