MOA

MOA

THE LIFE AND DEATH OF NEW ZEALAND'S LEGENDARY BIRD

QUINN BERENTSON

craig potton publishing

Mummified head of an upland moa, *Megalapteryx didinus*.

‘In those days of which geologists tell us, the principal parts were played, not by kings and queens, but by creatures many of which were very unlike those we see around us now. And yet it is no fairyland after all, where impossible things happen, and where impossible dragons figure largely; but only the same old world in which you and I were born. Everything you will see here is quite true. All these monsters once lived. Truth is stranger than fiction; and perhaps we shall enjoy our visit to this fairyland all the more for that reason.’
Reverend H. N. Hutchinson, ‘Extinct Monsters’, 1910

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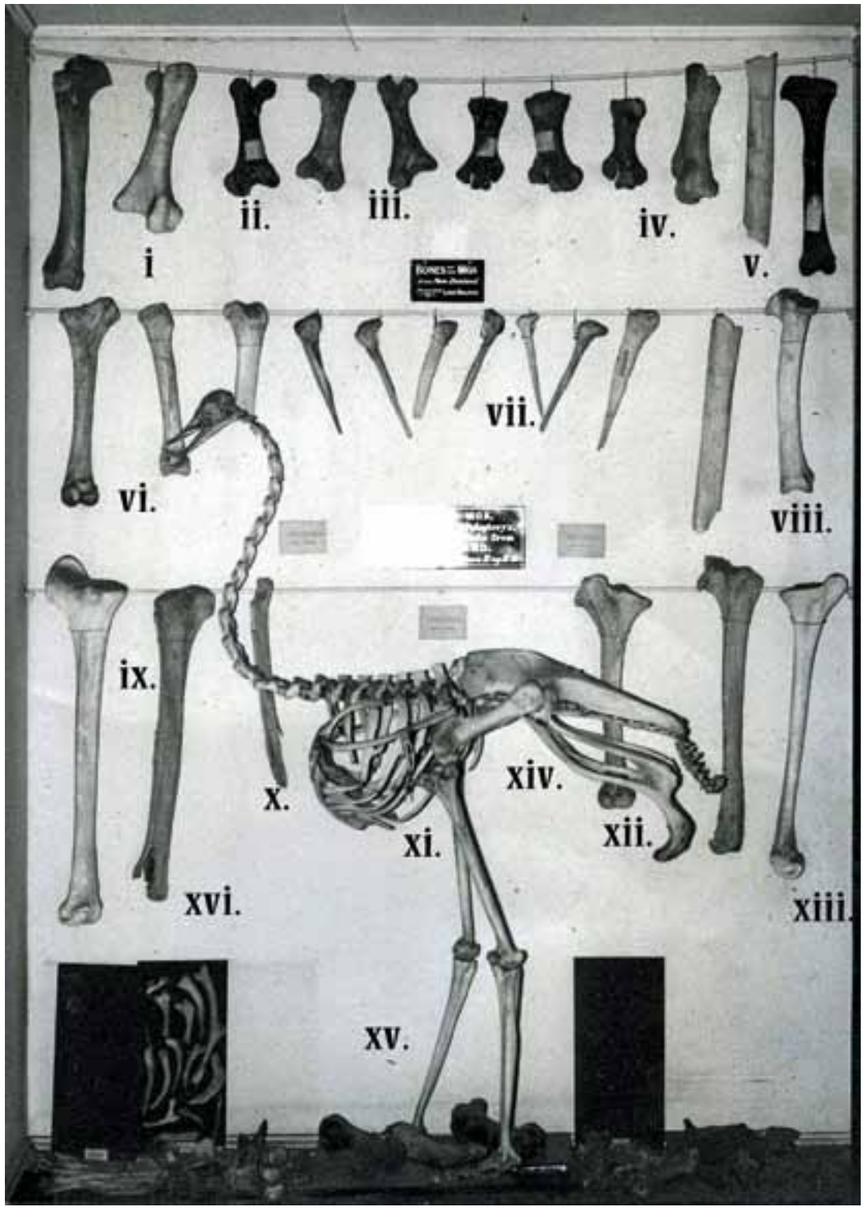
Mummified moa remains found in the Central Otago goldfields. Photograph by the Burton Brothers of Dunedin, 1870s.



