has the advantage that the induced current received is instantaneous instead of being a gradually increasing amount, as when no condenser is used.

There are other advantages arising from the use of condensers. They prevent earth currents from entering the cable. One part of the earth's surface may differ very considerably from another part in regard to the amount or potential of the electricity there. If these places are connected by a wire an electric current will traverse it. These currents sometimes interfere with the working of the telegraph where the line is not fitted with condensers. A faulty cable may be used for a long period by being insulated with condensers. If the fault is considerable enough to allow sea-water to penetrate to the copper, we have all the essentials of a galvanic cell—two metals (copper and the iron sheathing) in a saline solution. The effect is to corrode the copper, and thereby make the cable useless. When condensers are used the faulty cable may be permanently connected to the zinc pole of a battery at the shore station, whereby a negative current passes out at the fault. The water there is decomposed, hydrogen gas being evolved, and the cable is preserved from injury.

Ruptures of the cables across Cook Strait and the fitting of a cable-repairing ship by our Government remind us of the expense the proprietors of telegraph cables may be put to in keeping their lines in proper repair. On the whole, while our subject is of the keenest interest to the student and the scientist, the results of the various enterprises are often unsatisfactory to those who have invested their money. It has been proposed to lay a cable across the Pacific to unite these Australasian Colonies with British North America. I venture to think this most desirable in the interests of the British Empire as a whole.

ART. XXXIX.—*Have we the Remains of a Swimming Swan-like Moa?*

By TAYLOR WHITE.

[*Read before the Hawke's Bay Philosophical Institute.*]

IN *Nature*, published on the 8th April, 1897, at page 534, is a letter by Professor O. C. Marsh, of Yale University, New Haven, Connecticut, dated the 16th March. This communication is of great interest, especially to those who, like myself, take pleasure in searching the past history of those

wonderful birds the *Dinornidæ*, or moas. Professor Marsh claims to have been the first to notice and place on record the finding of the fossil remains of "a carnivorous swimming ostrich," which he named *Hesperornis regalis*.

In this paper I wish to draw the attention of our New Zealand scientists to the evident possibility that in this country, which was the last harbour or retreat of many distinct and peculiar varieties of those struthious birds (the moas), seemingly descendants of those escaped alive to the mountain regions of a large southern continent (now sunken below the ocean wave, carrying with it the records of ages of reptilian and avian life), there may exist records which, if available to human research, would assist man to work out the problem of the succession of animal life.

New Zealand was, as it were, the last great stronghold of the moa. There were many kinds, each differing in size, bulk, and the colour of the feathering, but each kind having the struthious or bipinnate feathering on certain parts of the body. This would lead us to infer that if at any time in the existence of life on our world—no matter if it be in a far country—there is proof that a swimming ostrich once lived and propagated its kind, then we may reasonably expect to meet with the signs of an aquatic moa in the land which was their latest place of refuge; for the moa lived almost down to the time of European occupation, and I have myself seen its bones lying on the surface of the ground in a fair state of preservation.

In New Zealand have been found the remains of a large bird having anserine characteristics, a bone from which was at first thought by Sir Richard Owen to be that of a new form of struthious bird, and of a genus "hitherto unknown to science," for which he proposed the name of *Cnemiornis calcitrans*.

Some two years ago, when looking through Tregear's "Maori-Polynesian Comparative Dictionary," I noticed the Maori word "*tarepo*," said to be "the name of *Cnemiornis calcitrans*, a bird probably now extinct." On looking up the meaning of "*calcitrans*" ("kicking with the heel," a truly moa-like way of treating an opponent), I began to think that this was a native word distinguishing one species of moa from its congeners; but, on referring to Sir Walter Buller's "New Zealand Birds" (page 26 of the introduction), I found the following: "Following this came the discovery by Sir James Hector of the remains of an extinct goose of very large if not gigantic proportions, and undoubtedly flightless. This proved to be the bird for a few detached bones of which Professor Owen [as mentioned already] proposed the name of *Cnemiornis calcitrans*. The first tolerably complete skeleton

of this anserine form, which was certainly contemporaneous with the colossal moas, was obtained by the Hon. Captain Fraser in the Earnscleugh Caves, and was afterwards presented by him to the British Museum."* Taking into consideration that Sir Richard Owen was clearly at first sight of opinion that the parts of this species which he had under examination showed moa-like peculiarities, and comparing this circumstance with Mr. Marsh's letter, we may, I think, safely infer the probability that *Cnemiornis* was a swimming, or swan-like, moa.

