Art. L.—*The Moa—Legendary, Historical, and Geological: Why and when the Moa disappeared.*

By H. Hill, B.A., F.G.S.

[*Read before the Hawke's Bay Philosophical Society, August, 1913.*]

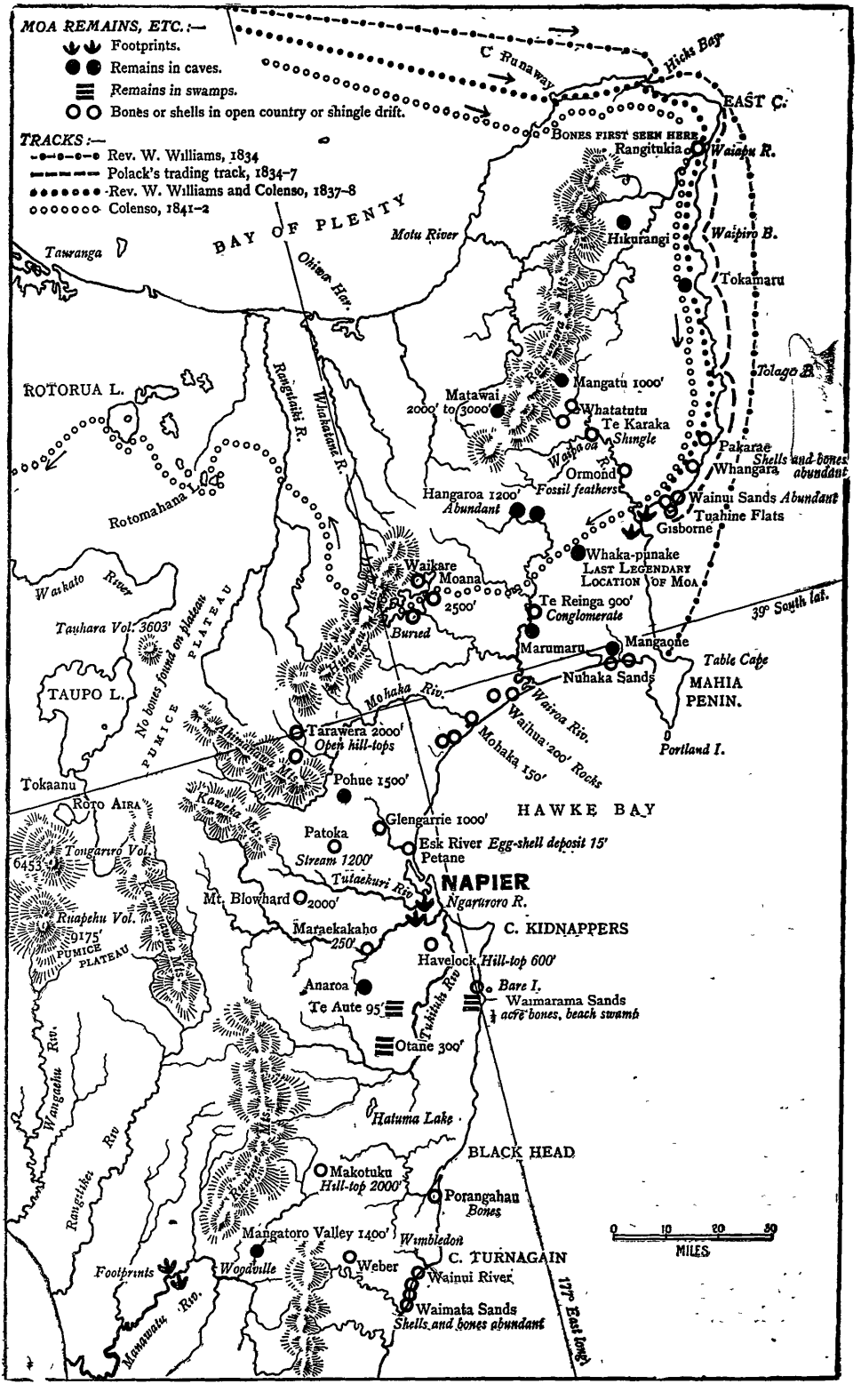
Few subjects occupy greater prominence in the earlier volumes of the "Transactions of the New Zealand Institute," and have created more interest among scientific men, than the published accounts of the bird known as the moa. Of the bird legends are few, Native information uncertain and unreliable, and the history of the discovery of its fossilized bones has never yet been satisfactorily settled.

The moa as a bird represents a remarkable past. There were giant birds in lands other than New Zealand during the days when the *Deinotherium* and *Mastodon* roamed at will in northern climes.

Why monster birds like the *Aepyornis* of Madagascar and the moa of this country were characteristic of areas south of the Equator contemporary with other monster forms of animals in northern lands is still a matter of surmise.

As far as I can trace, no mention is made by any of the earlier missionaries of fossil bones of any kind. Nicholas, who voyaged to New Zealand in the years 1814–15, and who published two volumes in 1817 of his travels and adventures, refers to the existence in New Zealand of a bird of the cassowary species. Thus, in vol. 2, page 225, he says, "From the feathers which line the garments of some of the chiefs it would appear that there is here a species of the cassowary, but we did not see any in our excursions. The feathers are precisely the same as those of the emu in New Holland, except being somewhat smaller." Of course, this has reference to the feathers of the *Apteryx*, or kiwi, which Nicholas did not see, nor does it appear to have attracted the attention of the missionaries until a later date.

Polack, a trader who spent two years or more along the east coast of the North Island between the years 1834–37, on his return to England published in the year 1838 two volumes relating many quaint things concerning New Zealand. On page 303 of vol. 1 he remarks of the North Island, "That a species of the emu, or a bird of the genus *Struthio*, formerly existed . . . I feel well assured, as several large fossil ossifications were shown to me when I was residing in the vicinity of the East Cape, said to have been found at the base of the inland mountain Ikorangi [Hikurangi]. The Natives add that in times long past they received the traditions that very large birds had existed, but the scarcity of animal food, as well as the easy method of entrapping them, has caused their extermination." Of the South Island Polack says (p. 307), "Yet, doubtless, the future ornithologist will be surprised by the discovery, among the hidden mountain-gorges and wilds of the Island of Victoria [*i.e.*, the South Island], many birds at present supposed to be no longer in existence. I feel assured from the many reports I received from the Natives that a species of Struthio still exists in that interesting land in parts which, perhaps, have never yet been trodden by man. Traditions are current among the elder Natives of atuas covered with hair, in the form of birds, having waylaid Native travellers among the forest wilds, vanquishing them with an overpowering strength, killing and devouring. The traditions are reported with an air of belief that carries


MOA REMAINS, ETC.:—
Footprints.
Remains in caves.
Remains in swamps.
Bones or shells in open country or shingle drift.
TRACKS:—
Rev. W. Williams, 1834
Polack's trading track, 1834–7
Rev. W. Williams and Colenso, 1837–8
Colenso, 1841–2
C. Runaway
Hicks Bay
EAST C.
BONES FIRST SEEN HERE
Rangitukia
Waiapu R.
Waipiro B.
Hikurangi
Motu River
BAY OF PLENTY
Tauranga
Ohiwa Har.
Tokamaru
Tolago B.
ROTORUA L.
Rotomahana
Rangitaiki R.
Waikakaua R.
Mangatu 1000'
Matawai 2000' to 3000'
Whatatutu
Te Karaka Shingle
Waipaoa
Ormond
Fossil feathers
Pakarae
Whangara
Shells and bones abundant
Hangaroa 1200' Abundant
Wainui Sands Abundant
Tuahine Flats
Gisborne
Whaka-punake
LAST LEGENDARY LOCATION OF MOA
Waikare Moana 2500'
Buried
Te Reinga 900'
Conglomerate
39° South lat.
Waikato River
Tauhara Vol. 3603'
No bones found on plateau
PUMICE PLATEAU
Marumaru
Mangaone
Table Cape
Nuhaka Sands
MAHIA PENIN.
TAUPO L.
Mohaka Riv.
Wairoa Riv.
Waihua 200' Rocks
Mohaka 150'
Tarawera 2000'
Open hill-tops
Portland I.
Tokaanu
Roto Aira
Pohue 1500'
HAWKE BAY
Kaweka Mts.
Glengarrie 1000'
Patoka
Stream 1200'
Esk River Egg-shell deposit 15'
Petane
Tongariro Vol. 6453'
Tutaekuri Riv.
NAPIER
Ngaruroro R.
Mt. Blowhard 2000'
Ruapehu Vol. 9175'
Maraekakaho 250'
C. KIDNAPPERS
Havelock Hill-top 600'
PUMICE PLATEAU
Anaroa
Bare I.
Te Aute 95'
Waimarama Sands
acre bones, beach swamp
Tukituki Riv.
Otane 300'
Hatuma Lake
Wanganui Riv.
Rangitikei Riv.
BLACK HEAD
Makotuku Hill-top 2000'
Porangahau Bones
Mangatoro Valley 1400'
Wimbledon
C. TURNAGAIN
Footprints
Woodville
Weber
Wainui River
Waimata Sands Shells and bones abundant
Manawatu Riv.
177° East long.
0 10 20 30
MILES

conviction to the younger Natives, who take great delight in the marvellous and the improbable." Polack makes no mention of the word "moa" in his reference to fossil ossifications of a bird belonging to the genus *Struthio,* and it is strange that no reference occurs from the time when the missionaries reached the country, in 1814, up to the time when the Rev. William Williams and Mr. William Colenso took a holiday trip from the Bay of Islands along the East Coast, following the completion, printing, and publication of the New Testament in December, 1837.