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INTRODUCTION

'I suddenly became aware that, although I was a native of New Zealand and had lived here all my life, I had only the most hazy notions of the Moa, and when it came down to fundamentals I really knew nothing of it at all.'
T. Lindsay Buick, 'Discovery of Dinornis', 1936

First we killed them, then we ate them and then we forgot about them. Human beings have not been kind to the moa.

Here was the most unusual and unique family of birds that ever lived, a clan of feathered monsters that were isolated on the small islands of New Zealand, and left to the wildest whims of evolution became so large and odd and different from the rest of the avian group that they became almost as much mammal as bird. With little competition and no ground predators moa thrived for millions of years, adapting and diversifying to fill virtually every terrestrial environment in the rugged isles of New Zealand, from sand dunes to flax swamps; deep primeval rainforest to frozen subalpine tussock. Some were the size of a turkey, while the largest of the group, the giant moa, became the tallest bird to have ever lived on this planet. Some had legs built like an elephant's, others laid eggs the size of rugby balls. New Zealand was the 'Land of the Moa' for the longest time, and their rule was undisputed until the arrival of a lethal new animal to the land – a cunning bipedal and highly social primate with the extinction capacity of a fair-sized asteroid. Along with the humans came their entourage of four-legged predators, who wreaked havoc among wildlife that had never encountered their like and had no natural defences against the mammalian invasion. Seemingly in the blink of an eye the moa disappeared, erased from history so quickly and thoroughly that even the memory of them died and today most New Zealanders scarcely spare them a thought. They have become creatures of myth and urban legend; ghosts in the bush and an enigma broken into thousands of pieces and scattered across New Zealand's spectacular landscape.

Author T. Lindsay Buick contemplates the remains of an ancient feast of moa at the mouth of the Waitaki River, 1937.

What is the real story of the moa?

Why is everything about their existence so mysterious and controversial?

What were the enormous birds really like, and what happened to them?

In 2009 I set out to capture this phantom in my own mind, or at least follow its trail around my home country and attempt to make my own sense of its mysteries. Like most 'Kiwis' I identify myself with the moa's small and humble cousin which has become our national symbol, while only occasionally sparing a thought for New Zealand's truly iconic native bird. My scant knowledge of the moa began and ended with a few words: big flightless bird; extinct; stalked in some ancient age by the Moa Hunters, a mysterious race who may or may not have been Maori. Like everyone else, I don't even say its name properly – it should be pronounced to rhyme with 'more' rather than 'mower'.

Once I began to dig deeper into the wealth of written material and speculation that the moa has inspired over the last century and a half, and travel to the locations where their remains have been uncovered, I soon realised that there is far more to the story of the moa than I had ever imagined. It covers not just the strange attributes of the flightless giants themselves (of which there are many) but also the unlikely series of events and people that were involved in turning the moa from a monster of ancient legend to an international sensation in the late nineteenth century, and in the twenty-first century to the most well-documented and understood extinct animal group of all.

Model moa near Awamoa, Otago 2011.

The flightless giants remain New Zealand's most famous contribution to natural history and when European science discovered the birds in the 1840s they were described as 'the zoological find of the century'. The moa made the front page of major newspapers and their bones were a star exhibit in every natural history museum and collection worth a visit. British royalty keenly awaited the latest news of these 'feathered monsters' and each twist in their revelation was broadcast to the far corners of the British Empire and commented on by literary luminaries such as Charles Dickens and Mark Twain.

The moa became so famous and their remains so valuable that baser human nature took over and highly personal and nasty in-fighting soon broke out between those who competed to study them. Scientific careers were built and lost over the moa – while

Photographic montage, made circa 1936, depicting a moa, and an unidentified Maori man holding a taiaha (Maori fighting staff). A note on the back of the print reads "The Maori and the moa. A museum reconstruction of a scene which probably was not very uncommon in New Zealand a long time ago."

some became international celebrities and accumulated wealth and titles by the dozen, others succumbed to treachery and despair and lost their lives while pursuing the moa's intrigue. Even the identity of the first European to 'discover' the moa is controversial, with at least three different contenders for the claim.

In its way, the moa shaped the early formative history of New Zealand and became a potent symbol in oral tradition, mythology, pop culture, jokes, art and poetry. The moa even came to symbolise that most revered bunch of New Zealanders, the All Blacks. A moa was featured in official coats of arms (it is still in Wellington's) and was the centre of any New Zealand display at the great International Expositions of the nineteenth century.

