No. Title

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Judicio perpende: et si tibi vera videntur
Dede manus: aut si falsum est, adcingere contra.

—LUCRETIUS.

The NEW ZEALAND JOURNAL OF SCIENCE was first published just nine years ago and after an existence of four years, its publication was suspended until better times should dawn on the Colony. The causes which led to the discontinuance of the periodical were stated in the last number, that of November, 1885. These causes may again lead to the suspension of the present issue, but we trust that by the exercise of a more severe economy in management, all expenses but the most necessary will be eliminated, and thus the Journal will be kept going as long as a minimum number of subscribers can be got. As was stated in the circular sent out on 1st November, 1890, there is no margin of profit in the publication of such a periodical, unless the subscribers are far more numerous than past experience leads us to expect. Should, however, the number of subscribers exceed our anticipations, then the size of the publication will be increased, and we may even hope to resume illustrations. As we have no machinery for the collection of subscriptions, it must be understood that all subscribers are expected to pay in advance, as on no other plan can the venture be carried out.

As regards the lines on which the publication will be conducted, past experience may supply a few hints. It is intended, as far as possible, to exclude all purely technical matter such as descriptions of species, &c., except where brief details may be introduced descriptive of authors' papers. Where it is desirable to give information on purely technical papers relating to New Zealand, the attempt will be made to obtain simple and concise abstracts. It is hoped that all scientific papers relating to this colony, or containing matter of special interest in this part of the world, will be brought under the notice of the Editor. Notes on Natural History, Acclimatisation and kindred subjects ought to bulk largely in such a periodical. We should also like to see our columns made use of for the discussion of scientific methods in mining and other applied arts, which are of immense use in a colony like this.

It may be asked: What is there in the signs of the times which should lead to greater anticipations of success than in 1882? We reply that in view of the recent formation of the Australasian Association for the advancement of Science, and the fact that its meeting this season is to be held in New Zealand, the time seems opportune for reviving the Journal. Such a gathering of scientific men in these islands, can hardly fail to excite a spirit of renewed activity among some whose interest may be flagging.

Every year there will probably be a more and more determined attempt to cut out of the annual Parliamentary estimates of this colony the small vote which secures the publication of the Transactions of the New Zealand Institute. The class of men who are being returned by many of the constituencies can hardly be expected to do anything to foster an institution regarding whose aims and benefits they can only have the haziest ideas, beyond that it is mainly supported by men who are *not* of their class. Unfortunately there is but little cohesion among the different branches of the Institute, beyond what is secured by their belonging to a central governing body in Wellington. Now a periodical like the Journal of Science should furnish just such a means of communication between the societies affiliated to the Institute as would serve to bind them together and bring them more into touch with one another. It is hoped, therefore, that these Societies will do what lies in their power to foster the Journal.

During the former period of its existence the publication was conducted at the sole risk of one individual. On the present occasion the attempt has been made to interest a larger number of persons in the venture, and it is gratifying to record that the following gentlemen have undertaken to act as sponsors for the new issue:—

A. S. Atkinson, Nelson; F. R. Chapman, Dunedin; Chas. Chilton, Port Chalmers; J. D. Enys, Castle Hill, Canterbury; Dr. T. M. Hocken, Dunedin; Professor Hutton, Christchurch; R. M. Laing, Christchurch; Jas. McKerrow, Wellington; S. Percy Smith, Wellington; and G. M. Thomson, Dunedin.

It now rests with those who take an interest in matters scientific, to see that they do their part to back the efforts of these gentlemen, and make the New Zealand Journal of Science a success.

ON THE HISTORY OF THE KIWI.*

BY PROF. T. JEFFERY PARKER, F.R.S.

The precise history of any existing animal or plant is extremely difficult to get at and can only be known with certainty by the discovery of a complete series of fossils linking it to the extinct ancestral form from which it sprang. Naturally such complete histories are among the rarest of biological triumphs, and even partial histories such as we have of many of the Mammalia are only obtainable in very favourable cases. As a rule we have to depend upon the evidence afforded by anatomy and embryology.

Anatomy is an exact and most valuable guide to affinity, especially between closely allied forms, but no truth has been more abundantly proved by recent research than that results obtained by

*This article is a semi-popular abstract of my paper "Observations on the Anatomy and Development of Apteryx," shortly to be published in the Philosophical Transactions.

this method must be tested and corrected at every point by the study of development: it is impossible to understand thoroughly the structure of any species or of any organ until we know something of its becoming. As the organism develops from the simple egg-cell to the complete adult, it passes rapidly through stages corresponding in a general way to those which its ancestors passed through in the course of their evolution, during long ages, from some simple unicellular form, and it is the recognition of this principle—that individual is a recapitulation of ancestral development—that has given to embryology so important a place in modern biological work.

The Kiwi—including under that name the four species of the genus Apteryx—is the most anomalous and aberrant of existing birds, and, living as it does only in the three islands of the New Zealand group, may be considered as one of the proudest possessions of our colony.

Apteryx is sharply distinguished from all other birds by the position of the nostrils which are at the tip of the long beak instead of near the base. It is also remarkable for its small eyes and its wonderfully perfect olfactory organs, all other existing birds having large eyes and a comparatively poorly developed organ of smell. The eye, moreover, differs from that of all known birds in being devoid of the *pecten*, a plaited process of the choroid coat which extends from near the entrance of the optic nerve to the back of the crystalline lens.

The Kiwi is placed, along with the Ostrich, Rhea, Emu, Cassowary and Moa, in the sub-class Ratitæ, all other existing birds being included under a second sub-class Carinatæ. The distinctive characters of these two groups may be very briefly summarized and are, for the most part, connected with the power of flight possessed by the great majority of the Carinatæ and the absence of that power in the Ratitæ, which are without exception terrestrial birds with extremely small and insignificant wings—quite incapable of raising their usually bulky bodies from the ground.

1. In Ratitæ the feathers are evenly distributed over the body: in Carinatæ they usually spring from well defined feather tracts separated from one another by featherless spaces.

2. In Carinatæ there are large tail-feathers or rectrices arranged in a semicircle around the blunt tail proper or uropygium ("parson's nose"): in Ratitæ there are no well defined rectrices.

3. In Carinatæ the barbules of the feathers are bound together by means of microscopic hooklets so that the whole vane of the feather forms a coherent membrane: in Ratitæ there are no hooklets, the barbules are therefore disconnected and the feathers have a downy or more or less hair-like appearance.

4. In Carinatæ the breast-bone is a large transversely curved bone provided with a keel for the attachment of the pectoral muscles: in Ratitæ the sternum is usually flat and never has a keel.

5. In Carinatæ the scapula and coracoid—the two chief bones of the shoulder-girdle—are large and set to one another at an angle which is usually acute though it may rise to 106°. There is nearly always a furcula or merry thought attached to a process of the scapula called the acromion and to two processes of the coracoid, the acrocoracoid or clavicular process and the procoracoid process. In the Ratitæ the coracoid and scapular are small, fused together into a single bone, and their long axes make an obtuse angle: the furcula is either absent or greatly reduced and the acromion, acrocoracoid, and procoracoid processes are reduced to mere insignificant tubercles.

6. The quadrate, or bone by which the lower jaw articulates with the skull, has a double head in Carinatæ, a single head in Ratitæ. As it is single-headed also in embryo Carinatæ this character is usually held to indicate the more primitive position of the Ratitæ.

7. In Ratitæ the hinder ends of the pterygoid bones of the skull articulate with a pair of large basi-pterygoid processes which spring from the body of the basi-sphenoid bone: in Carinatæ the basi-pterygoid processes are small, spring as a rule from the base of the rostrum of the basi-sphenoid, not from the body of the bone, and articulate with the pterygoids some distance from their posterior ends.

8. The vomer of Ratitæ is a large broad bone: in Carinatæ it is usually small.

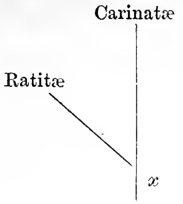
Zoologists are agreed as to the origin of birds from some kind of reptilian ancestor, but there are many differences of opinion as to the relations of the two sub-classes. The older ornithologists considered the whole of the Ratitæ as an order (Cursores) equivalent not to the whole of the Carinatæ but to one of its subdivisions, such as Passeres, Gallinæ, &c. The view now generally adopted is that the Ratitæ include several orders, each of which, although containing only one or two genera, is the zoological equivalent of an entire order of Carinatæ. This view is taken by, *inter alia*, Prof. A. Newton (Encyc. Brit., Art. Ornithology) and Prof. Fürbringer whose learned and colossal work on the Morphology and Classification of Birds has brought the results of all former workers to a focus and has provided the student of the group with a critical summary of the entire subject such as has never been attempted before.

Taking, then, the Ratitæ and Carinatæ as fairly equivalent groups the question arises what is their relation to one another? There are three views taken by modern writers on this matter.

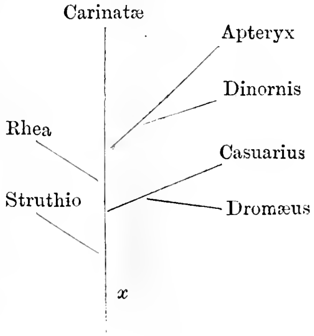
1. The Ratitæ represent an ancient type of birds derived from flightless reptilian ancestors. According to this view the progenitors of the group have never possessed the power of flight, and their relations to the Carinatæ may be expressed diagrammatically as follows:—

The power of flight may be supposed to have been acquired at the point x.

2. The earliest birds were able to fly: from them were descended (a) the Carinatæ in which the power of flight was retained, and (b) the Ratitæ in which it was lost in the course of evolution, the assumption of a purely cursorial mode of life being accompanied by degeneration of the wings and other parts connected with the function of flight. This view is illustrated by the following diagram, x again representing the point at which aerial progression began:—



3. The third hypothesis is a modification of the second. It also supposes that the earliest birds could fly and that the Ratitæ arose from these, their organs of flight becoming degenerate; but instead of supposing a single group to arise in this way and afterwards, by divergence of characters, to split up into the various forms of Ratitæ now existing, it assumes that each of these groups arose separately from primitive flying birds. Thus while hypotheses (1) and (2) ascribe a single or monophyletic origin to the Ratitæ, hypothesis (3) imagines them to have had a multiple or polyphyletic origin. The following diagram—taken from Fürbringer's elaborate "Stammbaum,"—expresses this theory, x having the same significance as before:—



I propose to give a brief account of the salient points in the development of the Kiwi, pointing out their bearing upon the three theories just enuntiated.

In the earliest stages, as might have been expected, there is little of importance to record, the resemblance to ordinary birds being very close. One interesting point must, however, be mentioned, although it has no bearing upon the origin of birds. In a stage corresponding with a chick of about the sixth day of incubation there is a distinct operculum or gill-cover extending back from the hyoid arch over the 2nd and 3rd visceral clefts. As far as I am aware no such structure has been found in any vertebrate animal above the Amphibia.

The feathers first make their appearance when the embryo is about 60 mm. long and corresponds in its general characters with a chick of the 8th–9th day. They do not appear evenly all over the body, but as a comparatively narrow tract along the middle of the back and afterwards spreading on to the thighs. Later a tract appears on each side of the belly and smaller tracts on the wings, all being separated by well marked featherless spaces. Even in the adult the most important of these spaces can be traced.

In the adult there is a loose fold of skin on the anterior border of the wing between the upper arm and the fore-arm, and a similar fold on its posterior aspect between the upper arm and the body. These obviously correspond to the alar membrane so characteristic of ordinary birds. Moreover the adult has a well-marked series of wing-quills covered by regularly arranged upper coverts.

These facts certainly seem to indicate that the ancestors of the Kiwi had the interrupted pterylosis or feather-arrangement characteristic of Carinatæ, and that their fore-limbs were true wings.

A minor circumstance which appears to point to the same conclusion is the fact that a sleeping Kiwi assumes precisely the same attitude as an ordinary carinate bird, the head being thrust under the side feathers between the body and the upwardly-directed elbow.

The development of the wing and of the parts in connection with it is also interesting. At an early stage the fore-limb ends in a three-toed paw, the digits represented being the 1st, 2nd and 3rd: later on the 1st and 3rd digits cease to grow and the fore-limb assumes the form of an ordinary bird's wing with a greatly elongated second digit and small first and third digits. Still later the 1st and 3rd digits disappear as distinct structures and the wing becomes the small one-fingered organ characteristic of the adult.

The skeleton of the wing shows similar changes: at first there are five distinct carpals and three metacarpals. As growth goes on the carpals of the lower or distal row unite with the 2nd and 3rd metacarpals, exactly as in existing birds. The upper or proximal carpals may either unite with the carpo-metacarpus thus formed or may remain distinct. All these facts seem to indicate that the fore-limb of Apteryx has passed through a stage in which it was a true wing.

The sternum or breast-bone of ordinary birds is a large keeled bone, placed almost horizontally: that of the Kiwi is flat and has a vertical position. In a young embryo, however, the cartilage from which the breast-bone arises is almost horizontal, and in three adult specimens I have found a low median ridge, obviously the vestige of a keel.

In Carinatæ the coracoid takes an oblique position while in Apteryx it is vertical: in an embryo shortly before the appearance of the feathers the coracoid is obliquely placed, the vertical position being gradually assumed at the same time as that of the sternum.

Moreover there are distinct vestiges even in the adult of the acromion, acrocoracoid, and procoracoid processes, and the coraco-scapular angle sometimes sinks as low as 122°, although it may rise to 150°. As in some of the Carinatæ this angle is as much as 106°, the gap between the two groups becomes comparatively slight.

Further evidence in the same direction is furnished by the muscles of flight. The elevator of the wing (subclavius) arises from the coracoid and passes over the acrocoracoid process to reach the dorsal aspect of the humerus exactly as in Carinatæ.

The most characteristic feature in the brain of birds is the position of the optic lobes which lie, not on the dorsal surface as in other Vertebrata, but one on each side. In Apteryx, in accordance with the small size of the eyes, the optic lobes are greatly reduced in size and are situated on the base of the brain. It is interesting to find that in young embryos these lobes are situated on the upper surface and in close contact with one another, exactly as in a reptile: at about the time when the feathers appear they separate from one another and pass one to each side of the brain, precisely as in ordinary birds: finally as the end of incubation is approached they diminish immensely in proportional size and come to lie on the under surface.

It has been mentioned that the Kiwi is the only bird in which the eye is devoid of a pecten. This peculiarity only applies in strictness to the adult: in advanced embryos a small but distinct pecten is present.

The vertebral column and the hind limb of Apteryx are those of a perfectly typical bird—more typical indeed than those of many Carinatæ, for instance the Penguins. The pelvis is also strictly avian although simpler than that of most birds.