Bishop Williams, of Napier, informs me in a letter that the Rev. William Williams first visited the East Coast to the south of East Cape in the year 1834. This being so, it is possible that he may have met Polack at Tolago Bay or elsewhere along the coast, and that he then heard of the fossil ossifications; but I can find no reference to this in any publication. Colenso was a born naturalist, and this fact may have suggested to the Rev. William Williams the advantage of being accompanied by Mr. Colenso during his second visit to the coast. But whatever the reason for the companionship of the Rev. William Williams (missionary, and editor of the first New Testament in Maori) and Mr. Colenso (the printer of that New Testament), the fact remains that previous to the date when the two started on their important journey together on the 1st January, 1838, no missionary or other person appears to have interested himself in the "fossil ossifications" such as Polack states he saw along the East Coast during his residence between the years 1834–37.

The gradual spread of information in England and elsewhere following the publications of Nicholas and Polack naturally increased the interest of zoologists in the flora and fauna of New Zealand. Every bit of information that it was possible to glean about the country was collected, in the hope of obtaining for Great Britain some of the credit that naturally marks a country by the discoveries of its scientific workers. The mere reference by Nicholas that a struthious bird existed in the country, and subsequent reference by Polack to the *Apteryx* and "fossil ossifications" of a former *Struthio,* sufficed to whet the imagination of zoologists in England, and to direct their attention to the importance of New Zealand as a land to be studied and exploited by scientific workers. In January, 1838, Polack's books could not have reached this country, but the frequent reference in the English newspapers posted to New Zealand sufficed to arouse the attention of missionaries and others to the many objects of Maori workmanship and the wonders in natural history around them. These, while differing from what was common in the Home-land, provided valuable material for scientific inquiry and research.

The years extending from 1837 to 1843 are particularly interesting, as representing an important page in the history of this country. The cities of Auckland and Wellington were founded. The Treaty of Waitangi was signed, making New Zealand an integral part of the British Empire. Captain Hobson, the first Governor of the new colony, was appointed, and many scientific men visited the country whose names to-day are world-wide. Among those may be named Dieffenbach, Dr. Sinclair, Sir John Franklin, Allan Cunningham, the late Sir Joseph Hooker, F.R.S., and—greatest of all—Darwin. All these visited New Zealand within the years named; and, to add still further to the growing importance of the country, the British House of Commons held an inquiry into certain matters connected with the growing lawlessness of the "flotsam and jetsam" that had reached New Zealand from Australia and the surrounding islands.

It was in November, 1839, that Professor Owen read his celebrated paper before the Zoological Society of London describing a bone new to science that had been purchased from a Mr. Rule, who said it had been brought by him from New Zealand. The bone was an imperfect one, but Owen recognized it as the bone of a bird, and boldly announced the former and perhaps present existence of a huge bird in New Zealand. We may suppose that Owen at this time had read Polack's volumes, which were published in 1838, containing reference to "large fossil ossifications" that had been seen in the vicinity of the East Cape.

It is important to keep in mind the month of November, 1839, in connection with Professor Owen's first paper. Owen showed that the "fossil ossifications" referred to by Polack in his book were none other than those of birds, and that the traditions handed down by the Natives to the effect that "in time long past . . . very large birds had existed" in the country was true in fact. Owen had said in his famous paper that a bird such as he described might be still living, but the Native tradition received in times long past by ancestors of the Natives who told Polack affirmed the bird had been exterminated in times long past in order to provide food for the Natives.

Nearly two years before Professor Owen's first paper was read the Rev. William Williams and Mr. Colenso, as explained above, had travelled down the east coast of the North Island. Mr. Colenso's account of the journey is available for reference (Trans. N.Z. Inst., vol. 12, p. 63). The two travellers started from the Bay of Islands on the 1st January, and returned on the 13th February, 1838.

Here is what Mr. Colenso wrote in 1842 for the "Tasmanian Journal," referring to the information first gleaned by him of "fossil ossifications," to be known subsequently as "moa-bones": "During the summer 1838 I accompanied the Rev. W. Williams on a visit to the tribes inhabiting the East Coast district. Whilst at Waiapu [*vide* map], a thickly inhabited locality about twenty miles south-west from the East Cape, I heard from the Natives of a certain monstrous animal. Whilst some said it was a bird and others 'a person,' all agreed that it was called 'moa'; that in general appearance it somewhat resembled an immense domestic cock, with the difference, however, of its having a face like a man; that it dwelt in a cavern in a precipitious side of a mountain; that it lived on air; and that it was guarded or attended by two immense tuataras, who, Argus-like, kept incessant watch while the moa slept; also that if any one ventured to approach the dwelling of this wonderful creature he would be invariably trampled on and killed by it."

This account differs somewhat from that given by Polack, but it suggests also a reference to what the latter writer states of the birds found in the South Island that were covered with hair, and that they killed and devoured human beings. Although differing in details, the statements suffice to show that throughout the East Coast traditions existed among the Natives of the former existence of strange and curious animals. The discovery of large bones in the river-beds confirmed the Natives in their opinion, and especially so as there were no animals in the country larger than the native dog.

There appears to be no doubt that Mr. Rule was the first person to carry a moa-bone to England and bring it under the notice of scientific men; and it was this same bone that enabled Professor Owen to build up his imaginary bird, and to announce to a wondering world that "there had existed and perhaps still exists in New Zealand a race of struthious

birds of larger and more colossal size than the ostrich or any known species." This paper, as already explained, was read on the 12th November, 1839, and the Rev. William Williams and Mr. Colenso were at Waiapu in January, 1838. Polack's book was published in 1838, and so it could not possibly have been seen by either Williams or Colenso; and we have the latter's statement that he did not see Polack's book until many years following its publication. Napier, Gisborne, and the East Coast generally are so closely connected with the early history of the fossil moa that it is of some importance to state as concisely as possible the historical sequence of events concerning the parties who played so prominent and honourable a part in making known to the scientific world the truth of Owen's generalization, that there had existed in New Zealand a *Struthio* bird equal in size to the ostrich.

In order to arouse interest in the subject of Professor Owen's paper among the settlers in New Zealand, it is said that a hundred or more additional copies of Owen's first paper were printed by the Zoological Society for distribution to the colonies; but the assurance is given by Colenso in Trans. N.Z. Inst., vol. 24, p. 474, that he never saw Owen's paper or heard of it. "Now, I positively affirm," he says, "that I not only never saw Professor Owen's *first* memoir, but that I had never once heard of it; neither did I ever hear of any resident in New Zealand who had seen it." But Colenso must have heard of the subject as dealt with by Owen in his paper, because the newspapers were full of the new wonder from New Zealand, and interest was aroused among the settlers throughout the whole of the two Islands.

Up to the year 1838, as far as I can find, no individuals living in New Zealand other than Allan Cunningham, botanist, and William Colenso, printer, had interested themselves in natural science. In the Proceedings of the Church Missionary Society there is a letter from Mr. Colenso in which he suggests how valuable and welcome would be the gift of a microscope, and it is evident from his earliest writings on botany and natural history that he was a keen and careful collector of natural-history specimens from the time of his arrival in New Zealand to the close of 1834.

Dieffenbach did not arrive in the country until 1839, and, although he states that a Native chief tried to dissuade him from ascending Mount Egmont by saying "it was guarded by a moa," he does not appear to have heard either legend or fact of the moa during his journey from Taranaki to the Bay of Islands. During Dieffenbach's stay in the Bay of Islands he resided next door to Colenso, and it was at this time that Dieffenbach met the Rev. R. Taylor, who had recently returned from the East Coast in the company of the Rev. William Williams. These missionaries started on their journey in January, 1839 — a year after Colenso's first visit — and returned on the 13th February. This was the Rev. Mr. Taylor's first trip to the East Coast, for he was a recent arrival in the country; but he is said to have succeeded in obtaining a fossil toe-bone, which, with other bones, Dieffenbach saw. It appears that small parcels of broken bones had been sent to Mr. Colenso (*a*) by the Rev. William Williams, and (*b*) by the Maori teachers who had been sent to the East Coast after the return of Messrs. Williams and Colenso in February, 1838. Colenso says he told the "Maori teachers," when starting to the East Coast, to inquire for fossil bones, and to send them to him at his home in the Bay of Islands whenever opportunity should offer. Hence Dieffenbach saw the toe-bone found by the Rev. R. Taylor and the bones belonging to Colenso sent to

him by the Maori teachers and the Rev. William Williams, both being obtained in the year 1839. (*Vide* map.)