For a long time, the moa defined New Zealand, and New Zealand was defined by their presence, until somehow the giant birds fell down some kind of collective memory hole and we mostly forgot all about them.

This book is my attempt to revive some awareness of what we have lost, follow the twisted and dramatic story of the moa's discovery by science and summarise what we have managed to learn about them since. This is nowhere near as straightforward as you may think, since it seems almost every aspect of the great birds' biology, evolutionary origins and final extinction has been argued over, rewritten and turned on its head over the last 170 years. Even in the twenty-first century, the moa continues to amaze as a new generation of technology allows modern researchers to delve deeper into their unique biology and life history and finally uncover the truth about the world's most legendary flightless bird.

NEW ZEALAND
Key Locations

CHAPTER FOUR

A STRANGE AND TERRIBLE GIANT EMERGES

'Of all the monsters that ever lived on the face of the earth, the giant birds were perhaps the most grotesque.'
Reverend H. N. Hutchison, 'Extinct Monsters', 1910

If the moa could be said to have a true day of discovery, at least in terms of European science and international attention, then that date is 19 January 1843, when Professor Richard Owen opened the first of two boxes of gigantic bird bones collected by the missionaries Colenso and Williams from various rivers on the wild East Coast of New Zealand.

Owen must have been quivering with anticipation – there was a lot on the line after all, chiefly his credibility as the true successor to Baron Cuvier as the world's greatest comparative anatomist.

He had spent three years waiting for more evidence of his 1839 claims that New Zealand was once home to the largest bird known to science and now, here before him in a large and heavy crate, was the evidence that could cement his scientific reputation.

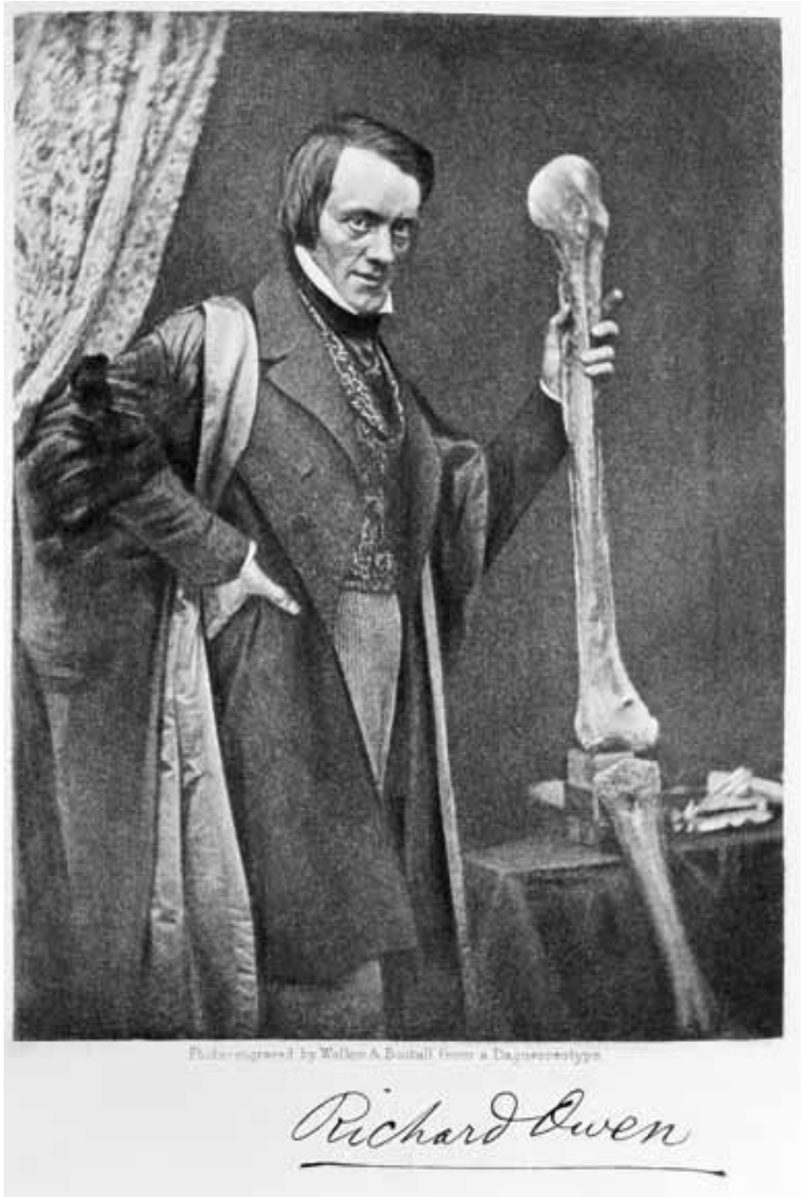
The historic first shipment was ritually opened in the Hunterian Museum's Hall of Giants in the presence of Owen, Buckland and William Broderip, another keen fossil enthusiast and member of the Royal Society. As Cotton had indicated, it was indeed a collection of huge bird bones, including the enormous tibia almost three feet long he had mentioned in his letter. Not only did Owen finally have the evidence that would totally validate his theories, the giant bird from New Zealand would surpass all estimates and expectations.