So far, then, the structure and development of Apteryx seem to indicate that the ancestors of this extraordinary member of the class were typical flying birds, having interrupted plumage, a keeled sternum placed horizontally, a shoulder girdle of the usual avian character, and true wings, *i.e.* fore limbs in which the hand has only three digits, the distal carpals are fused with the metacarpals, and the air-resisting surface is furnished by regularly arranged feathers.

It still remains to say something about the structure of the skull, which in certain respects is quite unique, presenting characters met with in no other bird.

In the skull of any bird except the Kiwi we notice three chief regions; the rounded brain case behind, the narrow pointed beak in front, and between these the orbital region consisting of the two immense eye-sockets separated from one another by a vertical plate of bone called the inter-orbital septum. This corresponds to the bone of the mammalian skull known as the pre-sphenoid, and its peculiar character in the bird is due to the enormously developed eyes encroaching upon surrounding parts and squeezing the intervening portion of the skull into a flat plate. In the hinder portion of the beak are contained thin scroll-like bones, the turbinals, very much smaller than the corresponding bones in the skull of a mammal and lying altogether in front of the eyes. In the entire head they are covered by delicate mucous membrane to which the olfactory nerve is distributed and therefore constitute the organ of smell. Lastly the external nostrils are situated at a considerable distance from the pointed end of the beak.

In the Kiwi two striking changes have taken place simultaneously. The eyes, undergoing a gradual diminution in size, have retreated from the median plane, a considerable space being left between them and the presphenoid. At the same time the turbinals have enlarged immensely, and, extending backwards, have filled up the space between the presphenoid and the eyes, actually reaching as far back as the posterior boundary of the latter. Thus the skull of Apteryx differs from that of all other birds, firstly in the small size of the orbits, and secondly in having those cavities separated from one another not by a thin inter-orbital septum, but by a spongy mass of bone formed by the posterior portion of the turbinals.

The turbinals are as complete as those of a dog, and are divisible into two regions, a hinder olfactory region covered by a delicate single layer of epithelium and supplied by the olfactory nerve, and an anterior respiratory region covered by a many-layered horny epithelium and supplied by the fifth nerve. Up to the middle of incubation the whole of the respiratory region of the nasal chamber is filled up by a solid mass of epithelial cells so that there is no passage to the exterior by the nostrils.

In early embryos the form of the head and the position of the nostrils is normal, but soon after an undoubted bird-form is assumed the nostrils are found to have their final position at the end of the beak. By this time the turbinals are already large but do not extend so far back as in the adult.

As in Carinatæ the quadrate in its earliest stages articulates with the skull by a single head, but in the advanced embryo the articulation becomes distinctly double, one facet coming in contact with a cartilaginous socket furnished by the prootic, another by a perfectly distinct socket furnished jointly by the alisphenoid and the squamosal. The single-headed character of the quadrate is thus shown to be a secondary and not a primitive character. Even in the adult the head shows an indistinct separation into two surfaces.

(To be continued.)

ON THE BREEDING HABITS OF THE EUROPEAN SPARROW *(Passer domesticus)* IN NEW ZEALAND.*

BY T. W KIRK, F.R.M. & L.SS., (Lond.)

The author stated that he had been for some years collecting evidence on the sparrow question in New Zealand. He divided the subject into various sections, but remarked that, as there was not yet sufficient reliable evidence to hand, on which to form an unbiassed judgment, as to the question of whether the sparrow did more good than harm, he would confine himself to the breeding habits of *Passer domesticus* in New Zealand; leaving for a future occasion the complete history of the sparrow in this country, which he hoped ere long to submit. He then went on to say that the statements on the breeding habits, though brief, are the result of numerous enquiries, and of lengthened personal observations. It is hoped that their publication may induce other persons who have made reliable notes, to help, by recording their observations and experience. "I shall assume, for the purposes of the calculation I am about to make, that no extensive action is taken by man for the destruction of his small opponent, if such he is to be called, and as the natural enemies in this country are hardly worth mentioning, we will allow only for accidental and natural deaths. Speaking of the natural enemies, reminds me of an incident I once noted between Featherston and Martinborough, showing to what lengths the daring and cool impudence of the sparrow will sometimes go. Hearing a most unusual noise, as though all the small birds in the country had joined in one grand quarrel, I looked up and saw a large hawk (*E. gouldi*, a carrion feeder) being buffeted by a flock of sparrows, I should say several hundreds; they kept dashing at him in scores, and from all points at once. The unfortunate hawk was quite powerless, indeed he seemed to have no heart left, for he did not attempt to retaliate, and his defence was of the feeblest; at last, approaching some scrub, he made a rush, indicative of a forlorn hope, gained the shelter, and there remained. I watched for fully half an hour, but he did not re-appear. The sparrows congregated in groups about the bushes, keeping up a constant

*Abstract of a paper read at the meeting of the Wellington Philosophical Society, on 2nd July last.

chattering and noise, evidently on the lookout for the enemy, and congratulating themselves upon having secured a victory. I have heard of sparrows attacking and driving away pigeons and other birds, but do not remember any record of their daring to attack a hawk. In this part of the Colony the breeding season of the sparrow begins in spring, and ends late in the autumn. The first broods appear in September, and the last in April. I have examined a great many nests, but never found less than five eggs under a sitting bird, more often six, and frequently seven. These are usually all laid in one week. Incubation occupies thirteen days. The young are fed in the nest for eight or nine days. They then return to the nest for two or three nights, after which they have to feed and lodge themselves, sometimes assisted by the male bird. In five instances fresh eggs were found in the nest, along with partly-fledged young. Both parent birds work in feeding the young till they leave the nest, and at first I was much puzzled to account for the fact that the second laying of eggs was not spoiled during the absence of the mother. From my observation I am convinced that the chief portion of the work of incubation, that is, after the first brood is hatched, is thrown on the young birds; for it must be apparent that the heat arising from the crowding of five or six young birds into a nest would be sufficient to cause incubation. So that by the time the young birds are finally turned out, the earlier laid of the next batch are within a few days of issuing from the shells. Therefore the mother is confined to the nest for little more than half the time to hatch the first brood of the season. Then after a very few days the process is again repeated. This does not occur in every nest, but it is a very important item to be noted when considering the "rate of increase." Moreover, in one instance, at least, the young birds belonging to the first brood, raised in September, were themselves breeding at the end of March. I can speak positively, as in the hope of proving whether the birds of one brood mated among themselves, I fastened a bit of red stuff round the leg of each. The only one I saw after they were turned out by their parents was a hen, which had mated with a male from another brood, built a nest close to her old home, and actually reared a brood of her own at the same time as her mother was closing her arduous duties for the season. From two nests I was able to prove that seven broods issued the year before last, but for the purposes of the calculation I am about to make, we will take it that the average is five broods of six each. This is below the mark. We then allow one-third of the annual increase for deaths. Here are the results":—

Mr. Kirk then read his calculations, of which the following is a summary. Starting with one pair, we shall have—

At end of First Year (allowing for deaths one-third)						11	pairs.
,, ,,	Second	,,	,,	,,	,,	121	,,
,, ,,	Third	,,	,,	,,	,,	1,331	,,
,, ,,	Fourth	,,	,,	,,	,,	14,641	,,
,, ,,	Fifth	,,	,,	,,	,,	,,146,051	,,

He concluded as follows:—

"This does not take into account those early broods which are themselves breeding; nor does it allow more than five broods a year, while six and even seven are of common occurrence. Further, the clutches of eggs often number more than six: so that we started on a low basis, and the allowance of one-third is, I think, more than ample." The following discussion ensued:—

Mr. TRAVERS said that Mr. Kirk's views regarding the food of the sparrow did not agree with naturalists in other countries. His experience led him to believe that their principal food was insects. The *Cicadæ* especially are caught in hundreds by them. It would be difficult to ascertain, as suggested, by dissection, whether they contained insect food or grain. If the increase is anything like what Mr. Kirk contends, the air would be full of these birds. The increase really depends on the amount of food they can get. That these birds are useful to the agriculturist is beyond question. The increase in crops is in proportion to the spread of the sparrow. The insects which used to swarm in the plains in the south have now almost disappeared, owing to the sparrow, and the grain has increased. The caterpillars, once so numerous, are disappearing from the same cause. In Hungary they made war against the sparrows; but after a time they had to get them back again, so that they might protect the wheat from the insects. The sparrow was also a good scavenger. It was said that the sparrow destroyed the grape, but it turned out to be the *Zosterops*, or the Minah. The hawk mentioned as being attacked by sparrows is the kind that never touches sparrows. He was an ardent admirer of the sparrow, and he did not think we should grudge the small amount of grain they consumed, when they were in other ways so useful.

Sir WALTER BULLER said he was prepared to accept his full share of the responsibility for the introduction of the sparrow, by the Wanganui Acclimatisation Society in 1866. While fully admitting and deploring the depredations committed by this bird on the settlers' crops at certain seasons of the year, he considered that the sparrow was an insectivorous bird in the strictest sense; and believing, as he did, that the balance of evidence was strongly in its favour, he never lost an opportunity, in public or in private, of putting in a plea for poor persecuted *Passer domesticus*. He declared that during the breeding season the sparrow was the farmer's best friend, for the young broods were supplied entirely on insect food. Mr. Kirk's observations on the fecundity of this bird in New Zealand, would give some idea of the great service he performed. The sparrow had also proved instrumental in exterminating the variegated Scotch thistle, which at one time threatened to overrun this country, by feeding on the seeds, and preventing their dissemination.

Mr. DENTON said that it was almost impossible to keep sparrows entirely alive on grain; they must have insects.

Mr. HUDSON remarked that of course the great disappearance in insect-life here would in some measure be accounted for by the clearing of the bush, and draining of the swampy land; no doubt the sparrow had done his share. He did not think it much advantage to have the *Cicadæ* destroyed, for they did no harm.

Mr. Travers differed from Mr. Hudson; the *Cicadæ* damaged the introduced trees considerably, and often so much as to cause them to die altogether.

Mr. Richardson pointed out that numbers of sparrows were often destroyed by strong gales of wind and rain.

Mr. Kirk, in reply, said that most of the discussion was on points which had not been raised in his paper; indeed, he had specially mentioned that there was not yet to hand sufficient reliable evidence on which to found an impartial judgment as to whether the sparrow was more beneficial than hurtful to agriculture and horticulture. As, however, the question had been introduced, he would state that when he entered upon this investigation he was as staunch a supporter of the sparrow as Mr. Travers or Sir Walter Buller. He was afraid, however, that he should now have to modify his views very much. There could be no doubt that the sparrow ate many thousands of insects, and did a vast amount of good. The point to be settled was, Did he exact more grain, fruit, &c., in payment for those services than those services were worth? He was intimately acquainted with M. Michelet's book, "The Bird," referred to by Mr. Travers, but he must draw attention to the fact that the author's remarks did not apply to New Zealand, where the rate of increase of the sparrow was phenomenal. He was of course aware that the large hawk mentioned did not feed on living birds, and was therefore the more surprised that the sparrows should venture to attack such a powerful opponent. Exception had been taken to his calculations, and Mr. Travers stated that at the rate mentioned the air would be "full of sparrows." He had already said that the calculation was based upon the assumption that no active agencies were employed by man for the destruction of the sparrow; but we all knew that poisoning on a large scale was indulged in. He was convinced that the one-third of the annual increase was ample to allow for accidental and natural deaths He might mention that the balance of evidence so far was against the sparrow. Miss Ormerod, Consulting Entomologist to the Royal Agricultural Society, a most ardent champion of the sparrow, had investigated the question in England, and had been obliged to abandon his cause. Professor Riley, Entomologist, and Messrs. Hartman and Barrons, Ornithologists of the U. S. Department of Agriculture, had been compelled to cast their votes against the "cussed little Britisher." If the sparrow had been condemned in England, where, according to Sir Walter Buller, it usually reared but two broods a year, what would be the result in this country, where the output from a single nest was five, six, and even seven broods a season? The sparrow did good work by eating the seeds of the large thistle, but the goldfinch and green linnet indulged even more in that habit. In conclusion, he would say that he for one would be very sorry to see the sparrow exterminated; but he was convinced some systematic steps would have to be taken to restrict the increase. The sparrow was like alcoholic liquor: good in moderation, but decidedly harmful in excess.

THE ORNITHOLOGY OF NEW ZEALAND.

Some important additions have been made to the Avifauna of New Zealand during the last year. At a meeting of the Wellington Philosophical Society, held on the 2nd July last, Sir Walter Buller exhibited a huge Kiwi from Stewart's Island, which he referred to *Apteryx maxima* of M. Jules Verreaux (Bonap. Comp. Rend. Acad. Sc., xliii., p. 841). Two of the largest specimens of *Apteryx australis* (male and female) were on the table for comparison; and he pointed out that this new bird had a bill fully an inch and a half longer, with proportionately robust feet; and that the claws, instead of being long and sharp pointed as in *Apteryx australis*, were short, broad, and blunt at the tip. He also pointed out other distinguishing peculiarities in the plumage. Referring to the history of this species, he said that the well-known French naturalist named had, as far back as 1856, distinguished it from the others on what appeared at the time to be very insufficient data; and a year or two later the government of New Zealand published in the *Gazette* a report by Drs. Sclater and Hochstetter, "On our present knowledge of the species of *Apteryx*," in which special attention was called to Jules Verreaux's new form, and the colonists invited to look for it. When, in 1871, Professor Hutton published his "Catalogue of New Zealand Birds," he referred the large Grey Kiwi of the South Island (*Apteryx haasti*) to *Apteryx maxima*. But Sir Walter Buller himself, in his first edition of "The Birds of New Zealand," dissented from this view, expressing himself as follows:—"The evidence, as far as it goes, would seem to indicate the existence of a much larger species of Kiwi than any of the foregoing —in fact, a bird equalling in size a full-grown turkey. For this reason I have considered it safer to retain *Apteryx haasti* as a recognised species, and to leave the further elucidation of the question to the zeal and enterprise of future explorers in the land of the *Apteryx*." Seventeen years had elapsed since this was written, and at length the veritable *Apteryx maxima* had turned up in Stewart's Island, the specimen now before the meeting being undoubtedly the only example known in any public or private collection. Sir Walter Buller then proceeded to give an interesting account of the geographical distribution of the various species of *Apteryx*, and the circumstances of their development. *Apteryx bulleri* is confined to the North Island, *Apteryx australis* to the South Island, and *Apteryx maxima* to Stewart's Island; whilst *Apteryx oweni*, inhabiting the colder regions of the South, has also been found on the snow-line to the north of Cook's Strait. All these species have doubtless sprung from a common parent, and the insular separation has existed for a sufficiently long period of time to admit of the development of distinct species under the ordinary laws of evolution. Whilst on this subject, Sir Walter Buller said he would take occasion to refer to some remarks made by a former President when Mr. R. B. Sharpe's paper was read, changing the name of the North Island bird from *Apteryx mantelli* to *Apteryx bulleri*. In the discussion which the President's remarks evoked, Mr. Maskell and others appeared to reproach him (Sir Walter) with having, as it were, filched the name from Mr. Mantell, who had so long enjoyed it. As a matter of fact, he (the speaker) had nothing to do with the change of name, beyond submitting his series of specimens to Mr. Sharpe's critical judgment; and he was afterwards merely the "passive bucket" in communicating Mr. Sharpe's paper to the Society. In selecting the speaker's name to distinguish the species, Mr. Sharpe only gave effect to a suggestion made by Dr. Otto Finsch, of Bremen, many years before. Agreeing, as he did, in the technical accuracy of Mr. Sharpe's conclusions, he (Sir Walter Buller) had no alternative but to adopt the proposed new name. As a rule, however, his own tendencies were conservative, and throughout his work he had, in regard to nomenclature, observed as far as possible the rule of "*quieta non movere.*" For example, he had declined to follow Dr. Meyer, of Dresden, in substituting the name of *Notornis hochstetteri* for *Notornis mantelli*, because he did not consider that the differences shown to exist between the fossil and the recent birds were sufficient to warrant the change. On the other hand, he had not hesitated to expunge from the list of species *Stringops greyi* (so named by Mr. G. R. Grey in compliment to Sir George Grey) as soon as he had satisfied himself that it was a mere variety of the common *Stringops habroptilus*. He was very glad however, of the opportunity afterwards of re-connecting Sir George Grey's name with the New Zealand Avifauna by dedicating to him a new form of *Ocydromus*. Sir Walter Buller concluded his remarks by saying that in such matters as this, people should not be thin-skinned, for a scientist should have nothing before him but the elucidation of truth, and in the fixing or altering of names there can no escape from the accepted rules of zoological nomenclature.