The interval that elapsed between the reading of Owen's first and second papers was an active one in New Zealand in the way of collecting bones. Colenso paid a second visit to the East Coast in the summer of 1841–42 (*vide* map). He started from the Bay of Islands on Friday, the 19th November, on board a little vessel bound for Poverty Bay. He, however, landed at Wharekahike (now known as Hicks Bay), between Cape Runaway and the East Cape. He continued his journey southward to Rangitukia, a large Native settlement of the Ngatiporou Tribe on the left bank of the Waiapu River. Here he obtained "several fossil bones of the moa" (five femora, one tibia, and one undetermined).* These were the first moa-bones actually collected by Mr. Colenso. He continued his journey southward along the coast to Poverty Bay, where he met the Rev. William Williams, now made Archdeacon, and who had gone to reside at Turanga (Gisborne) at the beginning of 1841. The Archdeacon had a number of moa-bones which had been obtained from the Natives. These had been collected with the intention of sending to Professor Buckland, at Oxford. Colenso states† that he gave some of the bones collected by himself to the Archdeacon. It is reasonable to suppose that mutual exchanges were made at this time. Colenso went inland from Poverty Bay, following the present inland Gisborne–Wairoa Road as far as Te Reinga Falls in the Hangaroa River (*vide* map). His inquiries for moa-bones were frequent as he passed round the famous Whakapunake headland of limestone, where, according to tradition, the moa still lived in a cave! (*Vide* map.) He was told just what Maoris always tell whenever they are ignorant—that the information he sought of the moa would be obtained from some other named person in another locality. Interest, however, was aroused by his inquiries for bones, and observation was quickened when it was known that money would be given by the missionary living at Turanga to those who should find bones and take them to him. Colenso tells us that many bones were taken to the Archdeacon, but that he himself could not obtain any information other than legendary about the moa, which the Natives near Whakapunake now said lived in the Wai-iti Mountains! Colenso undoubtedly made a brave effort at this time to discover facts concerning the moa as known to the Maoris, but his efforts were unsuccessful. The facts gleaned along the coast during his progress to Poverty Bay, and the legends common to the East Coast district, were not increased during his remarkable journey through the heart of the North Island.

During the year 1842 Archdeacon Williams sent a collection of bones to Professor Buckland, at Oxford. Some of these bones consisted of a pair of femora collected by Colenso at the Waiapu River, near Rangitukia, where, as already stated, Colenso obtained five femora, one tibia, and one bone undetermined. On returning to the Bay of Islands Colenso also set about making up a collection of moa-bones to send to his friend Sir W. J. Hooker for Professor Owen, and at the same time he wrote an account of his views on the moa, and a monograph on some New Zealand ferns. The former he sent to the editor of the "Tasmanian Journal of Science," and the latter to Sir W. J. Hooker. Colenso's paper on the moa was sent to the editor

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* "Memoranda of an Excursion in New Zealand." "Tasmanian Journal," vol. 4, p. 220.

† Trans. N.Z. Inst., vol. 12, p. 70.

of the "Tasmanian Journal of Science" early in the year 1842, and was acknowledged on the 6th August, as follows :—

MY DEAR SIR,— Hobart, V.D.L., 6th August, 1842.

I believe Mr. Henslow acknowledged your two papers upon the ferns of New Zealand and upon the fossil bones (which are indeed a very remarkable discovery). They were laid before the society at the last meeting (3rd August), and the next number, now in the course of printing, will contain your paper on ferns; the other we reserve for the succeeding number. We are not restricted to lithography by the expense, but the difficulty of getting the things done properly. However, I hope your illustrations will be to your satisfaction, as they are already in the workmen's hands. I enclose a copy of No. 4, and will not forget to send four copies of No. 5 when published. Communications may be addressed to me under cover of Sir J. Franklin, as I have undertaken the duties of secretary of the society.—Believe me, &c.,

To William Colenso, Esq. I. P. GELL.

The original of this letter is in my possession. Here it is clearly shown that Colenso sent his papers on "fossil bones" to the Tasmanian Society in Hobart soon after his return from what was at the time a very remarkable and successful journey by way of the East Coast, thence inland to Waikaremoana, through the Urewera Country to Rotomahana and Rotorua, and onward north to the Bay of Islands.

Colenso's paper on the moa appeared in the "Tasmanian Journal of Science" in 1843, and Professor Owen republished it in the "Zoological Magazine" (vol. 19, p. 81) the following year. This fact of republication by Professor Owen suffices to show that the paper was one of scientific value. Between the time of Colenso's writing his paper on the moa for the "Tasmanian Journal of Science" and Owen's republication of it a letter had been written by Owen himself to Mr. Colenso on the recommendation of Sir Joseph Hooker, and from this it is possible to correlate all the facts connected with the receipt of moa-bones in England up to the time of the professor's writing :—

Royal College of Surgeons,

SIR,— Lincoln's Inn Fields, 23rd October, 1843.

I am encouraged by Sir William Hooker to hope that you may interest yourself in transmitting me information and specimens relative to a point in natural history which I have been for some years endeavouring to elucidate—viz., the nature and affinities of the gigantic bird which appears to have become extinct, like the *Dodo* of Mauritius, within the historical period in the North Island of New Zealand. The Proceedings of the Zoological Society for January, 1843, which I take the liberty to transmit, will put you in possession of the amount of information which I had obtained on the subject of the *Dinornis* of that period.

I have subsequently obtained, by comparison of the specimens transmitted to Dr. Buckland by the Rev. Wm. Williams, good evidence of not less than four species of *Dinornis*, the bones of which have been obtained from the beds of streams descending from the mountains into Poverty Bay. These species are at present indicated by bones of the leg. No part of the head has yet reached England [note 23rd October, 1843], nor any trace of wings or rib-bones. The latter I conjecture to have been disproportionately small, as in the *Apteryx*. Every additional bone of the *Dinornis* would be of great value and utility in recomposing the different species. I have, for example, now got the femur and metatarsus of one species, without the tibia, or longest bone of the leg; in another species I have the tibia, but not the femur, or thigh-bone.

You will see that Mr. Cotton refers to a report which Mr. Williams had heard relative to the existence of the great species at the present time in the Middle Island. I should be glad to have any further information on that point which may have reached you.

With the notice of the *Dinornis* I send also an abstract of my anatomical description of the kiwi, or *Apteryx*, of New Zealand. The probability that the fate of this genus may soon be that of the *Dinornis* has induced me to spare no pains to secure a record of its organization. Hitherto the specimens (two) I have received have not reached me in a state fit for the dissection of the nerves. For this purpose a recently killed

Apteryx should be immersed in a strong colourless spirit, the skull having been carefully cut open and partly removed with a penknife to allow the spirit to get to the brain. An opening should be cut into the belly, and the spirit poured in there and down the throat. If after some weeks' immersion the spirit were changed the bird would without doubt arrive in such a state as would allow me to complete my monograph. . . .

For the honour of our country the scientific account of the rarities of our remote colonies should emanate from England. We have too often been indebted to foreigners for such information. . . .

As soon as I have published the memoir I am now preparing on the *Dinornis* I shall forward it to the Rev. Wm. Williams and yourself, and meanwhile remain,—
Yours, &c., RICHARD OWEN.

This letter, written on the 23rd October, 1843, is initialled by Colenso as having been received on the 17th January, 1846, or two years three months afterwards, and was answered on the 20th January, three days after its receipt. The delay may have arisen owing to the trouble with Hone Heke in the Bay of Islands, and to the circumstance that Colenso removed to Hawke's Bay about this time.

The two letters here quoted show—First, that Colenso's paper on the moa was written immediately following his return from his second journey along the East Coast in April, 1842, and acknowledged by the editor of the "Tasmanian Journal" in August; second, that Owen's second paper appeared in January, 1843; third, that between the appearance of Owen's second paper and his letter to Colenso of the 23rd October, 1843, Professor Owen had received from Buckland the collection of bones forwarded by the Rev. William Williams; fourth, that at the time of writing to Colenso Professor Owen was occupied upon a third paper on the *Dinornis*, a copy of which he promised to send to Colenso when sending one to the Rev. William Williams, who was most interested; fifth, that Colenso could not have obtained any facts connected with Owen's first paper at the time of writing his own paper; sixth, that Colenso's paper was republished by Owen in the "Zoological Magazine" (vol. 19, p. 81).