In the Chathams Mr. H. O. Forbes found "thousands of swan-bones" on the site which was pointed out as the spot where the Moriori in olden times killed and cooked the great bird poua. May not this bird have also been a swan-like moa? We are naturally surprised at the total extinction by primitive means of a bird having the sagacity and great powers of flight possessed by the swans. Moreover, Mr. Forbes had previously discovered the remains of a swan intermixed with moa-bones and shells, the refuse thrown by the occupants of a cave at Sumner towards the mouth of the cave after each primitive repast. I have felt surprise at not having heard further details or remarks by Mr. H. O. Forbes or others on these swan-like birds of New Zealand and the Chathams. No doubt we shall hear more about them soon, interest therein having been revived owing to the finding of this swan-like moa in America, actually "with the feathers in place" and of the true struthioid character.

Within the last thirty years or so the Australian black swan (*Cygnus atratus*) has been introduced into New Zealand, and it is increasing and spreading over the whole country wherever an expanse of water is found, even at Waikaremoana, "the lake of rippling water," in the so-called "King-country," which has only recently, by permission of the native owners, become accessible to the European. And now man, with the assistance of all the arts of gunnery and other devices, could not possibly exterminate the black swan in New Zealand. How, then, did the original inhabitants of this country exterminate the swan indigenous to the land? The swans are birds of the present time, and their tenure of existence is by no means "played out." I would suggest that the reason of the extinction of the swan-like birds of New Zealand will be found in their being flightless, and consequently they and their eggs were easily obtained by man, the ruthless destroyer.

* See also Trans. N.Z. Inst., vol. vi., p. 76, pls. x.–xiv.A, "On *Cnemiornis calcitrans*, Owen, showing its Affinity to the *Lamellirostrate natatores*," by James Hector, M.D., F.R.S.

Mr. John White, in his "Ancient History of the Maori," in describing how the Maori hunted the moa, according to their tradition thereon, tells us that warriors were stationed along the side of the paths leading through the scrub bushes armed with spears, and that the birds were then *driven from the lakes* and speared by those in ambush. We may well ask what the moa was doing, living at, or on, the big waters.

The name "*ta-repo*" would mean "one belonging to, or about, *repo* (the swamp)," a very suitable name for a swan-like moa. Mr. Tregear does not state his authority for connecting *tarepo* and *Cnemiornis calcitrans* together, which is to be regretted. Possibly the authority is to be found in one of the earlier volumes of the "Transactions of the New Zealand Institute."

The following is an extract from *Nature* of the 8th April, 1897, at page 534:—

"*The Affinities of* Hesperornis.

"In the autumn of 1870 I discovered in the Cretaceous formation of Western Kansas the remains of a very large swimming-bird, which in many respects is the most interesting member of the class found living or extinct. During the following year other specimens were obtained in the same region, and one of them—a nearly perfect skeleton—I named *Hesperornis regalis*.* . . . The results of this and other researches were brought together in 1880 in an illustrated monograph.†

"In the concluding chapters on *Hesperornis* I discussed the affinities of this genus based upon a careful study of all the known remains. Especial attention was devoted to the skull and scapular arch, which showed struthious features, and these were duly weighed against the more apparent characters of the hind limbs, that strongly resembled those of modern diving-birds, thus suggesting a near relationship to this group, of which *Colymbus* is the type.

"In summing up the case I decided in favour of the ostrich features and recorded this opinion as follows: 'The struthious characters seen in *Hesperornis* should probably be regarded as evidence of real affinity, and in this case *Hesperornis* would be essentially a carnivorous swimming ostrich.' ('Odontornithes,' page 114.)

"It is an interesting fact that this decision is now on record a quarter of a century after the discovery of *Hesperornis*, and a decade and a half after its biography was

* *American Journal of Science*, vol. iii., p. 56, January, and p. 360, May, 1872.