An active discussion, led off by Mr. Maskell, then followed as to the value of characters now generally accepted by naturalists in the establishment of species.

Sir Walter Buller, in reply, said that the only importance he attached to systematic classification was as an aid to memory in the study of the natural objects themselves. Birds, like other animals, resolved themselves into natural groups, and could be most conveniently studied in that manner. The discrimination of genera and species was, after all, empiric, and often very arbitary. Nothing was easier than to raise the *quæstio vexata*, What constitutes the difference between a species and a permanent variety? On no point probably were naturalists so much divided—some carrying their discrimination of forms to an extreme, others erring in an opposite direction. In fact most systematists might be divided into two classes—"lumpers" and "splitters." The thing was to hit the happy mean. There was much truth in what Mr. Maskell had said, and no doubt modifications of structure were of the first importance in the discrimination of species; but, as to nomenclature, it seemed to him that simplicity was the thing of all others to be desired. To adopt the system more or less in use among ornithologists of making sub-species or varieties was to his mind very objectionable, because it had the effect of encumbering the literature with names. For example, *Apteryx bulleri*, as it is now called, appeared in Dr. Finsch's list as *Apteryx australis* variety *mantelli*. According to the generally-accepted view among English systematists, the amount of variation necessary to constitute a species is not of much importance, and may be left to individual opinion, so long as it is persistent or constant. For his own part, he was quite indifferent whether the petrel now exhibited, and which he had named *Œstrelata affinis*, was regarded as a distinct species or a permanent race, so long as the difference of character was recognised. Admitting the distinction, it was merely a question of convenience with systematists whether to call it by a distinctive name, or to designate it "Species A, variety B." Dr. Finsch considered that this, and *Œstrelata mollis*, of which specimens were on the table for comparison, were varieties of one and the same species. But Mr. Osbert Salvin, our great authority on Petrels, had unhesitatingly pronounced them distinct species. They, belonged, however, to the same natural group, and were closely allied. Although easily discriminated now, no naturalist of the present day would deny that they had originally sprung from a common parent. This followed of necessity from an acceptance of the theory of evolution. As to the alleged worthlessness of colour as a criterion for discriminating species, he could not agree with Mr. Maskell, because our whole experience was opposed to such an argument. The cases put forward by that gentleman were not in point. For example, the condition of the albino Tui exhibited that evening was due to an accidental absence of the colouring pigment in the feathers. It was merely a *lusus naturæ*, or a freak of nature. However many examples of this kind might be met with, no naturalist of any experience would think of creating a new species out of such material. So in the case of individual peculiarities of plumage mentioned by him. No one would pretend that these were of specific value. Some birds, for example the red grouse (or brown ptarmigan), one of the commonest birds of Great Britain, is so variable in color that scarcely two males can be found with precisely the same markings, and this is likewise the case with the common albatross and some other sea birds. This variability of plumage becomes, then, a character of the species. But if you meet with, say, two forms of sea-gull, one having a black head and the other a white head, breeding true, and presenting this constant character, an ornithologist would, as a matter of course, treat them as distinct species, although he might not be able to discover any other points of difference. On the other hand there is a phase of colouring known as dimorphism, which obtains among some species of sea-birds—some individuals being dark and others white in one and the same species. Other birds, again, pass through several distinct phases of plumage in their progress from youth to maturity, These adolescent states, and the known instances of dimorphic colouration, do not by any means affect the argument that colour is an important external character in the determination of species. On the main question, however, of manifest structural or organic difference as the surest guide in the differentiation, Sir Walter Buller said that he quite agreed with Mr. Maskell. He would remind the meeting that the study of birds had often to be prosecuted with nothing before the investigator but skin and feathers, and that the systematist could only make the most of the materials before him. He did not believe that it would be possible to attain perfection in classification till the internal characters and anatomy of every known bird had been as completely examined and illustrated as that of the common rock dove (*Columba livia*) had been by the late Professor Macgillivray.

THE HUMBLE-BEE IN NEW ZEALAND.

BY GEO. M. THOMSON, F.L.S.

Among the numerous interesting and remarkable cases of naturalisation, or, as it is somewhat improperly called, acclimatisation in this colony, none surpasses in its interest and far-reaching results that of the humble-bee. For many years the agriculturists, especially of the South island, had been under the necessity of annually importing all the supplies of Red Clover seed which they required, so to obviate the continually recurring expense and to ensure the production of a valuable seed within the colony, the Canterbury Acclimatisation Society was induced to import humble-bees. With the steps taken to accomplish this object, I have not to do at present, though a brief history of this part of the undertaking would, no doubt, be interesting.

At the very outset, however, a mistake seems to have been made, which shows how much in the dark many of those are who guide the community in acclimatisation matters, and how largely chance often bulks in the final results of such experiments. Red Clover (*Trifolium pratense*) differs from White Clover (*T. repens*) and many other papilionaceous flowers in having its nectar secreted at the base of a tube 9 to 10 mm. (about $\frac{2}{5}$ths. of an inch) long, formed by the cohesion of the nine inferior stamens with each other and with the claws of the petals. Instead, therefore, of an insect being able to thrust its trunk down to the nectary by the two small openings which lie, one on each side of the superior stamens, as in White Clover, it must insert it directly down the staminal tube. Only in this way can the insect receive a dusting of pollen, and so ensure cross-fertilization of the flowers, without which this species is practically sterile. "In order to reach the honey in this way, an insect must possess a proboscis at least 9 to 10 mm. long."* This fact was probably not known to any one in New Zealand when the importation of humble-bees was decided upon. Only the fact was known that humble-bees were the principal agents in fertilizing red clover, and in sending for these insects, the species which is probably the most abundant in England, viz., *Bombus terrestris*, was selected. According to Müller, who is the best authority on the subject, *B. terrestris* does not enter the flowers of red clover in a legitimate way and so bring about cross-fertilization, but always makes a hole near the base of the flower and sucks the nectar through this. Its trunk is not more than from 7 to 9 mm. long, so that only the largest females could reach the base of the flower. On the other hand, it is the case in Germany at least, that no less than twelve other species of *Bombus* or humble-bees having trunks varying from 10 to 15 mm. in length, legitimately visit and fertilize the red clover. Of course the pollen and stigma of this flower are accessible to all insects which are heavy enough to press down the keel, and if bees visit the flowers for pollen only they will no doubt bring about cross-fertilisation. This may account for an

*"The Fertilisation of Flowers," by Prof. Hermann Müller.

interesting example given me by Mr. Wm. Martin, of Fairfield, near Dunedin, who informs me that as far back as 1858 he obtained a large quantity of very fine seed off a small patch of red clover which he had under cultivation.

I have never myself observed our introduced humble-bee biting the tubes of red clover, nor have enquiries to observers throughout Canterbury and Otago elicited any information, beyond the fact that the flowers always seem to be visited in a legitimate manner. And it is a further interesting fact, that though at first sight the wrong species of insect appears to have been introduced, yet the result sought to be attained by its introduction has been secured. Yet it would not have been at all remarkable, if the experiment had resulted in failure as far at least as red clover is concerned, were it not that under altered conditions, insects, like all other organisms, appear to have marvellous powers of adaptation.

In March, 1885, the Otago Acclimatisation Society liberated 93 females (queens) of *Bombus terrestris* in the neighbourhood of Christchurch. They appear to have established themselves at once and increased rapidly. In January, 1886, two were seen by Mr. J. D. Enys at Castle Hill on the West Coast road, and early in 1887 they were reported from Kaikoura in the North, and Timaru in the South, while by the autumn of the same year they had become established in the Oamaru district. Towards the very end of the same year they had spread up the Waitaki basin, through the Lindis pass and were observed on the Hawea flats. In Dunedin they appeared quite suddenly in the second week of February, 1888, and were almost simultaneously reported from Waihola, 30 miles south-west. In November, 1889, they were first recorded from the head of Lake Wakatipu, and in the beginning of 1890 were observed in the neighbourhood of Invercargill. I have no accurate record of their spread in the North Island. It may be considered certain that Cook's Strait would have proved an insurmountable natural barrier, but specimens have been repeatedly liberated within the last two or three years in the North Island. It seems doubtful, according to Mr. G. V. Hudson, whether they have yet become established. I have, however, records of their occurrence, both from Auckland and Wellington, and would be glad to have further information on this point.

Professor Hutton informs me that occasionally he has seen queen bees which were quite black, that is without the white and orange bands so characteristic of *Bombus terrestris*. It will be interesting to learn whether this variety has been observed elsewhere than in Christchurch.

One of the most interesting results of the introduction of foreign species of plants or animals into a new country, is that it becomes possible to watch and place upon record every change which the organism undergoes. As soon as humble-bees appeared in this neighbourhood, I resolved to devote a good deal of attention to them, and have already observed several details concerning their life-history, which show, it seems to me, that they may be expected to undergo considerable change in their habits, and may prove in time to be a not un-mixed blessing.

The first point to be noticed about them is that here the bees have few or no enemies except small boys, and perhaps bee-keepers. In their native habitats they have to contend against very numerous enemies, and most readers will remember Darwin's famous remarks* about humble-bees and field-mice :—"The number of humble-bees in any district depends in a great measure on the number of field-mice, which destroy their combs and nests; and Col. Newman, who has long attended to the habits of humble-bees, believes that 'more than two-thirds of them are thus destroyed over all England.' Now the number of mice is largely dependent, as every one knows, on the number of cats; and Col. Newman says, 'Near villages and small towns I have found the nests of humble-bees more numerous than elsewhere, which I attribute to the number of cats that destroy the mice.' Hence it is quite credible that the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice and then of bees, the frequency of certain flowers in that district." Mice are by no means abundant in the open country in New Zealand, at least in those parts where rabbits and introduced small birds have become a pest, and where, consequently, cats are encouraged. Nor can I find that there are any other enemies of the bees here that are at all conspicuous. Some of the insects are, however, extraordinarily infested by mites, which cover parts of the body—especially the bare posterior portion of the thorax—to such an extent as to completely hide the integument. These mites were no doubt introduced originally with the first bees, but I cannot say whether they are a greater pest here than in the Old Country.

A second remarkable point in connection with the life of the humble-bees is, that in many parts of the Colony they do not appear to hibernate at all. In England those insects which survive the winter appear about April, and immediately proceed to seek out suitable quarters for the establishment of their homes. Mr. Hudson tells me that the neuters do not appear until June.

In this part of the colony the past winter was extremely mild, and the hibernation of the bees was very short. I saw them nearly daily on various flowers right through the summer and autumn up till 5th June. On the following day the weather became suddenly cold with frost at night, and the humble-bees disappeared until August 13th, when they were again seen. For nearly a month afterwards the weather remained fine, and night frosts were frequent, yet for a few hours in the hottest part of the day the bees were seen regularly. Mr. James Gilmore of Goodwood, about 30 miles North of Dunedin, states that he saw them right through the winter, except in rainy weather. In the middle of July, when the nights and mornings were very frosty, the bees came out in the middle of the day if the sun was shining. If this is so in this comparatively cold part of the colony, we may expect that in those parts where frost is unknown no hibernation will take place at all. It is worthy of note, however, that only large females survive the winter. This season the first small bees of the new brood were seen by me on 22nd November.

* "Origin of Species," 6th Edit., p. 57.

The rate of increase of the humble-bee has been so great in this colony, that the question has arisen in my mind as to whether they will not become as serious a nuisance as far as honey is concerned, as the rabbit has proved to the farmer and squatter. This may seem to be an improbability to many persons who have never seriously considered the matter, especially as humble-bees do not visit many of the flowers which supply nectar to the hive-bee. But the fact remains that in those districts where the former have been very abundant the supply of honey has enormously diminished during the last two seasons, and many skilled bee-keepers are beginning to attribute a considerable share at least of this falling off to the humble-bees. To see how far these insects are adapting themselves to new flowers, I have for a considerable time past kept a record of the flowers which they visit, and those which they leave alone. I have noticed them on many species of introduced plants which they never appear to visit in Europe, and it will be interesting to note whether with increased numbers they are extending their search for nectar to flowers at present neglected by them. Two facts have particularly struck me in this connection. One is that they seldom visit white flowers; I know only about half-a-dozen altogether, though on some of these, like Plums, Cherries and Pears they are to be found very abundantly. The other is that with two exceptions I have never heard of them visiting the flowers of indigenous plants. The exceptions are *Fuchsia excorticata* which they appear frequently to visit, and the Ngaio (*Myoporum lætum*) on which they have been seen by Mr. A. S. Fleming, of Palmerston S.*

Another curious fact about them is that in one district they will absolutely neglect flowers which they frequent in another part. Many observers credit certain flowers with intoxicating the bees, but as the flowers recorded by one are not so credited by others, the question of so-called intoxication must be looked upon as quite unsettled, and is worthy of investigation, Again, in one part the bees pierce the tubes of certain flowers which, in another neighbourhood, sometimes only three or four miles away, they visit legitimately. I have thought it worth while here to give a complete list of the flowers—all introduced but the above two—on which I have observed humble-bees, or have trustworthy records of their visits. Under the various flowers I have made remarks which occur to me as bearing on the question. Such a minute attention to details may appear to some unnecessary, but it must be remembered that what may prove to be a biological problem of great ultimate interest is here being worked out before our eyes, and as we have the commencement of it within our observation now, it would be a mistake to allow any detail however apparently insignificant to escape attention. To facilitate reference I have arranged the flowers noted here according to their natural orders.