Reference has already been made to Dieffenbach and the Rev. Richard Taylor, as quoted by Colenso. It is necessary, however, to quote what each one says in order to avoid even the appearance of bias. Dieffenbach, in vol. 2 of his book on "New Zealand," page 195, says, "To this order probably belongs a bird, now extinct, called Moa (or Movie) by the Natives. The evidences are, a bone very little fossilized, which was brought from New Zealand by Mr. Rule to Mr. Gray, and by him sent to Professor Richard Owen (Proc. Zool. Soc., 1839, p. 169). I possess drawings of similar bones, and of what may possibly be a claw, which are in the collection of the Rev. Richard Taylor, in Waimate. They are found on the east coast of the Northern Island of New Zealand, and are brought down by rivulets from a neighbouring mountain called Hikorangi." In the year 1855 the Rev. R. Taylor published a book bearing the title "New Zealand and its Inhabitants." The following reference to the moa is taken from page 396: "But of all the birds that have once existed in New Zealand, by far the most remarkable is the moa (*Dinornis* of Owen). Perhaps it was the largest bird which ever had existence, at least during the more recent period of the earth's history; and it is by no means certain that it is even now extinct! I first discovered its remains in 1839, at Tauranga [Turanga], and now Waiapu."

Now, Colenso, so it is stated, lived next door to Dieffenbach; but the latter makes no mention of Colenso, and it is doubtful whether Colenso had any bones of the moa at the time of Dieffenbach's stay, for he had not

started on his second journey along the coast. In support of this suggestion is should be mentioned that Colenso, in the "Tasmanian Journal" (vol. 2, p. 7) refers to the fact that on the return of the Revs. William Williams and Taylor from the coast the latter carried with him "a part of a fossil toe (or, rather, claw) of some gigantic bird of former days."

In vol. 5, page 97, of the "Transactions of the New Zealand Institute" Mr. Taylor relates how he found a portion of a large bone at Waiapu, near East Cape, in 1839: "When in the house of a Native at Waiapu with the Rev. William Williams I noticed the fragment of a large bone stuck to the ceiling. I took it down, supposing at first it was human, but when I saw its cancellated structure I handed it over to my companion . . . asking him if he did not think it was a bird's bone. He laughed at the idea, and said, 'What kind of a bird could there be to have so large a bone?' . . . The Natives said it was a bone of the tarepo, a very large bird which lived on the top of Hikurangi, and that they made their largest fish-hooks from its bones." Nothing is said about the finding of a claw, as related by Dieffenbach and Colenso, Mr. Taylor's purpose, apparently, being to show that he found the first bone recorded in New Zealand. This bone, Mr. Taylor says, the chief readily gave him for a little tobacco. It is stated, further, that the bone was sent to Professor Owen through Sir Everard Home, but that it did not reach the professor for some time afterwards, when Owen had already announced in his famous paper the existence of a former gigantic bird in New Zealand, basing his conclusions on the specimen carried to England by Mr. Rule.

There is no reason to doubt the statement as to the finding of the bone in the ceiling by the Rev. Mr. Taylor; but in order to obtain the best available information concerning the earliest discovery of moa-bones in this country I have obtained from Bishop Leonard Williams, who is the son of the late Rev. William Williams, subsequently first Bishop of Waiapu, a memorandum on "Moa Remains," and concerning the discovery of which his late father was so closely connected. The legendary history to which the bishop refers in his letter affords no satisfactory evidence as to whether a long time or a short one has elapsed since the moa disappeared, or whether the moa and the Maori were contemporaneous. It can hardly be supposed that the disappearance of the moa, which was distributed throughout both Islands, occurred synchronously, or that the moa of the North Island disappeared synchronously, unless from some physical cause other than by man's means. Bishop Williams is of the opinion that the moa's disappearance is of recent date, and he is supported in his contention by men like the late Sir James Hector, Professor Hutton, and, latest of all, Professor A. Quatrefages.* On the other hand, Sir Julius von Haast, the Hon. W. B. D. Mantell, F.G.S., W. Colenso, F.R.S., and Mr. Tregear (the former from geological evidence, the last from etymological), and many others have expressed the opinion that the moa disappeared either earlier than the advent of the Maoris into the country or very soon afterwards.

The first actual information extant concerning the legendary history surrounding what are now termed moa-bones is the account given by Polack. He states, as already explained, that he "saw several large fossil ossifications, and that in times long past Natives received the tradition that very large birds had existed in the country." Further, that traditions

*Trans. N.Z. Inst., vol. 25, p. 17.

then current among the elder Natives related how atuas covered with hair, in the form of birds, dwelt in the forest wilds, and killed and devoured human beings whenever the opportunity arose. Here fact and legend meet. The bones have been proved to be those of birds, and the information had come in the long past from Natives who "received the tradition of the former existence of birds." The fact that atuas and birds are mixed in the legendary lore is very noticeable; but one would suppose that had the bird been generally known to the Natives of either Island the same name would have been applied to it. Polack makes no mention of the name of the legendary bird. The Rev. Mr. Taylor termed it "tarepo." In London Mr. Rule gave the name of the supposed bird as "movie," and Mr. Colenso, in his paper that appeared in the "Tasmanian Journal of Science" in 1843, states that when at Waiapu (near East Cape of the North Island) during the summer of 1838 along with the Rev. William Williams he first heard of a certain monstrous animal. Some said a bird, some a person; all agreed it was a moa—a domestic cock that had the face of a man and dwelt in a cavern in the precipitous side of a mountain; that it lived on air, and that it was guarded by two immense tuatara, which watched whilst the moa slept. Again, in vol. 11 of the Transactions, page 83, Colenso writes, "Yet not a single vestige of any osteological remains of any animal of the saurian kind has ever yet been discovered! While, on the other hand, the fossil remains of many large and extinct struthious birds of several genera and species, and commonly known in the lump as 'moa,' are to be met with in great abundance; and yet of these realities there are neither creditable history, nor curious legendary tale, nor myth nor fable that I have ever been able to lay hold of!"

Whakapunake, a bold scarp of limestone due south of Poverty Bay, was spoken of as the residence of the creature. The Natives were afraid of the moa. Colenso endeavoured to find out more about the moa on his second visit to the East Coast in 1841–42, but although he passed round Whakapunake and proceeded to the interior of the Island he was unable to gather any information, either legendary or other, about the moa.

It will be noticed that there is a general agreement between Colenso and Polack in their description of the atuas in the shape of birds that at one time existed in the country. The fact that such traditions alone remained suffice to show that the moa had disappeared from the North Island at least anterior to the arrival of any settlers, missionaries, or traders.

Bishop L. Williams refers to the legendary footsteps of a celebrated ancestor of the Maori—Rongokako; but I prefer to accept the evidence of Panopa Waihopi, the principal chief residing at Te Karaka, whose illuminating letter (when read in the light of Colenso's reference below) appeared in the *Poverty Bay Herald* of the 30th May, 1912. This letter was written after the alleged discovery—rediscovery, it should have been (see Transactions, &c.)—of moa-footprints at the mouth of the Waikanae Stream as you enter between the pier-heads into the Turanganui River, Gisborne. The following is a copy of the letter:—

SIR,—

I wish to inform you for the benefit of those who discredit the discovery of the moa-footmarks on the Waikanae. I am now approaching my eightieth birthday. In the year 1850 I was shown the very same footprints by Kahutia te Rangi, Lady Carroll's grandfather, and was told they were the footprints of Rongokako, of Maori historical fame. Kahutia's people before that knew of the same footprints. The footprints are therefore not moas', but Rongokako's.

When Colenso made his second visit to the East Coast, as related in the "Tasmanian Journal of Science," he remarks that after passing Te Kawakawa (Hicks Bay) "the clayey rocks had been so acted upon by the sea as to be worn quite flat in many places, stretching into a continuous layer of rock nearly a mile in length. Here in a clayey rock near high-water mark the Natives show the impression of the foot of Rongokako, one of their illustrious progenitors, the print of his other foot made in striding hence being near Poverty Bay, a distance of more than fifty miles" [100 miles ?]. Many marvellous exploits are recorded of Rongokako in the legendary realms of the Maori, but it is curious that the statement made by Colenso in 1842 should be substantiated by Panapa Waihopi in 1912. The statement of the Native chief is another instance as showing that the so-called footmarks of Rongokako and the footprints of the moa were unknown to the Maoris of the North Island except as mere legends.

In vol. 5, page 95, of the Transactions the Rev. Mr. Taylor says that on inquiring from the Natives as to what kind of bird the bone belonged which he had found in a Native house, he was informed "it was the bone of the tarepo—a very large bird which lived on the top of Hikurangi, the highest mountain on the East Coast. . . . I then inquired whether the bird was still to be met with, and was told there was one of immense size which lived in a cave and was guarded by a large lizard, and that the bird was always standing on one leg!"