As Broderip later excitedly recalled in the *Quarterly Review* (1852):

> That whitest day will ever be remembered. As each bone of the feathered giant was taken out it was impossible to repress exclamations; but when the enormous tibia came within our grasp, it was flourished aloft with a shout of wonder and joy that made the Museum ring again. Fortunately we wore no wig … or it certainly would have been hurled upwards, where it would have ornamented one of the many antlers which overhung us.[1]

The shipment included several huge and intact femur bones. On comparing them to what Owen had projected from the small fragment brought to him by Rule all those years ago, his estimate was proven to be spectacularly accurate. Broderip later wrote:

> We well remember seeing this fragment of the shaft of a femur when it first arrived, and hearing the opinion of the Professor as to the bird to which it must have belonged. He took, in our presence,



OPPOSITE Richard Owen poses with the largest of the moa bones sent by Reverend William Williams from the East Coast.

a piece of paper and drew the outline of what he conceived to be the complete bone. The fragment, from which alone he deduced his conclusions, was six inches in length and five inches and a half in its smallest circumference; both extremities had been broken off. When a perfect bone arrived, it fitted exactly the outline which he had drawn.[2]

It was soon evident that although Owen had been almost supernaturally correct in extrapolating the feathered monster from just one small piece of bone, the creature was much larger than he had ever suspected. His initial estimate of its height had put the mystery bird at about seven feet tall, slightly taller than an ostrich. But the largest of William's leg bones was almost three feet long in itself, larger than a horse's and dwarfing those of the tragic Irish giant, Charles Byrne, whose eight-foot high skeleton mutely observed the excitement from his podium in the Hall of Giants.

When the enormous tibia was matched with an equally robust upper leg bone, the length of leg alone of this mammoth bird was some five and a half feet – about the average height of a human at that time. The trio of natural scientists became so immersed in studying the amazing bones they skipped dinner, and as Broderip later wrote, 'instead we supped upon them'.[3]

The crate of bones was accompanied by a letter from William Williams, in which he detailed their origin and what information he had gleaned from the East Coast Maori:

> Poverty Bay, New Zealand, Feb. 28th, 1842.
> Dear Sir, —It is about three years ago, on paying a visit to this coast, south of the East Cape, that the Natives told me of some extraordinary monster which they said was in existence in an inaccessible cavern on the side of a hill near the river Wairoa; and they showed me at the same time some fragments of bone taken out of the beds of rivers, which they said belonged to this creature, to which they gave the name of Moa.[4]

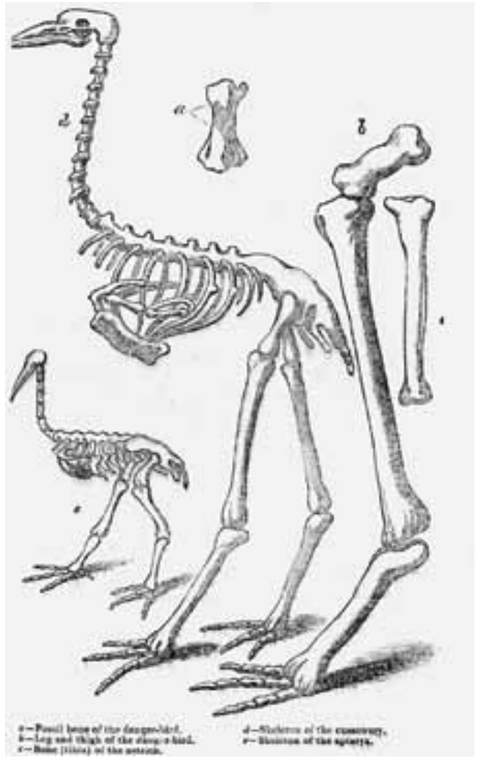
Official anatomical drawings of moa tibia from Owen's 1844 paper in the *Transactions of the Zoological Society of London*.