RANUNCULACEÆ.

Anemone—single red, blue and parti-coloured hybrids; occasionally visited.

Delphinium—blue hybrids, and also on Annual Larkspurs.

Aquilegia—hybrids. I have seen them on Columbines of

* Within the last day or two (Dec. 26th) I have seen small bees on *Veronica elliptica*.

various colours, except white. Frequently the tubes of these flowers are punctured by the bees.

BERBERIDÆ.

Berberis (*Mahonia*) *Darwinii*. Often visited.

PAPAVERACEÆ.

Papaver. All sorts of single poppies are greatly visited by humble-bees; one correspondent considers that they become intoxicated by the nectar of these flowers. I have never myself observed this effect.

FUMARIACEÆ.

Dielytra spectabilis. These flowers are great favourites, but as the nectar cannot be reached legitimately, the bees light on the outside of the keeled sepals and puncture them near the base. In the neighbourhood of Dunedin this spring it was almost impossible to get a spray of *Dielytra* which had not been more or less disfigured by humble-bees.

CRUCIFERÆ.

Cabbage flowers (*Brassica olĕracea*) are frequented by numbers of bees.
Wallflower (*Cheiranthus cheiri*) is also a great favourite.
Virginian Stock (*Cheiranthus*? sp.) occasionally visited.

RESEDACEÆ.

Reseda odorata. Mignonette is totally neglected in many gardens, while in others it is constantly visited. No doubt bees acquire tastes, and have their individual preferences.

VIOLARIEÆ.

Viola odorata. Violets are constantly visited in some gardens and are quite neglected in others. The same remark applies to the Pansy (*V. tricolor* and its hybrids), of which I have seen both white and yellow varieties visited, but not frequently.

I have no record of a single Caryophyllaceous flower being visited by humble-bees

HYPERICINEÆ.

Hypericum sp. A large kind of St. John's Wort in my garden is occasionally visited.

MALVACEÆ.

Abutilon sp. Reported from Christchurch; I have not observed them in Dunedin, where *Abutilon* is mainly a greenhouse plant.

TILIACEÆ.

The Lime-tree (*Tilia europea*) when in flower attracts the humble-bees (as well as other insects) in great numbers.

GERANIACEÆ.

Scarlet Geranium (*Pelargonium* sp.) is occasionally visited.
Indian Cress or Garden Nasturtium (*Tropæolum majus*) is frequently visited.

LEGUMINOSÆ.

Ulex Europæus. I have only once seen the humble-bee on this plant. As a correspondent remarks, "it is rather singular that this most plentiful of spring flowers appears to be neglected by humble-bees." I am even more struck with the fact that it is almost totally neglected by hive-bees also. In many parts near Dunedin there are miles of gorse hedges which in the months of September, October and November are blazing with flowers, and the air is heavy with their perfume, yet hardly an insect is to be seen on them. I am also struck with the fact that I have no record of humble-bees on the flowers either of Broom (*Cytisus scoparius*) or Laburnum (*C. laburnum*). Yet it is probable that these flowers are occasionally visited, as in Europe they are frequented by *Bombus terrestris* in great numbers. None of the three flowers named contain nectar, hence they would only be visited by bees for pollen.

Trifolium pratense. As has been already said the humble-bee was originally introduced to fertilise the Red Clover. In Europe the tube of the flower is almost invariably pierced by *Bombus terrestris*, but I have not a single record of this mode of getting the nectar from any of my New Zealand correspondents.

Trifolium repens. White clover is not mentioned by H. Müller among the flowers visited, but I have seen small neuters among our humble-bees, at work upon it.

Sweet Pea (*Lathyrus odoratus*) is frequently visited.

Faba vulgaris. Bees are very fond of the flowers of the Bean; they appear always to bite a hole into the tube.

Wistaria sinensis is a great favourite. According to Mr. A. D. Bell, the bees get intoxicated with the honey (?) and afterwards crawl helplessly on the ground below the plant.

I have no record of humble-bees visiting the flowers of Lupins, which in Europe, according to Darwin, depend on these insects for their fertilisation. In his "Fertilisation of Flowers" (p. 188) H. Müller states that "Mr. Swale observed that in New Zealand cultivated varieties of Lupinus were unfertile unless he released the stamens with a pin." On reading this, it at once occurred to me that I had frequently seen Lupins seeding in gardens here, and this was verified by my wife, who had frequently gathered seeds of Lupins both here and in Christchurch. On applying to Mr. Martin, of Fairfield, for a verification of this fact, he informs me that he has had about a dozen varieties in cultivation for the last twenty or thirty years, and never had any difficulty in obtaining seed from them, many sowing themselves.

One observer records having seen a humble-bee on flowers of Wattle. I have never seen bees of any kind on the flowers of *Acacia*, and am inclined to think that a mistake has been made.

In Europe humble-bees visit Bird's-foot trefoil (*Lotus corniculatus*), Vetch (*Vicia sepium*) and Scarlet Runner Beans (*Phaseolus coccineus*); I have no record of them in the colony.

ROSACEÆ.

The Plum (*Prunus communis*) and Cherry (*P. cerasus*) are visited by the bees in great numbers.

On the Cherry-Laurel (*P. lauro-cerasus*), I have also seen them in abundance.

The Peach (*Persica vulgaris*) is less frequently visited.

On Apple-blossom (*Pyrus malus*) I have seldom seen them, though in Europe they visit the trees in great numbers.

On the Pear (*P. communis*), on the other hand, Müller states that the bees seldom visit the flowers, and fly away after trying a few only. Here, I have seen the trees swarming with humble-bees.

Cydonia japonica is another favourite with these insects.

In Europe, humble-bees visit various species of *Spiræa* or Meadow-sweet, and *Rubus* (Blackberry, Raspberry, &c.); I have no record of them in New Zealand.

SAXIFRAGEÆ.

Escallonia macrantha occasionally visited.

Ribes. All the species, including *R. fruticosus* (Flowering Currant), *R. nigrum* and *R. rubrum* (Black, Red, and White Currants) and *R. grossularia* (Gooseberry), are visited by numbers of humble-bees.

Deutzia sp. I have observed the bees abundantly on a double pink *Deutzia* in my garden, although the ordinary single white species is never visited by them.

CRASSULACEÆ.

Sedum sp. I have occasionally seen a yellow-flowered species visited.

Crassula sp. The same remark applies to a pink Crassula in my garden.

MYRTACEÆ.

Eucalyptus globulus. According to observations made by Mr. Laing and others in Christchurch, the bees become intoxicated by the nectar from the flowers of the Blue Gum, and are frequently to be found on the ground under these trees in a state of complete helplessness, apparently scarcely able to crawl.

ONAGRARIEÆ.

Fuchsia excorticata. This species, which is a great favourite with the hive-bee, is occasionally visited by humble-bees. The latter species, however, swarm on the hybrid (South American) fuchsias which occur in gardens.

Godetia. The brightly-coloured varieties are much visited, but the white flowers appear to be ignored.

Œnothera. A correspondent from Waitepeka reports bees as common on the flowers of the Yellow Evening-primrose.

FICOIDEÆ.

Mesembryanthemum sp. A brilliant crimson-flowered species appears to be very attractive.

UMBELLIFERÆ.

Parsley (*Petroselinum sativum*) is the only umbelliferous plant said to be visited by humble-bees. I have not seen them on it myself, but am informed by a correspondent at Waitepeka, that they abound on it in his garden.

CAPRIFOLIACEÆ

Laurustinus (*Viburnum tinus*) and Honeysuckle (*Lonicera* sp.) are very much frequented. The common honeysuckle (*L. periclymenum*) has a very long tube, and in Europe is only fertilised by hawk-moths. It will be remarkable if *Bombus terrestris* is able to get the nectar from it without puncturing the corolla.

DIPSACACEÆ.

Scabious (*Scabiosa atropurpurea*), especially the dark-coloured varieties are especial favourites of the humble-bees.

COMPOSITÆ.

In all this enormous order, which is so abundantly represented both in the garden and the field, I have only observed the bees on nine species of flowers, none of which, however, were white.

Sunflower (*Helianthus*), frequently visited.
Dahlia, single yellow and red flowers of this genus are great favourites. A correspondent in Christchurch says:—"On these I have often noticed that the bees appear to be more or less stupefied, remaining on the flower in the same position for an hour or so, and then falling to the ground and buzzing about in a helpless manner when disturbed." I have never observed this in my own garden where the dahlias are abundant, and are much visited by the bees.
Gaillardia and hybrid Marigolds (*Calendula*) are often visited.
Thistle (*Carduus lanceolatus*). This flower, especially in North Otago, affords food to myriads of bees. An observer, long resident near Otepopo, informs me that the difficulty of getting through a piece of country infested with thistles, has of late years been enormously increased, for timid persons, by the swarms of humble-bees which are to be found among the flowers.

A Christchurch observer considers that they become intoxicated by the nectar of the thistle-flowers; this has not been verified.

Globe Artichoke (*Cynara*). These plants when in flower in my garden are frequently visited. Another great favourite is the Blue Corn-flower or Cornbottle (*Centaurea cyanus*).

The only liguliforal composites on which I have seen humble-bees are Dandelion (*Taraxacum dens-leonis*), and—more sparingly—Cape Weed (*Hypochœris radicata.*)

CAMPANULACEÆ.

Canterbury Bell (*Campanula media*) is frequently visited.
Lobelia erinus (hybrid). Beds of this plant proved very attractive to the bees last summer.

ERICEÆ.

Various cultivated Heaths (*Erica*) both purple and white are visited by the bees. I have never found or heard of them on long-tubed species however.
Rhododendron. Occasionally bees visit the brilliantly-coloured species.
Arbutus unedo. The flowers are often visited by humble-bees which, however, always appear to puncture the corolla.

PRIMULACEÆ.

The different forms of the genus *Primula* cultivated in gardens under the names of Polyanthuses and Primroses are hybrids probably between *P. vulgaris*, *P. veris*, and *P. elatior.* I have found bees on both varieties, and also on Auriculas (*P. auricula.*) Müller says of *Bombus terrestris* that it "makes a hole in the corolla-tube, a little above the calyx, sometimes biting it with its mandible, sometimes piercing it with its maxillæ, and so reaching the honey with its tongue, (I have sometimes seen this bee, before boring the flower, make several attempts to reach the honey in the legitimate way,—this observation is of interest, as proving that the bee is not guided by instinct to the plant adapted for it, but that it makes experiments, and gets its honey where and how it can.") I have watched bees on the flowers of Polyanthus and could only detect them brushing up the pollen, but never piercing the corolla so as to reach the nectar. Müller further states that "pollen-collecting bees are only able to secure their pollen in short-styled flowers; they learn to recognise the long-styled plants at a distance and to avoid them, and then never perform cross-fertilisation but very often self-fertilisation." However this may be, one interesting result I have noted in my own garden is, that this last spring, for the first time in my experience in New Zealand, my Polyanthuses have sown themselves in the flower-borders. Attempts have often been made both here and in other parts to naturalise the Primrose and Cowslip in the woods and waste places, but hitherto without success. Now it would seem as if by the agency of the humble-bees this might be possible.

BORAGINEÆ.

Anchusa sp. A large species in my garden is greatly frequented by the bees.

SOLANEÆ.

Solanum jasminoides. According to an Oamaru correspondent this plant is a great favourite.

Petunia. One correspondent has observed them on these flowers.

SCROPHULARINEÆ.

Linaria. Two cultivated species, one with white and purple flowers, the other (*L. tristis*) with yellow and crimson flowers, are frequently visited by the bees in the normal manner.

Antirrhinum (Frogsmouth or Snapdragon.) These flowers, like those of *Linaria*, are only fertilised by humble-bees, and are much visited by them. According to Mr. Page of Christchurch, the bees puncture the corollas, and this is particularly the case as the season advances. Presumably therefore it is the small bees which learn this habit only, the larger ones being both strong enough to open the corolla and having probosces long enough to reach the nectar.

Pentstemon. These flowers are regularly visited.

Digitalis purpurea. The Foxglove is a great favourite with humble-bees. I find however the flowers are perfectly self-fertile, as it blooms all the year round with us and sets seed in all weathers; this too, happened long before humble-bees were introduced.

Veronica. I have never seen the bees on any of the native species of this genus (except *V. elliptica*, noted on p. 19), but on the purple, and especially the crimson hybrids found in many gardens they are to be seen in abundance. While neglecting white flowers, the bees seem to be particularly attracted to red and blue flowers.

BIGNONIACEÆ.

Eccremocarpus scaber. According to a Christchurch correspondent, these flowers are always punctured by the bees for their nectar.

VERBENACEÆ.

Ngaio (*Myoporum lætum*) is visited by the bees, according to Mr. Fleming of Palmerston S.

LABIATÆ.

Rosemary (*Rosmarinus*) is eagerly sought after by the bees.

Salvia Grahami. According to the Editor of the "New Zealand Country Journal," the bees bite the flowers of this plant a little above the calyx. I find them common on a a species of *Stachys*.

Many flowers of this order are regularly visited in Europe by humble-bees, *e.g.* Self-heal (*Prunella vulgaris*) and Marjoram. I have no record of their being so visited here.

PROTEACEÆ.

Hakea sp. I have observed the bees in great numbers on the flowers of a pink species.

SALICINEÆ.

The Goat-willow (*Salix caprea*) is visited both for pollen and nectar. I have also seen the bees on the pistillate flowers of one of the Poplars (*Populus nigra*), presumably for the sweet (?) secretion which is found on the whole inflorescence.

IRIDEÆ.

The bees occasionally visit the flowers of a dark-blue species of *Iris* in my garden; I have not seen them on flowers of any other colour.
Crocus. Several observers have recorded them from *white* flowers, but on no other colour.

AMARYLLIDEÆ.

The Snowdrop (*Galanthus nivalis*) is one of the few white flowers visited by humble-bees.
Narcissus. I have notes of the bees visiting single and double Daffodils, single Jonquils, and both white and yellow hybrid Polyanthus Narcissus. In all those flowers having a tube-like corona, the bees alight on the perianth and pierce the tube to reach the nectar.