On the other hand, Colenso (vol. 12 of the Transactions, page 81) says an old chief of the coast informed him that "anciently the land was burnt up by the fire of Tamatea. Then it was that the big living things, together with the moas, were all burnt. Two moas, however, survived with difficulty that destruction, but only two; one of these lived at Te Wai-iti Mountains (in the interior) and one at Whakapunake. The feather of this one at Whakapunake has been seen, and was preserved as a plume decoration for the heads of the dead chiefs of note. The name of the feather was Ko-te-rau-o-Piopio (the special plume of Piopio). The forefathers of the Maoris heard of the moa, but they never saw its body, only its bones" This statement agrees entirely with what I have been able to gather from the Natives in the vicinity of Whakapunake, at the foot of which I have passed in going to and from Poverty Bay during the past thirty-five years. Invariably the same answer is given in reply to inquiries: "In a cave near the top of Whakapunake the last moa lived, and his feathers were used on great occasions; but this was a long time ago."

As showing how the traditional lore is passed on from father to son, the following account was related to me on the 16th July, 1912, by Urupeni Puhara, aged eighty-eight, an old chief still living at Pakipaki: The "moa" was not the name by which the great bird that lived in this country was known to my ancestors. The name was "Te Kura," or the red bird; and it was only known as "moa" after the pakehas said so. Te Kura was known to all ancient people, and was handed down from father to son, who spoke about the big bird that was as high as the top of the door (pointing to the door of the room in which we were sitting). Its legs were thick as those of a bullock. Neither his father nor grandfather had seen Te Kura, but it had been told to them, and tales were told of what it did. He did not know how it was caught or snared, nor had he seen or heard of moa's eggs, and knew nothing of its footmarks. The moa lived, he had heard, all over the North Island, but they disappeared after the coming of Tamatea, who set fire to the land. The fire was not the same as our fire, but embers were

sent by Rangi. The signs of the fire are still to be seen where red rocks like red berries are found. The place is called Te Pua-o-te-roku, or the Garden of Berries. The man that brought the moa to New Zealand was Rua Kaponga. Tamatea was the son of Rongokako, and he married Hine Maurea, or Muri Whenua.

Knowing that Colonel Porter, C.B., of Gisborne, had a wide acquaintance with Maori history and legendary lore, I drew his attention to Urupeni Puhara's account of the moa, particularly with reference to Te Pua-o-te-roku, and he replied to my letter thus :—

DEAR MR. HILL,— Heatherlea, Gisborne, 25th July, 1912.

Thanks for yours of the 18th ultimo. I quite appreciate the scientific interest you take in Maori legendary. *Re* the old chief's statement, the word "*manu*," as you know, means "bird," and some version of Rongokako says "his *manu*"; then on closer inquiry they say "like a kiwi, only bigger." None seem to have in mind the moa. The old man's story about the pakeha having so named the moa recalls an amusing story I heard on the train years ago between Napier and Wellington. An elderly gentleman *en tour* was questioning a well-educated half-caste on the original of the name "moa." The reply was, "Oh, the Maori had no name for it, only '*manu*,' and that it was after the pakeha came and discovered the skeleton remains throughout the country they exclaimed, 'More bones! More bones!' Hence the name 'moa' by the Maoris."

I was highly amused, but did not intervene. It is strange that there is no authentic record of the moa in song or legend; only one proverb, "*Ngaro a moa*"—lost like the moa. This tends to prove they had "the name," at all events.

There is a piece of forest land on the Mata River, near Hikurangi, called Rua-o-te-roku, noted for the redness of its rocks and berries; in former days a great pigeon-hunting ground.

Re the embers destroying the moa, I did hear that theory among Ngaitahu in the South Island, who said fires fell from heaven, set fire to and denuded the country of forests, so destroying the moa, whose remains are found only in caves and swamps, where they sought refuge. I have not heard any story of the kind in the North Island, which has always been so forest-clad.—Yours, &c., P. PORTER.

The historical facts and legendary references already presented show—(*a*) that fossil bones are first described as having been seen and subsequently collected along the east coast of the North Island; (*b*) that the first-known fossil bone taken to England from New Zealand was taken by a Mr. Rule, from the East Coast; (*c*) that the Revs. William Williams and R. Taylor early in 1839 obtained a bone in the vicinity of Waiapu, and that Colenso obtained some imperfect bones about the same time from Native teachers who were sent to the East Coast following the return of Messrs. W. Williams and Colenso early in 1838; (*d*) that Mr. W. Colenso obtained numerous bones on his second visit to the coast in 1841–42, and, reaching Poverty Bay, found the Rev. William Williams (now Archdeacon) had commenced to collect bones in order to send them to Dr. Buckland at Oxford; (*e*) that Mr. Colenso was certainly the first person in New Zealand who wrote a scientific account of the moa, early in 1842; (*f*) that Professor Owen read his first paper in 1839, and wrote a letter to Colenso in October, 1843, long after Colenso's first paper was published in the "Tasmanian Journal of Science," and before the publication of Owen's second paper; (*g*) that the legendary lore of the Natives, without exception, connects the moa throughout the East Coast with atuas and Rongokako and Tamatea, who are fabled ancestors of the Maoris; (*h*) that not a single Maori known to the missionaries and early settlers ever saw or heard of a moa, or of its having been seen by any of their ancestors; (*i*) that Polack's statement as to the great antiquity of the "fossil ossifications" has stood the test against every theory, palaeontological or otherwise, of moas being possibly living in recesses of mountains or forests in one or other of the Islands of New Zealand.

GEOLOGICAL.

Scattered throughout the "Transactions of the New Zealand Institute" are numerous papers dealing with the moa. Some refer merely to the discovery of bones in middens, in banks of streams, caves, and so on; several of great importance refer to the structure and general anatomy; and several deal with the geological distribution.

When at Home two years ago I made several special visits to the Geological and Palaeontological Section, Natural History Branch of the British Museum. Here are found, in the class *Aves*, the orders *Dinornithiformes* and *Aepyornithiformes*, which include fossil remains of the New Zealand moa and Madagascar *Aepyornis*. The latter bear a close resemblance to the moa-structure of this country. The Madagascar fossil bird remains belong to a recent geological period, and the opinion as to the age of the New Zealand moas is expressed by the authorities as follows: "The situation and state of preservation of the abundant remains which have been found indicate that they existed till comparatively recent times, and were probably exterminated by the present Maori inhabitants of the Islands. Feathers which have been found associated with the bones show the presence of a large after-shaft. . . . The moas are represented by several genera, the largest member being *Dinornis maximus*. . . . Some species seem to have survived until about four or five hundred years ago, or even later in the South Island."

The context will deal only with the East Coast district of the North Island. For thirty-five years I have been travelling between Cape Turnagain and East Cape on the coast, and Ruahine and Te Wai-iti Ranges on the west. This represents the classic ground of the earlier missionaries and collectors of moa-bones. For a number of years, and up to the time of his death, I was on terms of the closest intimacy with the late Rev. William Colenso, F.R.S., and my familiarity with the geological structure of the district-where traces of the moa have been observed places me in a favourable position in dealing with the geological distribution of the moa in terms of time.

For years records have been carefully kept of the various places where bones, or egg-shells, footprints, and feather-markings have been found, and as a result a map has been constructed showing the localities where moa-remains occur *in situ*, and the details are entered here for the benefit of future workers. The East Coast district extends for over three hundred miles from north to south, and about a hundred miles at its greatest width. The district presents features of its own that are characteristic.

Polack, who first saw "fossil ossifications" and related the legendary lore concerning them, was a mere trader and collector of curios, but he was an observant man, and suggested the rapid disappearance of certain birds whose wings were short or were altogether absent. All the earlier writers and collectors refer to the bones as being found in places where water has been in motion. Thus the Rev. Williams, in 1842, says, "None of the bones are found on dry land, but are all gathered from beds and banks of fresh-water rivers, buried a little distance in the mud." Dieffenbach says, "They are found on the east coast of the Northern Island of New Zealand, and are brought down by rivulets from a neighbouring mountain called Hikorangi." Polack says the bones he saw were found near a mountain called Ikorangi, far in the interior. He makes no mention of being found in the beds of streams.

Since the days of the first findings of the bones of the moa the South Island has produced even larger collections of bones than the North, and the information has been such as to suggest to persons in the South Island its comparatively late disappearance.

In vol. 1 of the Transactions the Hon. W. B. D. Mantell infers from an examination of Maori ovens that cannibalism prevailed at the time the moas were used for food; and Dr. Hector alluded to "the profusion of moa-egg shells in the ovens of the interior, which showed that eggs must have been prized as food, and that their consumption must have soon led to the extinction of the birds."