Conspicuously failing to mention that William Colenso was also present at the time, Williams explained that when he had established his permanent mission station at Turanga a year later he had again heard stories of the moa but had considered the whole thing a myth or 'idle fable'[5] since no Maori in living memory had actually seen one with their own eyes. Still, he offered a large reward to anyone who could catch him a moa or bring proof of its existence. It was a long time coming, but at length a large fragment of bone was brought from a nearby streambed, and just two months before the date of the letter he had been provided with another bone, although it was small and broken. However, the reward Williams paid to its bearer proved to be a sound investment – as word quickly spread that the Pakeha holy man was paying for old bones, large numbers of enterprising local Maori combed the riverbanks for bounty. In short order, they brought Williams a large collection of moa bones of various sizes. Williams was also able to supply small nuggets of information and speculation about the moa:

> 1st. None of these bones have been found on dry land, but are all of them from the bed and banks of freshwater rivers, buried only a little distance in the mud; the largest number are from a small stream in Poverty Bay, Wairoa, and at many inconsiderable streams, and all these streams are in immediate connexion with hills of some altitude.
> 2nd. This bird was in existence here at no very distant time, though not in the memory of any of the inhabitants, for the bones are found in the beds of the present streams, and do not appear to have been brought into their present situation by the action of any sudden rush of waters.
> 3rd. That they existed in considerable numbers. I have received perfect and imperfect bones of thirty different birds.
> 4th. It may be inferred that this bird was long-lived, and that it was many years before it attained its full size.
> 5th. the greatest height of the bird was probably not less than fourteen or sixteen feet. The leg-bones now sent give the height of six feet from the root of the tail. I am told that the name given by the Malays to the Peacock is the same as that given by the natives to this bird.[6]

Comparison of the massive femurs of two moa species from Williams' East Coast collection.

Five days after their arrival Owen triumphantly displayed the moa bones before the Zoological Society, completely vindicating his daring and controversial prediction of November 1839 and creating a scientific sensation. The professor now had enough remains to give the monstrous creature an official scientific name – *Megalornis novaezealandiae*, meaning the huge bird of New Zealand. However he was soon informed that *Megalornis* was already in use for another species, and by the time his lecture was officially published in the *Transactions* in 1843, Owen had chosen another name, one that shared an origin with the newly christened group of extinct giant reptiles he and Gideon Mantell were currently feuding over – the dinosaurs. Reusing the Greek 'deinos' and adding 'ornis' referring to the bird order, the monster was rechristened



From an 1843 issue of *Chambers's Edinburgh Journal* which refers to Owen's discovery as 'The Danger Bird'. The accompanying article described Owen's giant bird as: 'one of the most extraordinary additions to zoology which modern times have seen'.

Dinornis novaezealandiae – the great, terrible, or surprising bird of New Zealand, depending on your interpretation of Ancient Greek.

Based on just the crudest crumb of evidence, Professor Richard Owen had correctly deduced the existence of the largest bird ever known to man – a feat of scientific intuition that astonished the world and catapulted him into the limelight. In one bold and brilliant stroke he had validated an entire theoretical framework for understanding the physical structure of animals – comparative anatomy – and confirmed his own reputation as Cuvier's heir. Owen's feat of reconstructing such a huge creature from a small piece of bone seemed to both public and fellow scientists as, 'an arcane exhibition of his craft, similar to an astronomer's accurate prediction of hitherto unknown planets and satellites; the organic world appeared to be ruled by laws no less than the realm of planetary physics.'[7]

The confirmed existence of a bird able to peer in second-storey windows without leaving the ground tickled the fancy of the Victorian public, who were increasingly tuned to the wonders and oddities of the extinct world thanks to the public exhibition of the mammoth and the dinosaurs. The story spread beyond the inner circle of London's elite scientific societies and into the wider world of Britain's literati and the mainstream media.