LILIACEÆ.

Tulips are frequently visited by humble-bees, so also are Hyacinths. In many gardens I have noticed that the latter flowers are visited legitimately, while in others in a different district, three or four miles away, the perianths are invariably pierced by the bees. There is no doubt that when once a humble-bee has learned the art of getting nectar in an easy manner, it teaches others the art, so that all in a district acquire it. Growers of hyacinths in districts where the bees pierce the flowers, were this last spring in despair over the wholesale destruction of their favourite flower.

There can be no doubt that the list of flowers given above is still very incomplete, and others who will take the trouble to record their observations will be able to supplement it largely. It will be of interest also to watch whether as the bees increase, they extend their visits to flowers which at present are passed over.

Another point worth noting is as to the "swarming" of humble-bees. The life-history and social economy of these insects are quite different from those of hive-bees, and the habit of swarming in the former is not at first sight a probable one, yet both in Britain and in this colony, it has been affirmed that swarms of humble-bees have been seen. There is evidently ample room for observational work in connection with the development of *Bombus terrestris* in New Zealand.

PRELIMINARY NOTE ON THE DEVELOPMENT OF THE TUATARA (*Sphenodon punctatum*).*

BY PROF. A. P. W. THOMAS, M.A., F.G.S., F.L.S., University College, Auckland, N.Z.

A grant was made by the Royal Society in the year 1884 to Professor T. J. Parker, of Dunedin, for the study of the development of *Apteryx*, *Sphenodon*, and *Callorhynchus*. As *Sphenodon* does not occur near Dunedin, but is found chiefly on outlying islands belonging to the province of Auckland, at the opposite end of the colony, Professor Parker invited me to join him in the investigation of this form.

We gathered from what had been written on the natural history of the tuatara, as well as from oral information obtained from those who were best acquainted with the New Zealand fauna, that the month of February was probably the time at which the tuatara bred.

We therefore started from Auckland at the beginning of February, 1885, for what appeared the most promising hunting-ground—the island of Karewa, some ten miles from Tauranga, in the Bay of Plenty. Mr. A. Reischek, a naturalist well known by his researches on the natural history of New Zealand, who had already had opportunities of observing the tuatara, was good enough to accompany us.

The island of Karewa is situated some four miles from the mainland; it is little more than a rock which rises with precipitous sides high above the sea. At one spot only can a landing be effected, as the island is exposed to the ocean swell rolling in from the open Pacific, whilst the shores are for the greater part formed by unscaleable cliffs of rhyolitic rock. Our first attempt at landing was frustrated by the swell, but a day later a second attempt was successful.

The vegetation on the island is largely composed of small karaka trees and thickets of coprosma. The light, loose soil between the roots of trees and the rocks is mined by countless burrows, in which live mutton-birds (*Puffinus tenuirostris*) and tuataras.

On the "Chicken Islands" the tuataras have been described by Mr. Reischek as living with certain other sea-birds, namely, another species of *Puffinus* (*P. gavius*) and two species of *Procellaria*. This has been cited in 'Nature'† as an interesting case of commensalism, and and it is there stated that the birds "live in holes dug out by the tuataras and keep apparently on the best terms with them." It is stated that the tuatara generally lives on the right and the sea-bird on the left of the inner chamber.

I believe it is quite a mistake to suppose that any friendly relation whatever exists between the tuataras and the birds, and that here, as in the somewhat similar case of the prairie dog and rattlesnake, the idea of friendliness is quite out of place. It is true that the tuatara sometimes makes use of the burrows of the mutton-bird (though I have

*From the "Proceedings of the Royal Society," Vol. 48.

† October 19th, 1882. See also "Transactions of the New Zealand Institute," Vol. XIV., p. 274.

never found a tuatara living in the same burrow as a mutton-bird), but it cannot be said that the two species ever live on more favourable terms than those of mutual toleration. At one time I kept two kiwis in a large house with a number of tuataras, and a tuatara would at times shelter itself in the same box or corner as a kiwi—the two never attempting to fight, the tuatara hiding itself under the kiwi as it would do under a stone, whilst the kiwi seemed not to notice its presence. The tuatara seems to enter the burrow of the mutton-bird just as it would shelter itself in any other hole in the ground.

In any case, the tuatara must be an untrustworthy associate, for on four occasions I have seen or captured tuataras with young mutton-birds in their mouths. It is probably a truer view of the situation to suppose that the chance of getting a nestling renders the burrows of the mutton-bird more attractive to the tuatara.

Dr. Günther, in the absence of personal observation, supposed that the tuatara was incapable of burrowing. It is, however, certain that it can burrow well in such light soil as is found on Karewa, and even in the clay soil on which my lizard-houses are situated the animals have made burrows fully two feet in length, in which they are completely hidden. Not all the lizards, however, are so industrious; most of them have contented themselves with the artificial burrows, in the shape of long wooden boxes and drain pipes, with which they have been provided.

We spent some days camping on the island and captured a number of tuataras, but searched in vain for eggs, though we opened up many burrows in the hope of finding them. The smallest tuatara found was 4·9 inches in length. Not finding eggs, we dissected several tuataras, thinking that the condition of the ovaries might tell us whether we were too early or too late in the breeding season, but the dissection revealed no eggs at all approaching maturity.

We took away from the island a number of tuataras, hoping that they would breed in captivity. Some of these were taken by Professor Parker to Dunedin, a rather larger number being kept by me in Auckland, as it was thought that the warmer climate of the northern part of the colony would be more favourable.

Up to the beginning of January, 1886, no eggs had been obtained from my tuataras, and, as regards the lizards I then possessed, any such hope was futile, for I shortly afterwards discovered that all my tuataras (twenty-nine in number) were males. Thinking that our visit the previous summer had been too late in the season, I determined to make another expedition to Karewa, this time at my own expense. Professor Parker was unable to join me, owing to the great distance of Dunedin from the spot; he was, moreover, engaged in working at the development of the kiwi. From this date, therefore, the whole of the work fell into my hands. I spent three or four days at the beginning of January in camp alone on Karewa; but, although a month earlier in the season than on the occasion of the previous visit, I was again unsuccessful in procuring a single egg of the tuatara.

I made, however, a step in advance by discovering the external differences between the sexes. We had been assured by those familiar with the tuatara that there was no difference in the external characters of the sexes, and this statement seemed to be borne out by what we could learn from the literature of the subject. Thus, Dr. Newman, the latest writer on the subject, said*: "The males are so like the females that they have not yet been distinguisued with certainty."

"The male tuatara has no special strong marked tints, no special personal attraction; and, unlike the males of several other species of lizards, are not much, if at all, bigger than the females. The absence of special sexual attributes is perhaps due, &c."

On dissecting and carefully comparing a number of tuataras, I found that the current statements were not correct. There need seldom be any difficulty in distinguishing the sexes; the male is much larger, and has the crests on neck and back far more strongly developed. In the fully adult male, the crests with their white spines are very conspicuous; in the female, the crests are low, and the spines are reduced to a row of white points along the back. The male, too, is of more robust build, its coloration is somewhat brighter, and it is more pugnacious. During the breeding season the crests in the male become at times turgid and swollen, the spines standing stiffly up, and giving the animal a much more antique and grotesque appearance. It must be noted, however, that a good deal of variation occurs in both the tints and brightness of colour in both sexes, and the spines are larger in some females than in others.

The discovery of the external characters of the sexes showed me that all the tuataras I had kept for the past year (twenty-nine in number) were males. This arose chiefly from the fact that males are more easily obtained than females; but it is possible that our desire to obtain the largest, most vigorous, and fully adult animals for breeding accounts in part for our having retained only males for breeding purposes.

On the occasion of this second visit I secured as many females as I could, but found more difficulty in obtaining females than males, so that I set a number of males at liberty as being superfluous. The apparently greater abundance of the males is perhaps due to the females seeking concealment more than the other sex; at any rate, I am led to suggest this from the observation of my tuataras kept in confinement. The instinct of concealment would, of course, be of special value to a female laden with eggs.

Notwithstanding that I now possessed a dozen pairs of tuataras, no eggs were obtained till the following summer. The lizards had been kept in large houses and were well cared for, and appeared in good health, but would not breed. Captivity would seem to interfere with their reproductive powers, an effect which would hardly be anticipated with animals of so sluggish a nature.

I could only refer their sterility in confinement to a change in some of the conditions of life consequent on captivity, and endeavouring therefore, to make their surroundings approximate more closely to the natural ones, I had still larger houses constructed, and extensive runs on the open ground enclosed.

It was not, however, till January, 1889, that eggs were obtained, and even then some of them were infertile. Weary of the constant watching of the lizards in previous summers, I took a short holiday at the New Year, and during an absence of five or six days a female

* "Transactions New Zealand Institute," vol. 10, p. 225.

lizard died, but was not noticed by the attendant in charge. On my return I found that it had contained twelve fully formed eggs; they had, however, began to putrefy. A second female laid ten eggs, which proved infertile. A third, which promised well, died from inability to lay its eggs. It was closely watched, and dissected within an hour of its death. The oviducts contained four and five eggs respectively, fully formed and ready for laying. From these eggs were obtained a number of embryos at various stages of development, from a stage equal to a two days' chick up to a stage shortly before hatching. This year I hoped to obtain a further supply of embryos, but only one female has laid, and her eggs were infertile.

The eggs of the tuatara are oval in form, both ends being of equal diameter, and vary in length from 2·5 to 3·35 cm. The egg-shell is probably much like that of other oviparous lizards, being tough, flexible, and very elastic; it contains a varying amount of carbonate of lime. The eggs dry and shrivel with great readiness when exposed to the air, and must, therefore, be kept in damp surroundings. On the other hand, excess of moisture encourages the growth of micro-organisms in the mucus with which the eggs are frequently covered when laid, and such foreign growths tend to the destruction of the contents.

On the whole, the general features of the development are closely similar to those in other lizards; I propose, therefore, to reserve the details until a complete account can be given. I may, however, mention that the pineal eye becomes a promint feature at an early stage. When pigment is deposited in the skin, an oval spot is left free from it over the eye, and through this the dark pigment of the retina shows clearly. Spencer has stated that there is in *Sphenodon* very little external trace of the pineal eye. This is true of the adult, but in the recently hatched tuatara the pineal eye still shows as a dark spot through the translucent skin over the parietal foramen. This I have been able to observe even in a tuatara 8 inches in length. But as the tuatara grows older the skin over the pineal eye becomes more opaque, and though in some individuals the scantier development of the pigment over the parietal foramen affords a feeble indication of the position of the eye, yet in others the pigment is deposited there as elsewhere, so that all external trace of the eye is finally lost.

GENERAL NOTES.

"The Birds of New Zealand."—Lovers of books will regret to learn that two shipments of Sir Walter Buller's "Birds of New Zealand" have been lost at sea. In the early part of last year over a hundred copies of this work destined for Auckland subscribers went down in the ill-fated steamer "Maitai," when she struck on a rock off Mercury Island; and now, by the mysterious loss of the barque "Assaye," on her voyage from London, one hundred and forty more subscribers' copies have disappeared. The edition having been strictly limited to one thousand, and the colour stones having been destroyed (so as to keep faith with the subscribers), the commercial value of the copies that remain ought to be considerably enhanced; indeed, we are informed that Messrs. E. A. Petherick & Co., the well known Sydney booksellers, sold their last copy for £16, being five pounds in excess of the original price paid by original subscribers in this colony. Subscribers who possess this work will, however, do well to retain it; for there is no reason why it should not, like the former edition, rise to a phenomenal value in the course of a few years. The cost of producing the highly finished illustrations in colours is so enormous that it is hardly likely ever to reach a third edition; whilst on the other hand, the birds themselves are becoming so rapidly extinct that ere long many of the species will be a mere memory of the past. We have lately seen a letter from Sir George Grey, in which he refers to it as "a valuable and beautiful work," which he has added to his munificent gifts of books to the Auckland Free Library. Professor McCoy, F.R.S., the accomplished Director-General of the National Museum at Melbourne, who is himself engaged on the Fauna of Victoria, says, in a letter to Sir Walter Buller:—"I congratulate you "heartily on the magnificent work which you have completed—taking "letterpress and figures together, far and away the finest local Fauna "the Colonies have seen. You have shewn the way, but it will be "very hard indeed to follow."

The Spread of Ferrets, Weasels and Stoats in the South Island.—The action of the Government of this colony in introducing these noxious vermin, at the instigation of a few runholders, proves to be a most disastrous experiment as far as the indigenous avifauna is concerned. The following extract is instructive. It is taken from the report furnished to the Surveyor-General by Mr. G. Mueller, Chief Surveyor of Westland, of a "Reconnaissance Survey of the head-waters of the Okuru, Acton, and Burke Rivers, Westland," and appears in the last report (1890) of the Survey Department. Mr. Mueller says:—"During the past summer several weasels and ferrets were caught and killed at the Okuru and Waiatoto settlements. These creatures were taken close to, and some within a mile from, the sea coast. To the question as to where they come from there could be only one answer: nobody introduced them into Westland, and hence they must have been the progeuy of those imported by the Government, and must have found their way across the Dividing Range, from either Otago or Canterbury, or both. But in the absence of any signs of rabbits about the coast settlements, it is difficult to understand what brought these creatures over. This mystery was effectually cleared up on my exploration trip. We were prepared to meet with rabbits on the first day's travel inland, but we were disappointed. It was not until we got near the Actor, about nineteen miles from the sea-coast, that we noticed the first traces of rabbits, and it was not until we got to the very head-waters of the Okuru that we saw the rabbits in numbers. The ferrets and weasels, no doubt came up the Dividing Range with the rabbits, but as soon as they discovered our ground-birds—our kakapos, kiwis, wood-hens, blue-ducks, and such like—they followed up the more palatable game. This is what brought the ferrets and weasels down to the coast settlements, and the rabbits on our side of the dividing range will henceforth be left undisturbed and be allowed to spread as they please. Past experiences have satisfied me that rabbits never will do much mischief on the West Coast. Years ago they were turned out in several parts of Westland—parts most favourable to them, open lands and sandhills—but they all died out. The climate is evidently too damp for them, and they certainly will never thrive in our dense bush-country. But, as regards the ferrets, weasels, &c., they will thrive, and will continue to thrive until the extermination of our ground-birds, which has now begun, is fully accomplished. That I am not prophecying evil without good ground I may prove by the following:—In all my explorations on the coast, the certainty of getting a good supply of birds made it possible to keep the provision swags, which men had to carry, within reasonable weights and dimensions. On this last trip of mine rather more than the usual amount of provisions was taken, but in spite of this precaution, the party had to be put on short rations for the last three days—namely, one scone per man per day. The further inland the more plentiful the birds, used to be the rule; but that is reversed now. At the head of the Okuru and the Burke some nights passed during which we never heard the screech of the kakapo or the shrill whistle of the kiwi; and, as for the blue-ducks, we saw only three during the whole time we were out. In former times while camping near the head-waters of any of the rivers, the fighting of the kakapos amongst themselves, and the constant call of the other birds around the tent and camp-fire during the night, often kept people from sleeping. This has all changed now; at least in the southern part of the West Coast absolute stillness reigns at night, and there is nothing to keep a traveller from sleeping, except owing to the absence of birds—an empty stomach."