There is no such evidence as this along the East Coast. Traces of middens are common everywhere, and all the evidences of a long Native settlement are abundant. So likewise there is evidence of the existence of the moa and scores of other birds; but a careful examination satisfies me that the moa dwelt along the coast before the advent of man, and that no disturbing causes from the human side tended to their disappearance. The sand-dunes along the coast where the traces of moa-bones, shells, moa-chick bones, &c., are common require to be carefully studied. The dunes do not consist of a single series of sands, but two, and sometimes three, separate deposits are traceable. The sand and clay accumulations extend from the foothills over an extensive shelving area of low rocks—remnants of land that the sea has borne away and covered with the clay-sands from the greensands and limestones that are found along the coast. These sands represent an accumulation over a long period of years, during which time even the physical features of the country have changed. The lower beds present the appearance of having been occupied by birds without intrusion of an enemy, for there are many varieties of bones, and no trace of occupation by human beings. The middle beds contain obsidian, bones of the walrus, fish-bones, human bones, and shells, whilst the upper sands represent blown or moving sands which soon cover the other beds, and make an appearance as if all the beds belong to one and the same series. It can readily be understood how the middle and upper sands may get mixed with the lower by wearing, and this has taken place more rapidly of late years, so that a very careful inspection is necessary in order to separate the beds from each other.

The moa findings are mainly on the high almost inaccessible ridges of limestones, in very broken country or in caves, except in the case of deposits on shelving coast areas where sand occupies the site of land that has been worn down to the level or below the level of the surrounding sea. An examination of the coastal beds shows that fresh-water shells are associated with the bird-bone beds, and that the bones represent birds that have disappeared or are disappearing to-day.

Between Wainui (south of Cape Turnagain) and the East Cape the sands provide no evidence of contemporaneity between the moa period and the Maori period, and certainly one could not gather that the Maoris ate the eggs of the moa because broken shells are common among the bird-bone sand-deposits. Frequent visits to the deposits along the coast have convinced me that the moa period coincided with the deposition of the lowest sands, which go back a long series of years. The extensive sand-deposits south of Turnagain, at Waimarama (south of Cape Kidnappers), at Nuhaka (on the north shore of Hawke's Bay), at Wainui (east from Gisborne), and at Pakarae (near Whangara, to the north of Wainui) contain numerous bones of the adult and chick moas, together with broken shells, but there is no

trace of a moa having been cooked in a Native *hangi* or of being disturbed by a horde of hungry hunters. For miles along the coast near Wainui South moa-bones and broken pieces of egg-shells are common. I have seen entire skeletons exposed following long-continued easterly winds, and lying as if the birds had died on the spot or had been carried to the place by means of water, to be subsequently covered and buried in the sands. In the vicinity hundreds of Maoris have lived for centuries, judging by their extensive middens, and it is inconceivable that the complete bodies of moas should have been left untouched within a short distance of a Native village when animal food was so scarce among them.

At Waimarama, as related by Mr. A. Hamilton, F.G.S.,* we saw a place where a big storm had washed out half an acre or more of the upper sand-beds, and had left exposed many thousands of bones in the lower beds, but too fragile for removal. They were arranged as by an artist. Had the birds to which the bones once belonged been killed and cooked by the Maoris the bones could never have lain as we saw them, and had there been dogs it is hardly likely that such an abundance of bones would have remained in perfect condition and spread about in regular order.

The moa-footprints at Gisborne, near the mouth of the Waikanae, suggest that the birds were either seeking for food in the vicinity or that it was a crossing-place to the birds' resorts a few miles farther on. It appears as if the coast sands were occupied as breeding-grounds, and nothing more.

Near Pakarae, where extensive sand-dunes exist, I found some years ago a depression in the lower sands that had been exposed after a succession of bad weather and fierce winds, and it contained the broken remains of the greater part of a moa-shell cemented together in a way that suggested it had been broken by pressure—the inner surface held together by the yolk material.

Indeed, everything along the coast where moa-remains occur suggests that the sands were frequented for breeding purposes only. I am not prepared to say the same of all the other birds whose bones are found along with those of the moa. Thinner and different kinds of broken egg-shells are to be found, but there are no traces that the birds when living were disturbed by man. As far as I can discover after working again and again the sands along the East Coast where Maoris have dwelt for many generations—and middens are numerous—there is no evidence to show that the moa was ever hunted by the Maori for food, that eggs were cooked and eaten, or that bones were ever broken for the extraction of marrow for food of dogs.

It has already been remarked as to the great length of time represented by the lower deposits of certain coast sand-deposits. They correspond to the age of high-level shingle conglomerate that preceded the plains, like those of Heretaunga, Ruataniwha, Wairarapa, Wairoa, and Poverty Bay. These alluvial plains are of comparatively recent make, and to gain a true conception of the days of the moa and the surface features of the country when the bird flourished and roamed over it the surface features as represented by its remains must be carefully studied. The moa could not live or breed on or within an area which was subjected to constant change. Its home was among the downs, the rough limestone hills, and solitary uplands, where food was plentiful and enemies few. The localities enume-

* Trans. N.Z. Inst., vol. 21, p. 313.

rated show that moa-remains are found from sea-level to an elevation among the mountains exceeding 3,000 ft., and throughout an extensive district containing rocks representing various geological periods. The localities are classed under the following periods: (1.) Lowest coast sands, corresponding to the high-level gravels or oldest Pleistocene, containing bone, egg-shells, and chicks. (2.) Footprints and fossil feathers, corresponding to high-level gravels and lowest sand-deposits. (3.) Swamps, Te Aute: abundance of bones: period, Pleistocene, corresponding to moa feather and footprint period. (4.) On Pliocene country: Havelock, Maraekakaho, Napier, Pohui, Puketitiri, and Petane. (5.) Miocene country: Anaroa, Makotuku, left bank of Manawatu, Ngapaeruru, Wimbledon, Mohaka, and Waikare. (6.) Secondary rocks: Tarawera, Matawai, Motu country. (7.) In caves among Tertiary rocks: Upper Hangaroa, Waikaremoana, Marumaru, Pohui, Mangatu, Mangaone, Mount Hikurangi, Mangatoro Valley. (8.) In high-level shingle conglomerates, at the south end of the Whakapunake Range.

The distribution of bones and complete skeletons, some in caves and others in the open country, suffices to indicate that in general the surface features of the land have not altered to any large extent since the times of the moa. The great plain formations and river-basins have changed considerably, but the general features of the country, except the forest area, have undergone no distinctive change other than in the formation of new river-basins and the growth of plains like those of Heretaunga, Poverty Bay, Ruataniwha, and Wairoa. Thus it is certain that—(*a*) the moa was living previous to the plain deposits such as now exist; (*b*) it was living in Pleistocene times; (*c*) it roamed over the hill country through a district extending for 350 miles, and at elevations from sea-level to 3,000 ft. or more; (*d*) although moa-bones are found in numerous caves of different ages, there is no evidence that the caves were used for shelter at intervals; (*e*) it lived at a time when conditions existed for the accumulation of many bird-skeletons within a single water area or swamp.

Had there been human beings or native dogs in the country during the moa period it is difficult to understand the large bone-accumulations such as are met with in swamps, in caves, and other areas, and it is more difficult to understand why moas under ordinary conditions should have congregated in caves and have died there.

In the Hangaroa district, near to the place traversed by the Rev. William Colenso in 1841–42, a cave was lately discovered and explored by me containing several perfect skeletons of the moa. The entrance had been long closed by a deposit of pumice sand when first visited. All the appearances suggested that the birds had sought the cave for shelter and safety from some danger that beset them, and that the entrance had been closed by the loose pumice sands sliding from overlying rocks, leaving the birds to die a lingering death. Since Colenso's visit many bones of the moa have been found within the Hangaroa River basin, in which the celebrated peak called Whakapunake is situated. The country has scores of rock shelters and potholes leading to underground caves, which are numerous, and no doubt many great finds of moa-bones will be made as the country becomes more settled.

At Pohui, on the Napier–Taupo Road, many specimens of the moa have been found among the large limestone rock-masses and caves that occur along the east valley and deep gorges at the foot of the Te Waka Range.