Chambers's Edinburgh Journal declared, 'Thus on a comparatively insignificant piece of bone, was the existence, either actual or recent, of an extraordinary bird affirmed; a remarkable triumph of reason, combined with a habit of correct observation.'[8]

The article quoted Owen as saying:

> Its dimensions prove the Dinornis of New Zealand to be the most gigantic of all known birds. There is little probability that it will ever be found, whether living or extinct, in any other part of the world than the islands of NZ or parts adjacent.[9]

The moa bones also opened the door to the Royal Family, as Queen Victoria's husband, Prince Albert, let it be known through Buckland that he wanted to meet Owen and see the 'Danger Bird' for himself. In January 1843 Owen wrote to his sisters:

> He [Buckland] sent me a note this morning which he had received from the Queen's Master of the House-hold (Hon. Charles A. Murray), who says, after a compliment to me 'The Prince has read your letter with the greatest interest; he desires me to thank you in his name, and if any further discoveries should be made in elucidation of the mystery of this feathered monster, pray let me again have the pleasure of hearing from you and of communicating the information to His Royal Highness.'[10]

A friend later recalled of Owen's *Dinornis*:

> No work of his created so much excitement. Society, headed by Prince Albert, hurried to inspect the huge remains, of which a large series soon reached this country, and to be introduced to the fortunate necromancer, at whose bidding a phantom procession of strange creatures had suddenly stepped out of the past into the present.[11]

But this was just the beginning – the moa was only starting to reveal its surprises.

Rev. Williams' letter from the East Coast indicated that he had split the collection of moa bones into two for safety – in those early sailing days, when a voyage from New Zealand to England involved a three-month, 12,000-mile journey through some of the Earth's most dangerous waters, more than one precious cargo of natural history specimens ended up on the bottom of the ocean. In the first crate, Williams had selected the largest of the leg bones, including two collected at Waiapu by his fellow missionary Colenso.

Richard Owen and reptile skull.

Comparison of the tarso-metatarsal bones of three of the new moa species from Owen's 1844 memoir.

The second consignment arrived safely in Owen's hands later in 1843, and it contained not only more of the smaller leg bones, but also pieces of the toes, pelvis, spine, and ribs plus a small crushed and incomplete moa skull.

Now possessing 47 moa bones, Owen had a flood of new information to work with, and began to fill in the blanks in the bird's extraordinary anatomy. Throughout the next year he meticulously described every one of them in terms of their type, size and proportions, calculating the ratios between various groups such as those of the leg, as well as noting the slightest variation in the various knobs, cavities and protrusions projecting from their surfaces.

As he did so he realised to his astonishment that although the bones were all similar enough that he could be sure they came from the *Dinornis*, there was an extreme size and proportion range among them, and the only conclusion to be drawn from that was the quite sensational fact that not only was New Zealand home to one species of giant, flightless bird – the largest that had ever been known to man – there were at least six different species of moa, and some of them were even bigger.

He later records in his memoirs:

> That the bird I had pictured in imagination, and afterwards, on acquiring sufficient evidence of specific characters … was not the sole representative of its genus, and was far from being the largest, were facts for which I was not prepared.[12]

It is likely you've never seen a bird's knee. You might think you have, but the joint halfway down a bird's leg that bends the opposite way to ours is technically a bird's ankle, and the knobby bit at the back is actually the equivalent of our heel. The legs of birds and humans have the same basic set of bones, but each differs radically in size and arrangement. The leg of a human is 'L' shaped, with the largest bone – the femur - and lower leg bones held vertically under the body and the small cluster of foot and toe bones resting on the ground at a right-angle. In contrast, the leg of a large flightless bird like the moa is the shape of a stretched-out 'Z'. The short and stout femur at the top of the leg is held almost horizontally and is usually hidden under the bird's plumage. The short femur is joined to a long thin tibia which is the longest bone in the leg and makes up the middle of the 'Z'. This joins to the tarsal and metatarsal bones of the lower leg. In humans they make up the middle of our foot, but in birds they are stretched out and fused together into a complex called the tarso–metatarsal bone (TMT) and are held off the ground almost vertically. At its lower end, the TMT bone flares out into three sockets where three digits connect and the entire bird balances only on the very tips of its toes.