"Select Extra-Tropical Plants," by Baron Ferd. Von Müeller.—This valuable work has now reached its seventh edition, and is greatly enlarged in bulk and usefulness. Every species of useful plant suitable for cultivation within the temperate and warm temperate zones is treated of, its general character, uses, and native habitat being given. At the end are given tables, indicating all the genera of these plants according to their uses, thus greatly facilitating reference. Other useful tables give (*a*) the names of the plants according to their geographical distribution, (*b*) important cultural plants arranged according to the length of time they require to yield a return, (*c*) those adapted for a frostless climate, (*d*) those adapted even for very cold regions, and (*e*) those fitted even for the driest climate. A very full index to vernacular names concludes this useful volume. Editions of this useful work have already appeared in India and the United States. It has also passed through a German edition by Dr. Goeze, and a French recast by Professor Naudin. It is also appearing now in a Spanish translation by Professor Kurtz. These facts show how much the work is in demand among all the colonising peoples of the world.

Forthcoming Botanical Works.—All botanists will be rejoiced to hear that "The Student's Handbook of the New Zealand Flora," by Mr. Thos. Kirk, F.L.S., of Wellington, is now in the printer's hands, though it will probably not be completed for some time yet. Judging by the specimen pages received, the work will be of a very handy size and excellently printed, while the author's name is a guarantee of its botanical value.

Another work, which will very shortly be published, is an "Introduction to Structural Botany, for use in New Zealand Schools," by Mr. Geo. M. Thomson, F.L.S. It will be a small volume of about 150 pages illustrated by over 200 figures, drawn on wood by the author.

Both works are being printed at the Government Printing Office.

Are there any Freshwater Crayfish in Fiji.—A freshwater crayfish belonging to the same genus as those from New Zealand —*Paranephrops*—is said to be found in Fiji, and is mentioned by Professor Huxley in his paper on Freshwater Crayfish in the "Proceedings of the Zoological Society, 1878," p. 770. The statement appears to rest on specimens in the British Museum, and Professor Walter Faxon in his "Revision of the Astacidæ," suggests that the locality-labels are perhaps erroneous. For some years past I have been watching for an opportunity to get specimens from Fiji if possible, so as to settle the question, but it was not till this year that I could hear of anyone to collect for me. Through Professor Hutton I then became acquainted by correspondence with Mr. H. H. Thiele of Nansori, Fiji, and this gentleman very kindly set to work at once to collect for me, and I received a bottle of specimens from him in August last. Unfortunately, however, these specimens turned out to be Freshwater Prawns or Shrimps (*Palaemon*), not Crayfish (*Paranephrops*), so that they were of no use in settling the particular question at issue. However it seems that Freshwater Crayfish must undoubtedly exist in Fiji, for in October, 1889, Major W. G. Mair kindly wrote to me to say that his late brother, H. A. Mair, who is well known as a keen observer and collector in Natural History, had lived for some years in Fiji, principally in Ovalau and Viti-Levu, and had caught Crayfish in the mountain streams of these places, which appeared to him to be identical with those found in Rotorua, Rotoiti, and other lakes of the North Island. If any of the readers of the "New Zealand Journal of Science" can give me any further information on the matter, or can get specimens for me I shall be much indebted to them.—Chas. Chilton, Port Chalmers, 6th December, 1890.

New Zealand Entomology.—Our readers will be glad to learn that Mr. G. V. Hudson of Wellington is about to publish a popular handbook of the insects of New Zealand, with coloured illustrations from drawings by himself. The book will be issued at Ten Shillings, and will form an acceptable addition to our local literature. A reference to this publication will be found at p. 48, in the report of the meeting of the Wellington Philosophical Society, held on 29th October.

MEETINGS OF SOCIETIES.

OTAGO INSTITUTE.

Dunedin, 14th October, 1890.—Rev. H. Belcher, M.A., LL.D., President, in the chair.

Papers.—(1) "On a new parasitic Copepod," by Geo. M. Thomson, F.L.S. The author described and figured a new species of *Lepeophtheirus* which was forwarded to him by Mr. J. F. Erecson, of Waipapapa Point Lighthouse, and which he has named after that excellent observer and collector *L. Erecsoni*. It is a small species, and was taken in considerable numbers on the bodies of the Moki (*Latris ciliaris*). Mr. Thomson then gave a popular account, aided by numerous diagrams, of the form, development and mode of life of the ecto-parasites belonging to the Copepoda.

(2) "On two new species of Cumacea," by Geo. M. Thomson, F.L.S. The author pointed out that no Crustaceans of this group had previously been found in New Zealand. The two species described and figured belong respectively to the genera *Cyclaspis* and *Diastylis* and were taken with the dredge in the Bay of Islands. Small specimens of the *Cyclaspis* were also taken with the surface-net in Otago Harbour.

The genus *Cyclaspis* was originally founded on a deep-sea form *C. longicaudata*, found by Professor Sars off the Coast of Norway and again at great depths in the Atlantic. A second species was subsequently found in the Mediterranean, and the "Challenger" Expedition brought back three more, all belonging to the Australian seas. The New Zealand species though very distinct from all the others appears to be most nearly allied to the Australian *C. pusilli.*

The genus *Diastylis* is largely represented, especially in the Northern Ocean. The local species appears to be quite distinct from any of the 31 species previously described.

(3) "Notes on the New Zealand *Squillidæ*," by Chas Chilton, M.A., B.Sc. In this paper it was shown that the two species of *Squillidæ* given in Miers' "Catalogue of the N.Z. Crustacea," viz:—*Squilla nepa* and *Gonodactylus trispinosus*—are not represented from New Zealand in any colonial collection, and that it is very doubtful whether they really belong to the New Zealand fauna. The only species actually known from New Zealand are *Squilla armata* recorded from Wellington by Mr. T. W. Kirk, and *Lysiosquilla spinosa*, the latter being taken to include *Coronis spinosa* Wood-Mason, *Squilla indefensa* Kirk, *Squilla lævis* Hutton, and *Squilla tridentata* Thomson. This species is widely distributed over New Zealand and the adjoining islands. Both sexes are fully described and measurements for comparison with the species described by Brooks in the "Report on the 'Challenger' Stomatopoda," are also given. The peculiar structure found on the endopodite of the first abdominal appendage of the male is also described and figured.

(4) "On the changes in form of a parasitic Isopod (*Nerocila*)," by Chas. Chilton, M.A., B.Sc. This paper contained a few notes on a parasitic isopod—*Nerocila macleayii*, Leach, of which *N. novæ-zealandiæ*, Schiödte and Meinert, is considered a synonym. The younger forms which differ from the adult females in the breadth of the body, eyes, prominence of epimera, &c , are described and compared with the adult, and figures of each are given.

(5) "On the origin of the Sternum," by Professor T. Jeffery Parker, F.R.S. The author contrasts the two forms of Sternum found in Vertebrata, the costal sternum of Amniota and the omo-sternum (pre- and post-omo-sternum) of Amphibia, and attempts to show how, in spite of their different ontogeny, they may be genetically connected. He also describes the shoulder-girdle of *Natidanus indicus* and draws attention to the fact that its mid-ventral portion is formed by two distinct cartilaginous elements, apparently the pre- and post-omo sternum. This appears to be the first instance hitherto recorded of the occurrence of a sternum in fishes.

ANNUAL MEETING.

Dunedin, 18th November, 1890.—Rev. H. Belcher, M.A., LL.D., President, in the chair.

Paper.—The President read a paper on Ibsen's Works.

ANNUAL REPORT.

The Secretary (Professor Gibbons) read the annual report as follows :—

In presenting their report for the past session the council has to again express its regret that the meetings of the society have not been more largely attended by the members and the public. The system of sending out post cards to members on the eve of each meeting has been abandoned in favour of putting an advertisement in the newspapers, without producing any appreciable change in the numbers attending the meetings. A conversazione was held on March 1, during the visit of the Senate of the New Zealand University to Dunedin. During the session six general meetings were held. At the first an interesting account was given by Mr. Chapman of his visit to the outlying islands south of New Zealand when he exhibited maps and specimens of the birds and plants obtained on them. At the July meeting a paper "On the extinction of the Moa" was read by Rev. Mr. Christie, of Waikouaiti; and at the September meeting a paper "On the food of the Moa and its extinction," by Mr. Vincent Pyke, was also read. At the August meeting a paper "On the philosophy of David Hume" was read by Professor Salmond. At the other meetings papers were read as follows: —"A new species of Megeis," by Mr. Goyen; "Description of Native plants," by Mr. Petrie; "The etymology of the Penguin," by Dr. Belcher; "On the Cat in Ancient Italy," by Dr. Belcher; "On the anatomy of the Red Cod (*Lotella Bacchus*)" by Mr. Beattie; "The New Zealand Squillidæ," and "The change in the form of an Isopod," by Mr. Chilton; "On a new parasitic Copepod," and "Two species of Cumacea," by Mr. Thomson; "On the origin of the Sternum," by Professor Parker. In the course of the session a new bookcase has been obtained for the library, to which numerous additions of books have been made, including Day's "Fishes of India"; and a large number of back volumes of periodicals have been bound. A microscope-attachment to the magic lantern has been obtained, which the council hope will prove an additional attraction to the meetings. During the session four new members were elected. The number on the roll is now 123, of whom 10 are life members. The balance-sheet shows a balance from last year of £76 2s. 1d., subscriptions to date £129 2s. 6d., making total receipts £205 4s. 7d. Cash expenditure, £96 5s. 7d.; leaving a credit balance of £108 19s. The liabilities amount to £50. There is also a sum of £277 14s. standing in the bank on fixed deposit.

On the motion of Mr. A. Wilson, M.A., the report was adopted.

The following gentlemen were elected office-bearers for 1891 :—President: Professor F. B. de M. Gibbons, M.A. Vice-Presidents: Rev. H. Belcher, M.A., LL.D., and Mr. C. W. Adams. Hon.

Secretary: Mr. A. Hamilton. Hon. Treasurer: Mr. E. Melland. Council: Professors Parker, F R.S., and Scott, M.D., Drs. Hocken, F.L.S., and de Zouche, Messrs. F. R. Chapman, D. Petrie, M.A., and Geo. M. Thomson, F.L.S. Auditor: Mr. D. Brent, M.A.

Mr. D. Brent mentioned that the Otago Institute had now come of age—that was to say, it was just 21 years old. On July 3, 1869, Mr. J. S. Webb, who took a very active part in the foundation of the institute, convened a meeting in the long room of the Athenæum Hall, at which Dr. Hocken was also present. About three weeks afterwards a meeting was held in the Provincial Council library, at which the Otago Institute was formally constituted. A list of the original members showed 80 names, and on looking over it he was surprised to find that 20 of them still belonged to the institute. They were:—Messrs. C. W. Adams, G. M. Barr, A. Bathgate, L. O. Beal, A. Beverly, D. Brent, Robert Chapman, W. Fraser (Earnscleugh), Dr. Hocken, James M'Kerrow, W. Martin (Green Island) A. C. Purdie, E. C. Quick, James Rattray, Hon. W. H. Reynolds, G. G. Russell, H. Skey, and Sir R. Stout. Others had left the colony, but the following original members had since passed away:—Messrs. W. Arthur, Dr. Borrows, R. Gillies, S. Hawthorne, W. Langlands, J. Macandrew, W. D. Murison, A. C. Strode, and J. T. Thomson. Judge Ward presided at the meeting to which he had just made reference, and Messrs. J. S. Webb and Dr. Hocken were the first joint secretaries.

WELLINGTON PHILOSOPHICAL SOCIETY.

Wellington, 23rd July, 1890.—Charles Hulke, F.C.S., President, in the chair.

New Member.—Mr. J. W. Poynton.

Papers.—(1) "Curiosities of Polynesian Speech," by E. Tregear, F.R.G.S. Mr. Tregear said that having been for some years employed in the comparative study of the Polynesian dialects, he had devoted himself to the task of collating different vocabularies and putting them into a position wherein they could be easily examined. The Maori language was a branch of a great family of human speech, and any effort made to understand it in its original purity would fail if it was studied without the light thrown upon it by the sister dialects. In many of the islands inhabited by the fair Polynesians letters had been lost from their alphabets, and the work of an investigator was cramped if he had not the time or energy to accumulate the material at present lying in a chaotic state. His Comparative Dictionary was an endeavour to produce a work tending to simplify this labour, and to allow a student to perceive at a glance what words or probable words were equivalent to those in use in New Zealand. Any attempt to compare the Polynesian language with the speech of peoples dwelling on the great continents would also be simplified by the existence of such a handbook. During the course of his investigations he had searched through hundreds of old poems, legends, &c., and had compared the mythologies, genealogies, &c., of celebrated deities, and heroes, as given in New Zealand, Samoa, Tahiti, Tonga, Raratonga, the Marquesas, Hawaii, &c., in order that the book might serve as a classical dictionary for Polynesia. The work had proved so interesting to him that he believed some of the results might also be of interest to the members of the Society, and he proposed to adduce some examples of words, showing the curious letter-changes and remarkable distortions of meaning in many cases. Mr. Tregear then gave at length comparatives and meanings of the Maori words *koi, kao, ehu, ike, huru, hono, whenua, raumati, kerokero, taurekareka, erangi, ua, whakairo, mua, hoa, mahara, kokiri, tareparepa, mangere, romi,* &c, &c.

In the second part of his paper Mr. Tregear said, that the habit of substituting a lost consonant between two vowels, or before a word commencing with a vowel, became so confirmed with one accustomed to study the Eastern Polynesian dialects that it was almost impossible not to read Maori in the same way. Some of the words used by the Maori people had a double form, with or without the *k;* and other words, if compared with similar forms in the different dialects, appeared to have lost a consonant. It was possible, he believed, by comparative study, to restore the lost consonants in the Maori language, although it would need much study and great care. The result of his research was that, although the New Zealand Maori had lost less than any of the other Oceanic dialects, it was by no means the primitive and virgin speech commonly supposed.