The distribution of the bones of moas throughout so large an extent of country in horizontal and vertical space shows conclusively, it appears to me, that the birds had few or no enemies to limit their existence, their movements, or their multiplication. At Lake Waikaremoana, and at Matawai, in the Motu country, the *Dinornis maximus* appears to have predominated. Enormous pelves and leg-bones and whole strings of tracheal rings and vertebral bones have been collected in a number of places, and doubtless the time will come, as the country is settled, when many specimens of the moa will be found in this bold rugged country, where caves, potholes, and rock shelters are common. In the Marumaru caves, beyond Wairoa, the bones are also very large; but the largest pelves I have seen were from the Matawai caves, which certainly existed before the country was forest-clad. The absence of skulls in several cases is to be regretted, but it appears to arise from the lack of knowledge in the case of those who first enter the caves. Usually the discoverers do not appreciate a find unless there are great leg-bones. The mandibles, sternum, vertebral bones, and foot-bones are considered as being of no use, and on one occasion I discovered a pelvis had been taken for the skull of a bullock by a roadman, who found a particularly fine specimen of the skeleton of a moa among some great rock-masses near Waikaremoana Lake.

In the hill-range leading to Mount Hikurangi—the mountain referred to by Polack—a settler discovered a number of moa-skeletons a short time ago. Thus Mr. Allen Watkins, of Tokomaru Bay, to whom I am indebted for the information, writes,—

The moas—five in number—were in a rock about 8 ft. by 8 ft., and were all lying with their heads together on a ledge at the extreme end of the cave.

Very few of the bones were missing, and, the heads being in an excellent state of preservation, my brother mounted the biggest of the birds, and it stands about 5 ft. high—a little over, if anything. Horihori Station, where the birds were found, is twenty miles from the sea, and of extremely rocky formation, and where the cave is must be quite 2,000 ft. up. The surrounding timber was exceptionally heavy, including all the well-known larger forest-trees—rimu, miro, pukatea, rata, &c. Distance from Hikurangi, five miles.

The position of the birds leads me to think they were fleeing from some enemy, or perhaps fire, otherwise why the heads all together on a little ledge with the bodies out in the cave—a peculiarity of this species when escaping from danger?

This description agrees generally with what appeared in the Hangaroa caves.

All the caves that have come under my notice as containing moa-bones are at a fairly high elevation, and are usually found in the midst of a bush area. The position of skeletons in the caves as seen by me suggests that the birds had sought refuge from fear. The caves in no single instance showed traces of frequent use as a resort, and the only suggestion is that the birds hurried from open country or from the hills in the vicinity to shelter themselves or protect themselves from some sudden danger. Everywhere there are traces of a heavy pumice-sand deposit, and the surrounding rocks are usually broken and greatly disturbed, as if great earth-movements had taken place. Scattered bones and bone-heaps are found in some of the highest and roughest country, as if the birds had been hurrying from the lowlands in search of shelter. Death had met them by the way, and there had been no enemy—either man or animal—to interfere with flesh or bones. In some places heaps of smooth small whitish stones are found where great bush-fires have occurred and burnt all that was capable of burning of moa-remains.

In the case of deposits of moa-bones in swamp areas that were obtained at Te Aute, and described by the late Mr. A. Hamilton, F.G.S., Director of the Dominion Museum,* it is necessary to understand the character of the country in the vicinity. The long north-east–south-west valley extending from Waipukurau to Pakipaki runs between two ranges of hills, the range on the right (in the direction of Hastings) being made up of older Pliocene and Miocene beds, and that on the left of Miocene and Cretaceo-tertiary marls. These separate ranges were once a part of the same series, but during the times of volcanic activity which closed the Pleistocene period there was a violent uplift along the present valley, followed by a subsidence, and the lake and lakelets are the remains of the changes that then took place. Since then the Heretaunga Plain has been rebuilt, the rivers Tukituki and Waipawa have made a course along a subsiding fracture from Waipukurau, by way of Patangata, and down the valley behind Havelock, into the Heretaunga Plain. All the hill country in the vicinity of the ranges named appears to have been inhabited by numerous moas at the time of the volcanic period, when earthquakes were common and surface changes frequent. The moas were either suddenly destroyed at this time or disappeared from the East Coast district. They were not destroyed by man or any natural enemy, as otherwise their bones could never have accumulated without injury in an area of limited extent and of a particular type. The abundance of bones uninjured and undisturbed shows that the animals must have died suddenly, and were uninjured by man or beast. Further, they were either drowned or destroyed in some way where their bodies were found, or in close proximity. Subsequently their bodies were washed from the hill country into the depressed area by great floods following the volcanic and earthquake disturbances. Thus the moa-bone accumulations in the Te Aute Swamp, as described by Mr. Hamilton, might easily have been brought down from the surrounding hills by heavy floods following a period of great volcanic activity and earth-movements, when vegetation was destroyed either by falling ashes or by poisonous exhalations from the ground such as were experienced at St. Pierre in the West Indies and at Messina in Sicily in times of intense earth-movements.

Mr. Hamilton, in his interesting account,† offers the hypothesis that the spot where the vast accumulations of bones were obtained "was a narrow crossing-place in a swampy forest"; but the discovery of other bones in a spot nearly two miles from the original find, and at the foot of a spur, leads to the conclusion that the birds were fleeing when overtaken by some sudden catastrophe.

The section exposed in the Te Aute Swamp, where Mr. Hamilton made his first find of moa-bones, was in "the cutting of a drain about 15 ft. deep, of which from 8 ft. to 10 ft. was of silt deposit (pumice and washings from the Cretaceous rocks of the district)." These facts all go to suggest volcanic and earthquake disturbances when the moas were living; but the fact that the moa-bones are found associated with *Cnemiornis* (a great extinct goose), with *Harpagornis* (a great extinct eagle), and with *Notornis* (the gigantic rail), as Mr. Hamilton points out, provides additional support to the theory that all these birds were destroyed suddenly when assembled together in the vicinity of the rifts where their bones are found.

And does not the legendary history of the Maori along the East Coast offer a suggestion and an interpretation to the geologist who studies the

* Trans. N.Z. Inst., vol. 21, p. 311.
† Trans. N.Z. Inst., vol. 21, p. 316.

surface features of the country? The sending of hot embers by Rangi in answer to the prayer of Tamatea suggests disturbances and destruction by fire. Along the East Coast and inland, as I have elsewhere indicated,* pumice sands are to be seen varying in thickness from a few inches to many feet, constantly thickening as they are followed to the volcanic area.

The falling of hot pumice and scoria might cause the destruction of most of the vegetation in the country throughout the Island, just as the mud, sands, and pumice did in the vicinity of the Tarawera eruption in the year 1886.

If accompanied by gaseous exhalations from earthquake-rifts such as were common during the later Pliocene and Pleistocene periods, all difficulties vanish in supplying reasonable explanation for the sudden disappearance of the moa, and why skeletons are found in caves and in the open so perfect and complete.

The fossil feather-markings are described in vol. 21 of the Transactions, page 318, from the Ormond pumice-mud deposits, and the footprints of the moa from the several localities show that the pumice was loose and soft when the impressions were made. Associated with these beds are others at Whautaupoko, Ormond, and the Kidnappers, which contain perfect leaf-impressions, representing a great variety of trees and ferns and Lycopods, with numerous fish vertebrates and the fossil feathers. Had man existed at the time, why is there no trace in the shape of footprints, broken bones, stone implements, or other forms of human industry?

The history of the East Coast is complete as a geological sequence, and the sudden disappearance of birds over a wide extent of country under varying conditions of living requires an explanation that carries conviction and is supported by geological evidence. That evidence is forthcoming in the wide distribution of pumice, in the traces of earthquake-rifts, and in the absolute knowledge that volcanic activity was particularly active during a portion of the Pleistocene period. At that time the moas were numerous in the land; they had become widely differentiated; they were found occupying Tertiary and Secondary land-surfaces, and were constant visitors along the East Coast to the warm sands, where breeding appears to have been carried on. They range in vertical space to a height exceeding 3,000 ft. The association of bones of the moa with others whose habits were altogether dissimilar must be explained in a way likely to carry conviction. Native legend tells us of the destruction by fire of the moa. It makes no reference to other birds. Tamatea was the reputed son of Rongokako, to whom reference has already been made with respect to footprints.

These legendary heroes the Maoris dwell upon with pride in relating their ancestry. In times long past the tradition had been received of very large birds having once existed; but they knew nothing as to the kind of bird, and so crude were their ideas on the subject that Polack, Colenso, Taylor, and others could obtain no single fact on the subject.

Does not this suffice to show the utter ignorance among the Natives concerning the bird that was called "moa," "movie," and so on? The Natives from whom Polack first obtained his legend had never seen the bird as described by them. They were unaware of its having dwelt on the coast sands: they stated it lived at Ikorangi, a mountain far in the interior, in one instance; at Whakapunake, in another instance; and Colenso was

* Trans. N.Z. Inst., vol. 20, p. 293.

told the moa was in the Te Wai-iti Mountains, whilst White, in his "Ancient History of the Maori," says the last moa was killed at Waipukurau! All these tales suffice to show the uselessness of describing the moa as having disappeared during the last century. The middens suffice to the contrary. The swamp areas show a long period of slow growth that must be counted by centuries, and the caves wherein so many complete skeletons of moas have been found suggest that they were sealed by pumice or other volcanic material centuries ago.