Although the three-feet-long tibia Williams had sent from the East Coast was the most spectacular specimen in the consignment, it was the smaller bones of the lower leg in the second box that were of the most anatomical value to Richard Owen. Guided by what he called 'the seldom failing law, that distinctive characters are most strongly developed in the peripheral parts of the body',[13] Owen began his comparative examination of the *Dinornis* remains with the TMT bones which were considered '*the* bone and the key to the whole'.[14] In a bird the size of a sparrow, the TMT is less than two centimetres in length; the largest TMT in the collection of *Dinornis* bones was almost half a metre long.

But there was also a huge size variation among the three intact TMT bones in the collection and from the smallest, just a quarter of the size of the 50-centimetre one, Owen immediately declared a brand new species of moa, with proportionately much shorter and broader feet than its giant relative. In this respect, the small moa's feet resembled those of the infamous poster child of extinct birds the dodo (rather cruelly named *Didus ineptus*) and Owen considered the New Zealander with short broad feet could not have been much bigger than its unfortunate brethren and named it *Dinornis didiformis* (the 'dodo-like moa').[15]

Owen judged that the third intact TMT from the missionary's collection, intermediate in size to the other two, was also distinct enough to justify another separate species of moa. It shared its proportions with the living African ostrich, and Owen soon realised that logically this bone must belong to the same ostrich-sized moa he had so triumphantly conjured from John Rule's original fragment in 1839. He performed another abrupt taxonomic U-turn and this particular moa species, which could be called 'the original', received its third different scientific name in as many years: *Dinornis struthioïdes* (or the 'ostrich-like moa').

> We may therefore regard its height to have not exceeded seven feet, or to have been about equal to that of a moderate-sized Ostrich, but of a more robust and stronger build. The fragment of the femur first described by me in 1839 belongs to this species.[16]

Putting together the longest tibia bone, the largest of the TMT bones and an equally robust femur 16 inches in length, Owen managed to reconstruct an entire gargantuan leg of a moa that dwarfed anything he had found so far.

The bones featured distinctive ridges and tuberosities where mighty leg muscles must have been anchored in order to propel the creature's great bulk. Owen noted that they rivalled those of large draft horses in proportion. Calculating that the average African ostrich was around seven feet tall, Owen calculated this whole bird, which he named *Dinornis giganteus*, stood an incredible 10 feet tall – shorter than Williams' admittedly amateur estimate of 14 feet, but still easily the tallest bird ever known to science.

Owen soon found a fourth distinct species of moa that was almost as big – its tibia was still an impressive 29 inches long and six across at the end, although slimmer in build than that of *Dinornis giganteus*. Owen estimated it may have stood nine feet high and provisionally named it *Dinornis ingens* (the 'vast moa').

Owen named the smallest of his moa species, *Dinornis didiformis*, after the infamous poster child of extinct birds, the dodo.

Among the rest of the bones Owen found enough uniqueness to name two other medium-sized species of moa: *Dinornis otidiformis*, after the Great Bustard, the heaviest bird in Europe, and *Dinornis dromaeoides*, which was similar in proportion to the living emu at about five feet tall.

Williams' incredible collection of bones from the rivers of the East Coast had not only confirmed beyond all doubt that the moa existed, but also yielded six different species, ranging from a 10-feet tall giant to something the size of a turkey.