The President congratulated the members upon the fact of this paper being the first one that had been offered in competition for the Society's medals, although he was afraid that the author would have the field to himself. As regards this paper it was a most interesting one, not only on account of the subjects but on account of the manner in which the subject had been treated. Those who took an interest in these matters should be thankful for any addition made to our knowledge of these dialects; the more so when such work was done as a labour of love. The way in which the author had made a comparative analysis of the different Polynesian dialects threw a new light entirely upon them. Some persons might consider such a paper dry, but the author, from the novel manner in which he had treated his subject, had made it very interesting, and the suggestions were extremely valuable. The great value of this paper lay in the author's views on the reconstruction of the originals of the numerous dialects in use in Polynesia.

(2) "On the New Zealand *Cicadæ,*" by G. V. Hudson, F.E.S. The author began by drawing attention to the erroneous name of "locust" which was frequently applied to the *Cicadæ,* and pointed out that they had no manner of affinity with that family of insects. Allusion was also made to the fact that they were essentially characteristic of the tropical and warmer temperate regions of the world. The apparatus which enables the males to make the well-known chirping was then briefly described, as well as the ovipositors of the females. Six species of *Cicadæ* were noticed, and their habits, &c., described, two of which, *Cicada singulata* and *muta,* were already known, and four, *C. tristis, C. aprilina, C. cassiope, C. iolanthe,* were new species. The author then recounted a few observations he had made on the life-histories of the *Cicadæ,* and pointed out what a large amount of investigation was still needed in that direction.

Mr. T. W. Kirk was surprised that this interesting genus had hitherto been almost passed over by New Zealand entomologists. The paper just read would be extremely welcome to naturalists. As far back as 1872, the late Dr. Powell described, in the "Transactions of the New Zealand Institute," the stridulating organs of the New Zealand species, and about two years ago Mr. Lucas did the same for Australia. Mr. Hudson made no mention in his paper of the destructive habits of the *Cicadæ.* A few days after the female emerged she commenced to lay. Making a longitudinal slit in the bark of the tree, she proceeds to saw a number of V-shaped cuts in the wood so as to raise the fibres and prevent the bark from healing. She then deposits her eggs in pairs in each wound. The total laying sometimes amounts to hundreds. The female then dies, the eggs hatch, and the young grub drops to the ground, and then undergoes the transformation mentioned by Mr. Hudson. The *Cicada* prefers the Manuka, but nothing comes amiss, and the young shoots of orchard trees sometimes suffer considerably; the damaged shoots, if not killed, generally break off when the fruit begins to swell. As regards the pupa being mistaken for mole-crickets, he might say that there certainly were veritable English mole-crickets in New Zealand. He had exhibited specimens which were alive when received.

Mr. Maskell had seen twigs of fruit- and other trees damaged by these insects, but he did not think the urgency was so great as supposed; still it was sufficient to make those concerned take steps to prevent it.

Mr. Hudson, in reply, said that he had not in this paper gone into the subject of the eggs of the *Cicadæ;* indeed he had great difficulty in procuring eggs, and would be glad to get them from any member.

Wellington, 13th August, 1890—Charles Hulke, F.C.S., President, in the chair.

Paper.—"On some Means for increasing the scale of Photographic Lenses, and the use of telescopic powers in connection with an ordinary Camera," by Alex. McKay, F.G.S. This is a discovery in the art of photography, by which, through the use of telescopic powers in connection with an ordinary camera, photographs of remarkable correctness in all matters of detail may be taken several miles distant. (The author described in detail the series of experiments he had made in perfecting his process.) In the first place, by the use of a telescopic eyepiece, consisting of one or more dispersion-lenses of different powers, photographs on an increased scale, and greater size can be produced from the same standpoint without it being necessary to use a camera other than that which is fitting to the photographic object in the first instance. The instrument may also be used in connection with microscopic photography. Secondly, a travelling screw, connecting the two parts of the telescopic tube, which, with a thread of, or approaching, 40 to the inch, affords the required degree of nicety in adjusting the objective and the eyepiece. Thirdly, a focusing-glass or eyepiece, to be used in the position of the focusing-screen, enables the use of a focusing-cloth to be dispensed with, and also the screen in giving the final and highest degree of sharpness to the picture, and by means of a sliding part or travelling screw it may be made to adjust differences in the length of the foci resulting from the use of imperfect lenses in the other optical parts of the instrument. Mr. McKay concluded by stating that he was taking steps to procure protection of his invention, and in due time he hoped to secure patent rights for the same, and such other improvements as may yet be effected. Several hundreds of views of the North and South Island taken by the new process were afterwards shown with a lantern, and comparisons made with those taken by the ordinary process.

Mr. W. T. L. Travers expressed the opinion that the discovery would completely revolutionise photography, and would prove most valuable for astronomical research and for the purposes of warfare.

Sir James Hector considered that the thanks of the Society was due to Mr. McKay for having brought his important discovery before the members. He had perfected his invention after years of work and at great expense.

Mr. Field said he suspected the so-called invention was no new thing, as he had seen photographs of Auckland which, taken from the North Shore, showed the minutest details of the buildings and shore line on the opposite side of Waitemata Harbour.

Mr. R. C. Harding said that the possibilities of Mr. McKay's discovery seemed only to have been faintly indicated in what had been said that evening, and, for his own part, he was most impressed by its value in connection with the graphic arts. The comparative views of the same landscape as taken by the ordinary lens and by the telescopic combination were specially interesting and instructive; and the question had been raised as to which of the two processes was the more artistic, or more closely resembled the effect to the eye. The difference between two such photographs was obvious, and the question raised was one in dispute among artists themselves. It was the accepted practice in painting to give well-defined detail both to near and distant objects, though it was impossible for the eye, without a change of focus, to recognise both in nature. Hence the contention of the impressionists that the conventional style was false, and the practice on their part of representing some portion of the picture in detail and slurring over the rest. He considered that the conventional art and the pictures taken by Mr. McKay's process, representing both the nearest and most distant objects with perfect clearness, were truer, both to art and nature, as the necessary change of focus in the human eye was so rapidly and unconsciously effected. Mr. McKay's discovery, therefore, was quite as important on artistic as on scientific grounds.

The President (Mr Hulke) said that members had overlooked the fact that Mr. McKay's discovery would materially lessen the load photographers have to carry at the present time, and that the number of lenses required would by the same means be lessened. The pictures referred to by Mr. Field were taken by a good but ordinary instrument. Mr. McKay's invention would be invaluable to geologists.

Wellington, 8th October, 1890.—C. Hulke, F.C.S., President, in the chair.

New Member.—Mr. W. Barton.

Papers.—(1) "Further Coccid Notes, with descriptions of new species from New Zealand, Australia, and Fiji," by Mr. W. M. Maskell. The author said that as this was a technical paper he would not read it in full. He might explain that it was in continuation of similar papers read last year and in former years on work he had been engaged in for the last fourteen years. It described about twenty new species—five from Australia, one from Fiji, and the rest from New Zealand. Plates figuring these accompanied the paper. The paper also contained remarks on formerly described species in this and other parts of the world. He also exhibited about 150 different species of insects, including those he had already described, together with others from various localities. He regretted much that entomologists generally did not think it worth their while to study this particular family, the coccidæ. He believed that he himself was the only person in New Zealand who had published anything about it. Outside New Zealand there were not more than eight or ten who gave attention to scale insects. This was a bad thing, and he felt it much, as he had here no one to discuss the subject with, or to correct him if he fell into any errors. Two gentlemen at Reefton collected for and assisted him greatly, but they did not write on the subject and relied entirely on him for determinations—there was no one to keep him straight, so to say. But chiefly he regretted that entomologists would not depart from the general groove of butterflies, moths, and beetles. We knew pretty well all that can be known of these; at least their study had been so close that the varieties seemed now-a-days only trivial. In the coccidæ there was infinite variety and work of the greatest interest—a variety of life-history, habits, and customs that seemed greater than that afforded by any other branch of entomology. He gave instances of peculiarities in these insects—wonderful vitality in some cases, and about the boring habits of one particular insect after it had thrown off legs, mouth, &c.—all tending to prove that these little despised creatures were more interesting for study than all the butterflies.

Mr. Hudson said that he wished to say a few words on the subject of general entomology. While fully appreciating the great value and interest attaching to the study of the coccidæ he felt confident that any other family of insects closely investigated would yield equally interesting results. After showing the limited extent of the coccidæ, compared with the remainder of the great class insecta, he pointed out the vast variety existing in the habits of various other families and orders, commencing with the lepidoptera. He said that some fed on the leaves of plants, some on roots, some burrowed in the stems of trees, making a trap-door to protect themselves from enemies. Others again constructed cases which they dragged about with them, while others, among the minute species, tunnelled between the layers of leaves, lived in the kernels of fruits, nuts, seeds, &c., &c. Their mode of passing the winter was equally varied. Some hibernated, laying their eggs on the sprouting plants in the spring, others spent the same period in the ground or in cocoons as pupæ, others hibernated as larvæ, while others again passed the inclement months in the egg state. Turning to the coleoptera or beetles, equal variety in habits was found to exist. Many species burrowed through trees in the larva state, others were carnivorous, forming pitfalls in the earth to capture their prey. As a striking instance of diversity of habit the genus *Sitaris* was mentioned. This beetle laid an enormous number of eggs near the entrance to the nests of various species of solitary bees. These eggs hatched out as minute active insects with six legs. Numbers of them perished, but a few managed to jump on to the bees as they visited their nests. Here the larva remained until the bee was in her own cell, where she deposited an egg which floated on the top of the honey that the bee had industriously stored up for her offspring. As soon as the *Sitaris* larva got a chance it left the bee and jumped on to the egg, which it then devoured. Casting its skin it now appeared as an ordinary beetle-grub, feeding on the honey until it was all consumed, when it was transformed into a pupa, from which the beetle finally issued. The remarkable habits of social insects were also alluded to, and the number of the other orders of insects compared with the hemiptera, of which the coccidæ were but a small family. He did not wish to detain the Society further, but hoped that he had said enough to show that the whole insect world was teeming with interest and variety.

Mr. Travers: The great value of Mr. Maskell's work has been the determining of insects that have been so injurious to our fruit and other trees, and the pointing out of remedies to be applied to prevent damage. The fruit-growers of New Zealand are under great obligations to Mr. Maskell; so that although Mr. Maskell's labours are principally of value from a scientific point of view, yet for economic purposes they have been of the greatest benefit. Had it not been for his great labours many of these pests would have escaped observation and have gone on doing the greatest mischief. Beetles and other insects are also very injurious to trees, and are easily introduced from other countries, so that anyone who devotes his attention to the observation of the life-history of such objects is deserving of credit.

Mr. Maskell, in reply, said he did not wish it to be understood that he thought the study of other forms of insect life had no interest. He considered, however, that there was very little new to be gathered in other branches of entomology—the subject of butterflies and beetles had been pretty well worked out, while there was still so much to learn from the study of the coccidæ. What he was doing now was purely for science—he was rather sick of the economic side of the question. His reasons were partly personal, no doubt, as he found great numbers of persons ready to ask advice as to the means of treating their trees and improving their property, but nobody seemed to recollect that their adviser might have economic necessities of his own, or to think it necessary to offer the least remuneration for the advice. But, principally, he found that whatever counsels might be given, the chief object of many persons seemed to be to introduce at once confusion and uncertainty. For example, in the case of phylloxera, which is now well-established in New Zealand, in view of the wretched obstructiveness of the colonists, he had considered it his duty to strongly recommend to the Government and to Parliament the total destruction of all vines in the infected districts. At once the newspapers threw, as it were, a wet blanket over the proposal by terming it "drastic," a word which frightened everybody; members of Parliament with a general election in view declined to study the real interests of their constituents in comparison with their votes, and so nothing was done, and phylloxera is now spreading at its own sweet will through the North Island. In fact the "economic" side of the matter was enough to sicken anybody, and he had in the present paper left it entirely aside.

Mr. Hulke: Mr. Maskell's remarks on this subject were most interesting, given as they had been to-night in a popular manner, and quite within the capacity of all to understand and apply. He considered that Mr. Maskell's work had not only a great scientific value, but had been most beneficial to agriculture generally.

(2) "On the Life History of the New Zealand Glow-Worm," by G. V. Hudson, F.E.S. The author gave a most interesting account of these curious insects, and illustrated his remarks by drawings of the stages of development of the worm. He dwelt particularly on the peculiarity of the light given by these creatures in all their forms of growth.

Mr. Travers said that these worms were first mentioned by Hochstetter, but he did not think they had been described.

Mr. Maskell: Has the light been microscopically examined? Could it possibly be phosphorent infusoria? It might not be at the will of the insect that the light went out, as described by Mr. Hudson. He was sorry that Mr. Hudson did not describe the insect himself, instead of sending it to some one else to do. He thought Mr. Hudson was quite able to describe his own insects.

Mr. Poynton was of opinion that the extinction of the light was quite a voluntary act on the part of the worm. He had seen numbers on the West Coast, and was quite satisfied of this.

Mr. Hudson, in reply, said that he was confident that the extinction of the light of the glow-worm was a voluntary act on the part of the larva, and, as such, could not possibly be due to parasitic infusoria. It was also almost incredible than an aggregation of animalculæ could give such a brilliant light. He felt sure that the organ he had described produced the light at the will of the insect, but its use he was entirely unable to explain.

Wellington, 29th October, 1890.—Charles Hulke, F.C.S., President, in the chair.

It was announced that in conformity with the Act, Mr. Charles Hulke had been nominated to vote in the election of Governors of the New Zealand Institute for the ensuing year.

Papers.—(1) "An exhibition of new and interesting forms of New Zealand Birds with remarks thereon," by Sir Walter Buller, K.C.M.G., F.R.S. The author said that probably no section of New Zealand Zoology had received such careful attention or been so thoroughly worked out as the Birds. Their beauty of form and colour and the peculiar interest attaching to their life history—their natural habits, their song, their wonderful modes of nidification—and their general ministration to the wants and caprices of man, all tended to make the study of our birds more attractive than that of any other branch of natural history. So much had already been written on the subject that it might reasonably have been looked upon as an exhausted field, but so far from this being the case, new forms and characters of bird-life, and new facts in the history of even our commonest species were being continually brought to light, and it seemed to the author that, after the manner of the Zoological Society of London, which had proved so eminently successful, the best mode of bringing observations of the kind before such a Society as this was to exhibit specimens wherever practicable, and to make brief remarks upon them by way of explanation or suggestion. By this means facts and observations of a valuable kind might often be elicited during the customary discussion that follows the reading of a paper. The author then exhibited and remarked upon the following species:—

Miro traversi, Buller. Obtained at the Snares, where it is comparatively numerous. It inhabits the Chatham Islands, but has never been met with in any part of New Zealand, or on the Auckland, Campbell, Antipodes, or Bounty Islands. The author offered no explanation of this very remarkable distribution.