From these remarks it will be noticed that the East Coast district provides no evidence in support of those who contend that the moa has only recently disappeared from the country, and this by the hands of Maori hunters. In vol. 24, page 169, of the Transactions the late Professor Hutton concludes his able paper "On the Moas of New Zealand" thus: "In the North Island we have at Wanganui and near Whangarei undoubted proofs that the ancestors of the present Maoris killed and ate moas . . . and we must conclude that the moa was exterminated not long after their arrival in New Zealand." In vol. 15 there is a paper on "Moa and Moa-hunters," by A. de Quatrefages, translated from the French by Laura Buller, and it concludes as follows: "It is therefore clear that, far from being too bold, I had underestimated the time of the disappearance of the moa in carrying it back so far as the end of the last century."

On the other hand, the late Sir Julius von Haast (vol. 4, p. 91) gave it as his opinion that "the moa owed its destruction to a different race and period to the Maori race in New Zealand"; whilst the Revs. William Colenso, F.R.S., and James Stack, Major Mair, Colonel Porter, and many others affirm that the moa was a traditional something—bird, or man, or atua—in the early days, when the bones found on the banks and in the beds of rivers began to be sought after by the early missionaries and settlers. The geological facts brought forward by me dealing solely with the East Coast throws back still further the time when the moa disappeared.

The history of the moa is the history of a race of birds that disappeared long anterior to the coming of the Maoris to New Zealand. It belongs to the later Pleistocene period rather than the Recent—to the period of intense volcanic activity, the period of great earth-movements and earth-breaks, when birds that flew congregated with birds that ran, birds herbivorous with birds carnivorous, in their efforts to escape from the destructive effects of dust and ashes and poisonous vapours that were spread broadcast over the land, and from the great floods that followed in their wake. The birds, in their efforts to escape, made for the uplands, some seeking shelter in caves, some amidst the fallen and broken rock, and some reaching the open lands and the topmost hills. All died suddenly; nor was there an enemy left, man or beast, that could use the flesh or bones of the thousands of dead birds that were destroyed. Those that sought shelter in the caves died like those in the open, and each entrance to them was sealed by the falling pumice or loose debris near by. Those on the hills were washed down into the newly formed earth-breaks with pumice and dust to testify as to their mode of destruction and their mode of preservation. The history of the moa is the history of a long past. It reaches back to the legendary history of the Maori race, to the time when the South Island was peopled by giants who could stride from mountain-range to mountain-range, could swallow up rivers, and transform themselves into animate or inanimate nature, as told in White's "History of the Maori," vol. 3, p. 191. The history of settlement in the North Island has the same legendary basis, and the moa

was just as legendary among the Maoris of this Island as was, and is, the story of those wonderful men like Rongokako, Tamatea, and Rangi, and scores of others, who were able to perform such wonders and exploits, according to Maori tradition.

The following table gives particulars of moa-remains found in New Zealand :—

Places and Locality.	What found.	Remarks.
1. Wainui–Herbertville	Full skeleton, many bones, shells	Sandhills south of Herbertville, Cape Turnagain. Would repay further search. D. Munro and H. H.
2. Wimbledon ..	Many bones, imperfect skeleton..	Taylor White and others.
3. Ormondville ..	Odd bones, mostly leg-bones ..	In caves near river. H. H.
4. Paroa–Ngapaeruru	Skeleton, top of limestone hill, 2,000 ft., dense bush.	Have seen bones. H. H. Messrs. Holden and Fletcher.
5. Mangatoro Valley..	Three skeletons (nearly complete) in cave, 1,400 ft. above sea-level	Mr. John Wright, Coonoor, Mangatoro Valley.
6. Palmerston North..	Moa-footprints	Mr. Gilberd, H. H. (Trans. N.Z. Inst., vol. 27, p. 476.)
7. Waimaramara beach sands	Half an acre of bones	A. Hamilton, H. H. (Trans. N.Z. Inst., vol. 21, p. 313.)
8. Otane	Well-sinking at school, 18 ft.; tarsal bone	Mr. Garry, at school. Young bird.
9. Te Aute Swamp ..	Many skeletons; innumerable bones; excellent preservation. Many other birds	See Hamilton's paper (vol. 21). Have visited the locality and collected specimens. Mr. Williams, Te Aute, possesses large bone specimens. Napier Athenaeum specimens. Mrs. Ellison and H. H.
10. Anaroa	In Mason's caves, north-west Te Aute	Have obtained several specimens. H. H.
11. Havelock North ..	Skeleton of moa, 800 ft. ..	Colenso (vol. 12).
12. Kaokaoroa Valley, in Havelock district	,, ,, ..	Mr. Joseph Price.
13. Maraekakaho ..	Tibia, 30 in. long	Mr. Lockie, Maraekakaho Station; 1912.
14. Napier	Footprints, Reservoir, Lighthouse Road	Mr. R. Lamb, H. H.; 1887.
15. ,, ...	Many bones, near Drill-shed ..	A. Hamilton and H. H.; 1886.
16. ,, ...	Shakespeare Road, several bones	Mr. Errol, F. W. Williams, and H. H.; 1912.
17. Petane	Egg-shells and bones	F. W. Williams, A. Hamilton, and H. H.; 1884–90.
18. Pohue	Several skeletons, humeri, pelves, &c.	Mr. Crawford, Mr. King, and H. H.; 1890 and onward.
19. Tarawera (50 miles north-west of Napier)	Several leg-bones, tibia, femora; 2,000 ft. above sea-level	Mr. Cropp, Postmaster. Have examined these. Were washed from hilltop during a heavy flood.
20. Pakipaki ..	Numerous bones in road-cuttings	A. Hamilton and H. H.; 1890.
21. Hawkestone, near Puketitiri	Numerous bones, skull, sternum..	T. Hallett, H. H.
22. Waihua, Mohaka ..	Tibia-bones and other bones exposed in cutting on roadside	Mr. Guthrie-Smith. Sent to Wellington.
23. Mohaka, on Wairoa Road	Numerous large bones exposed after blasting on roadside	Bishop Williams, Albert te Kati; 1886.
24. Marumaru caves ..	Many bones, skulls	Mr. Beckett and H. H.; 1906–8.
25. Te Reinga (shingle conglomerate)	Fossil femora in conglomerate, 900 ft. above sea-level and 50 ft. in conglomerate	J. Ramlose, H. H.; 1912.

Places and Locality.	What found.	Remarks.
26. Waikaremoana ..	Numerous skeletons, reserves of hills and dry bush	J. Goodall, Rosie Bay; 1912. A. Adams, J. McGrath; one mile from accommodation-house.
27. Nuhaka	Skeletons, many bones, shells; sea-beach	A. and H. Hamilton, H. H.; 1910.
28. Mangaone Valley, near Nuhaka	Shells, skeletons, &c.; in caves 500 ft. above sea. Old and young bird bones	H. Hamilton and H. H.; 1906–12.
29. Opoutama, Te Mahia	Bones, shells	H. H.; 1910.
30. Gisborne.. ..	Fossil footprints, bones; numerous since 1839	Bishop Williams, sen.; 1878. H. H.; 1879. Bones since 1839 onward.
31. ,, ...	Many bones at Tua, Muto swamp, near island	H. H.; 1880.
32. Wainui beach ..	Many bones, egg-shells; on beach, lower sands	Many persons have collected specimens for years.
33. Ormond	Shells fossilized and bones in railway cutting and river-bank	Mr. Chambers and H. H.
34. Pakarae	Shells, bones; next depression ..	H. H. Collected for a number of years.
35. Hikurangi Mountain	Number of moa-skeletons, caves, lower range, 3,000 ft.; numerous bones in Waiapu River	Mr. Watkins; 1912.
36. Waiapu, East Cape, near mouth of river	Bones first obtained in 1839 ..	See map.
37. Matawai, Motu ..	Caves in hills, 3,000–3,300 ft.; numerous bones. More exploration desirable	Mr. McKenzie and H. H.; 1912–13.

The map I have prepared (p. 331) shows the different places where traces of the moa are personally known by me, and as stated in the accompanying tabulation. There may be others with which I am not acquainted, but this can be entered later. Similar maps might be prepared for other districts by those who are interested in the subject, and similar inquiries pursued with a view to arriving at a correct knowledge of the life-history of the moa.

The map also shows—(*a*) Polack's locality for trade, 1834–37; (*b*) Rev. William Williams's visit to Te Mahia, 1834; (*c*) journey of Rev. William Williams and Rev. W. Colenso, 1838–39; (*d*) journey of Rev. William Williams and Rev. Mr. Taylor, 1839; (*e*) journey of Rev. William Colenso, 1841–42.