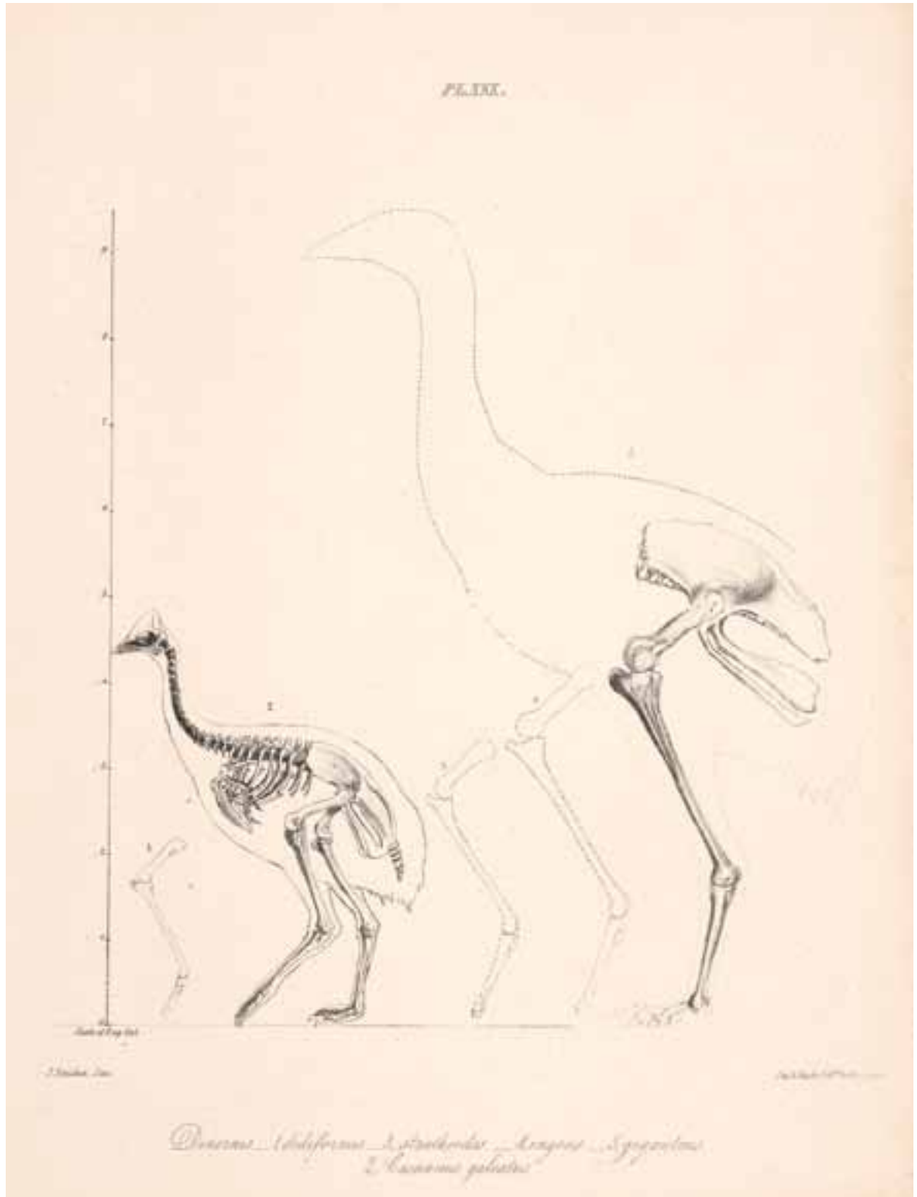
While the two boxes of assorted remains enabled Owen to fill in the broad anatomical details of the six moa species, parts of the moa the trove did *not* contain became just as interesting to him – namely those limbs most distinctive of the class Aves – the wings.

While Williams' collection had included moa leg, foot, rib, toe and vertebrae bones there was not a single fragment of the upper limbs and Owen quickly realised there were no moa wing bones collected because there were none to find.

Each of the moa's living relatives has lost their flying apparatus to a certain extent. The rhea and the ostrich have the largest remaining wings of the group – both use them to run faster, flapping their stubby but still substantial upper limbs to power themselves along. Indeed Owen considered that the ostrich was so vigorous and successful in this flapping, that at full speed the body half flies and half runs. The bones of both the ostrich and the rhea have external openings that are connected to the respiratory system, so warm and expanded air from the lungs fills and lightens them, especially the skull, vertebrae, ribs, sternum, pelvis and the femur.

At the other end of the scale, the Australian relatives of the moa – the emu and cassowary – have uselessly small wings and far fewer of their large bones contain air-filled cavities.

Summary of the first six moa species described by Richard Owen in 1843:

1. *Dinornis didiformis*: the dodo-like moa; about four feet tall.
2. *D. struthioïdes*: the ostrich-like moa; seven feet tall; the 'original' – the same species as John Rule's original fragment.
3. *D. giganteus*: the giant moa; conservatively estimated at 10 feet tall; the tallest bird in history at that time.
4. *D. ingens*: the vast moa; close second to above in size; nine feet tall, but slimmer bones suggest it wasn't as massive.
5. *D. otidiformis*: the Great Bustard-like moa; five feet tall and slender.
6. *D. dromaeoides*: the emu-like moa; five feet tall and solidly built.

ABOVE African ostrich from Cuvier's famous work *Nouvelles Illustrations de Zoologie* published in 1776.
OPPOSITE In his 1844 paper Owen compared the size of four of the new moa species against the complete skeleton of a cassowary (2). He estimated the largest moa, *D. giganteus*, stood at least 10 feet tall – the largest bird yet discovered by science.