† "Odontornithes: a Monograph of the Extinct Toothed Birds of North America," 34 plates, Washington, 1880.

written in the 'Odontornithes'; its true affinities, as recorded in that volume, are now confirmed beyond dispute. In the same region where the type specimen was discovered a remarkably perfect *Hesperornis*, with feathers in place, has been found, and these feathers are the typical plumage of the ostrich."*

Dr. R. W. Shufeldt has a letter in *Nature* of the 13th May, 1897, in which he attacks Professor Marsh's theory of the struthious affinities of *Hesperornis;* but in saying "that *Hesperornis* possessed some kind of a plumaceous plumage, however, I long believed, and see no reason to change that opinion now," Dr. Shufeldt has supported my contention that the poua and *Cnemiornis* carried a covering of feathers resembling those of the moa, and so had no powers of flight. Certain of the moas had a considerable portion of their feathers, especially those on the breast, well covered with a fine down, and this down would be greatly impervious to water and buoyant, owing to the air entangled therewith, and would not by any means be such an unsuitable protection to an aquatic bird.

To quote again from the same writer, "Professor Marsh is not the only writer that has been led astray in some parts of avian classification by employing what have been called 'struthious characters' in avian osteology, and now he thinks his views are supported by the recent discovery of Williston, referred to above. Having carefully examined the published plate of the latter author, I must say that I am quite sceptical as to what he believes to be long tarsal feathers (leg-feathering) in *Hesperornis*. Surely in the figure the resemblance to feathers is very remote; and, quite as surely, long drooping plumaceous feathers hanging down to the feet in a big powerful diver would in no way whatever assist it in either swimming or diving. . . . Plumaceous plumage was very likely far more prevalent among the earliest birds in time than it is now among modern types, and this applies absolutely to not a few characters in the skeleton. The latter, along whatever line we may trace them, are evidences of an approach reptilewards, and by no means point to struthionine affinity. Certain peculiarities of the pelvis and at the base of the cranium, when associated with certain others, have, as I say, been unfortunately termed 'struthious characters,' and, with this mistaken idea operative, our more superficial avian anatomists can see but little beyond 'ostrich' in either *Finamon* or *Apteryx*. . . . There is no more ostrich in *Hesperornis* than there is diver in *Struthio*."

* Williston, "Kansas University Quarterly," vol. v., 53.

Whether or no, Dr. Shufeldt would seem to be of the same opinion as myself—viz., that where you find birds of an early and primitive type it is reasonable to expect their feathers to resemble more or less those which we have found were carried by the moas. I would therefore warn collectors of so-called moa-feathers which may possibly be discovered at some future date to consider the claim of poua and *Cnemiornis* as likely one-time owners of somewhat similar feathers, and not to connect all such with the moas only.

Art. XL.—*Moa and Toa—the Bird and the Tree.*

By Taylor White.

[*Read before the Hawke's Bay Philosophical Institute.*]

In vol. xxv. of the "Transactions of the New Zealand Institute" Mr. Edward Tregear gives a very interesting paper on the etymology of the word "moa," which he maintains to be nothing more nor less than the Polynesian name for *Gallus domesticus*, the domestic fowl. That this bird, so useful to mankind, may be said to be the bird *par excellence* of the Britisher we must all allow, for has it not, as time passed on, monopolized three main words in the English language—that of "fowl," or the bird, and the designation for male and female in those of "cock" and "hen"?* That the fowl has also proved as great a boon to the inhabitants of Polynesia I do not doubt, but I am of opinion that first a large struthious bird was known to the people of Polynesia under the name "moa," possibly before these people came to the further isles of the Pacific, and that after having left the lands where these great birds were found some of the Polynesians became possessed of the domestic fowl, and gave the now traditional word "moa" to their new acquisition. But the time when the fowl was brought to the islands was some time after the Maori came to New Zealand, and the Maori was totally unacquainted with *Gallus domesticus*.

When the Maori of the later migrations reached New Zealand they found various large struthious birds still living in that country, but which were almost exterminated by another

* Captain Cook brought the fowl to New Zealand, say, fifty years before the pakeha missionary questioned the Maori as to the name for the large bones found lying about, and the answer was, "They belong to the moa, and those gizzard-stones are moamoa." Is the hen also called "moa"? for we see that word was not forgotten; and why not?