Sphenœacus fulvus, Gray. Also from the Snares, where this species inhabits the trees, instead of fern-beds and swamp vegetation like its near ally (*S. punctatus*) in New Zealand. The author pointed out modifications in structure, apparently the result of this different habit of life.

Prosthemadera novæ-zealandiæ, Gmelin. A very remarkable specimen of the Tui, almost a pure albino, was exhibited, and mention made of several other departures from the normal character.

Platycercus novæ-zealandiæ, Sparrm. A pair from Antipodes Islands was exhibited, showing a larger mixture of yellow in the plumage than ordinary New Zealand examples, and some interesting particulars given respecting the local varieties of this highly variable species.

Gallinago aucklandica, Gray. Of this rare Snipe two specimens were shewn from the Snares and two from the Auckland Islands. The sexes are alike, but the birds from the former locality are some shades darker in plumage than those from the Auckland Islands, and ought perhaps to be referred to *Gallinago pusilla.*

Tringa canutus, Linn. A specimen of this cosmopolitan species (the Common Knot) from Pelorus Sound, just passing into the summer plumage, was next commented on.

Larus novæ-hollandiæ, Stephens. A fine specimen of this bird from Otago was shewn to the meeting, and also an apparently new and undescribed Gull, which was critically compared with *Larus scopulinus* and *Larus bulleri*, to bring out the points of difference.

Ocydromus earli, Gray. An example of the true *O. earli* from Marlborough was exhibited, and an interesting account given by the author of his discovery, that the common Woodhen of the North Island, till then supposed to be *Ocydromus earli*, was really without name. Finding, when he looked over the old type-collection of birds in the British Museum, that Sir George Grey had been one of the earliest and most liberal contributors of specimens from New Zealand, he decided to dedicate the species to him, and named it accordingly *Ocydromus greyi*.

Nycticorax caledonicus, Gmelin. A very beautiful specimen of the Nankeen Night Heron, with white occipital plumes, rolled in the form of a queue and fully seven inches in length, was then handed round, and gave the author further subject-matter. This bird, presumably a visitant from Australia, was shot at the mouth of Catlins River, in Otago.

Diomedea fuliginosa, Latham. The next subject was a nestling Sooty Albatross, remarkable for its thick covering of warm woolly down, enveloping the body like a great blanket.

Œstrelata mollis, Gmel.; *Œstrelata affinis*, Buller; and *Puffinus gavia*, Forster. The exhibition of a series of specimens of these somewhat rare species was accompanied by a dissertation on Petrels, in the course of which some very curious facts were given.

Puffinus bulleri (so named by Mr. Salvin, the great authority on Petrels) and a species of *Eudyptes* (Crested Penguin), which the author had not yet been able to determine, were the last birds noticed. Of *Puffinus bulleri*, only three specimens are known, one of which is in the Colony, and another in the British Museum collection. Of the Penguin supposed to be new, the author has lately received two specimens from the West Coast Sounds. He concluded his paper with an expression of regret that the unique example of Hutton's Black Penguin (*Eudyptes atratus*) had been lost, with many other treasures, by the wreck of the "Assaye."

Mr. Maskell: The remarks made by Sir Walter Buller, who was an acknowledged authority on the subject of Ornithology, were most interesting, and the specimens exhibited very beautiful. Without wishing to make any reflections on the work done by Sir Walter Buller, he would like to say a few words regarding the establishment of species. It was a rule in almost all branches of science to establish what they called species on grounds that seemed to him very unsatisfactory, and from his own experience and reading for over twenty years he was led to the conviction that scientific works generally were overloaded with species determined in a very vague manner. This applied to all branches of natural science. Mere differences in colour seemed sufficient to account for thousands of so-called species when in his opinion the birds or insects were really the same, but slightly varied. He thought it would be quite as correct to say that all bay horses were of one species and all black horses another, as to say that birds in other respects alike were of different species because they were different in colour. Why should science be so loaded up with differences merely on account of colour, especially as so few agree as to colour, which depends so much on the formation of the human eye? If there is any organic difference that would be quite another matter.

Mr. Hudson would like to remind Mr. Maskell that domestic productions vary more than those in a wild state, because in selecting animals and plants for his use man has always taken those that vary in the direction he requires, hence domestic animals and plants have a tendency to vary in all directions.

Mr. Robert Pharazyn said that the question was largely one of experience—there were some branches of science where colour would not apply, such as chemistry. In natural history colour would have greater weight, but it was really for naturalists themselves to judge from experience. If difference of colour proved to be followed by difference in structure or habit, then it would certainly be reliable. Animals were much alike in habit, and it would hardly apply to them. We must associate colour with other characters before it can be generally used in selecting species.

Mr. McKay said that colour was often the result of a structural peculiarity, and in many instances must be regarded as specific; nacreous and iridescent shells might be mentioned as illustrating this. While believing that colour was never purely accidental, as contended by Mr. Maskell, he did not think that colour-spots in all cases could be used to determine specific differences. With respect to the occurrence of a species of Robin on the Snares and Chatham Islands, but not found elsewhere within the New Zealand area, he thought this might be accounted for on the supposition that the species had established itself on these now separate and distant islands at a time when the Snares and Chatham Islands were connected with each other, and formed part of a large island which also included New Zealand.

Mr. Henley thought the establishment of true species was a matter that was determined by the instincts of the animals themselves. In the cases of tamed quadrupeds, referred to by Mr. Maskell, the animals recognised no distinction—to a horse every other horse was also a horse; every dog recognised his species in any other dog. If this were not so—if gray horses refused to associate with bay horses, and if, except in cases of close confinement, horses of the two colours did not cross, they might fairly be considered to be two species. If they did not cross the colours would be persistent, as a rule, in the offspring. In cases of wild animals and birds if individuals different in colour, but seemingly alike in other respects, never coupled, the colour alone noted a difference of species. Whether this instinct for separate breeding was likely to be present in special instances of birds with peculiar-coloured plumage, only one or two specimens of which birds had been collected, only a specialist was competent to decide, and he would probably base his opinion upon points, the cumulative force of which, sufficiently plain to himself, he might find it difficult to explain to others. If albinos were sporadically produced in sufficient numbers to find albinos for partners, and never obtained partners of the normal colour of the species, they would probably have a large proportion of albinos in their offspring, and would soon form a species that he thought all naturalists would recognise as such.

Mr. T. W. Kirk mentioned having seen a specimen of the Nankeen night-heron near the mouth of the Pahau river in March last. The bird had been slightly wounded, but managed to escape capture. Sir Walter had exhibited an albino tui. Now it was well known that birds in New Zealand showed a decided tendency to assume abnormal plumage. Nor was the peculiarity confined to native species. There was in the Museum a black skylark; he had seen several specimens of goldfinch exhibiting unusual colours; and early this year he had noted a sparrow having white wing-feathers, black head, and normal-coloured tail, while the whole of the remaining portions were a decided red. This specimen lived with a large flock of ordinary sparrows about a wool-shed on the East Coast. Could Sir Walter suggest any theory to account for these frequent freaks? Also could he explain the reason why dimorphic phases of plumage were present in some species?

Mr. Richardson pointed out that on the Kermadec Islands the mutton birds were so numerous as to form an article of food for those who were unfortunate enough to live there.

(2) "Notes on the Entomology of the Inland Kaikouras," by G. V. Hudson, F.E.S. Perhaps one of the most beautiful of the many objects that can be seen, on a clear day, from the hills in the neighbourhood of Wellington, is Mount Tapueawaeonuku, standing prominent on the north-eastern end of the South Island, and having from Wellington a south-westerly direction. It had often been my ambition, while collecting on these hills, to cross the Straits and explore this fine looking mountain which appeared so likely to be teeming with new and interesting insects. How far my expectations were fulfilled will appear from the following account of a visit I made to the district, in company with a friend, last February.

Leaving Wellington at three o'clock on the morning of February 9th, we arrived in Blenheim about midday, remaining there until the following morning, when we left by coach for Kekerangu, where we arrived at five o'clock on the evening of the 11th. The ride is somewhat uninteresting after leaving Blenheim, the country, which is very hilly, consisting almost entirely of tussock-grass. It is absolutely teeming with rabbits, as many as six or eight individuals being often noticed at the same time. The only really striking features on this journey are the gigantic escarpments cut out by the Awatere River.

On the morning of February 12th we left the Kekerangu sheep-station and proceeded straight up the valley for about a mile, where we found the stream divided. Here considerable time was lost in taking the right-hand branch of the stream instead of the left one, along which the track to Mount Tapueawaeonuku goes. In these ravines, which are densely wooded on each side, large quantities of *Mecyna deprivalis* occurred, both as larvæ and perfect insects. We also observed some lovely specimens of *Vanessa cardui*, an insect that has been unusually abundant this year in the Wellington district. About one o'clock we left the bed of the stream, near a small galvanised iron hut, and ascended the hills to an elevation of 1900 feet. The weather was now very gloomy, and we could only obtain occasional glimpses of the mountains between the clouds, which however appeared very imposing. Absolutely no insects were to be seen, and at five o'clock we were very glad to reach Coverham.

Leaving here first thing the following morning, we arrived at the Dee Hutt, situated immediately at the foot of Tapueawaeonuku, about two o'clock in the afternoon. The weather was wet and miserable, so of course no work could be done that day. On Thursday, 13th, we made our way for some distance up the bed of the Dee stream, but found the travelling very bad. Here we only took a few specimens of *Chrysophanus boldenarum*, which slightly differ from those from Nelson and the Wairarapa; also, two *Cicada muta* and a few *Aclenonyx bembidioides* under stones near the stream. We then attempted to make our way on to the hills, but were prevented by the precipitous sides of the creek. At 11 o'clock a thick mist came up, which effectually stopped all further work for the day. On Friday, 14th, we started at six o'clock with the intention of collecting on some of the higher spurs of the mountain. After much difficulty we succeeded in attaining an elevation of 4600 feet, but the outlook from this point was so extremely uninviting that I decided to return. Above 3000 feet *Argyrophenga antipodum* occurred, as well as *Cicada cassiope* and *Notoreas crephos*, besides a few *Cicada muta, var. sub-alpina.* When I say that this was by far the best day's collecting we had, and that all the above species and many others may be taken in great numbers on the Dun Mountain, near Nelson, the extremely unproductive nature of the locality may perhaps be understood.

During the two following days I collected in the Dee and Clarence Valleys, with the result of one grasshopper, resembling very closely the grey stones in the stream, *A. bembidioides*, *Cicindela feredayi*, *Lyrcea alectoraria*, a small black *Larentia sp.* (?) all common and widely distributed insects. I should also mention that the little grasshopper *Caloptenus marginalis* occurs in this district, in countless numbers, amongst the tussock grass.

On Monday, 17th, we returned to Coverham. Tuesday, 18th, was wet, and on Wednesday we ascended the Chalk Range at the back of Coverham. At 2500 feet *Argyrophenga antipodum* again occurred, also *Asophodes abrogia*, besides a small species of *Syrphus*, the three last being the only insects of any consequence taken during the whole expedition.

On Thursday we left Coverham, and on Friday Kekerangu, arriving in Wellington at an early hour on Saturday morning.

In conclusion I must certainly recommend future entomologists in New Zealand *not* to visit the Inland Kaikoura mountains if they wish to have a successful holiday.

Mr. Maskell was well acquainted with this part of the country, and he was not surprised to hear that it was such poor ground for the collection of insects. Large fires had frequently swept the surface of all growth, and this no doubt would be unfavourable to insect life.

Mr. Mackay thought that probably the reason why so few species of insects were found in this locality was that as high and mountainous country this corner of the South Island was of very recent date, and it might be that many species had not yet found their way into the region in question, or had been there for so short a time that by evolution fresh species had not as yet made their appearance.

Mr. Hulke took this opportunity of stating that, as agreed upon at a former meeting, he had in company with Sir W. Buller waited on the Minister of Education to urge the Government to assist Mr. Hudson in the publication of his new work on New Zealand Entomology, with the result that the Government had agreed to take a thousand copies for distribution among the State schools of the colony. He was sure that the members would be glad to hear that they had been so successful.

Mr. Hudson thanked the President, Sir W. Buller, and the members generally for the interest they were taking in the production of his work.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

Christchurch, November 6th, 1890.—Annual Meeting.

Papers.—(1) "New Land and Fresh Water Shells," by H. Suter. (Communicated by the Secretary).

(2) "Miscellaneous notes on Land and Fresh Water Shells," by H. Suter. (Communicated by the Secretary).

(3) "Appendix to Paper on Drift Formation," by J. Hardcastle.

(4) "On the occurrence of Struthious remains in a sub-dolerite bed of laterite, near Timaru," by H. O. Forbes, F.R.G.S. (Communicated by the Secretary).

(5) "On the Earthquake of the 27th December, 1888," by G. Hogben, M.A.

(6) "New Species of Lepidoptera," by E. Meyrick, F.Z.S., &c.

The annual report and balance-sheet were read and adopted. The following is an abstract:—"During the year seven ordinary meetings have been held at which sixteen papers have been read; which may be classified as follows:—Geology and Palæontology (5), Zoology (4), Seismology (3), Meteorology (2), Miscellaneous (2). This shows an advance of five in comparison with the number read last year. There is also a slight increase in membership compared with last year; the number now on the books being 98, as compared with 86 in 1889. At the meeting in May, Mr. J. T. Meeson was elected President in the place of Mr. S. H. Seager resigned. Mr. R. W. Fereday was elected Vice-President in place of Mr. Meeson. There is a credit balance of £24 10s. 1d.

The following were elected officers for the ensuing year:—President: Prof. F. W. Hutton, F.G.S. Vice-Presidents: J. T. Meeson, B.A.; T. W. Naylor-Beckett, F.L.S. Treasurer: J. T. Meeson, B.A. Secretary: R. M. Laing, M.A., B.Sc. Council: R. W. Fereday, F.G.S., W. H. Symes, M.D., R. H. Webb, F.R.M.S., — Jennings, M.D., G. A. Mannering, F. Barkas.

The retiring President read an address, and the newly-elected President dismissed the meeting.

Matthews, Baxter & Co., General Printers, Dowling Street, Dunedin.

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THE NEW ZEALAND JOURNAL OF SCIENCE

DEVOTED TO THE FURTHERANCE OF
PURE AND APPLIED SCIENCE THROUGHOUT THE COLONY.

Judicio perpende: et si tibi vera videntur
Dede manus: aut si falsum est, adcingere contra.

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THE FORTHCOMING "FLORA" OF NEW ZEALAND.

Our last issue contained the announcement that there is every prospect of the early appearance of a new Students' Flora of the colony, from the pen of Mr. Thos. Kirk, F.L.S., of Wellington. For the formidable task which he has set himself Mr. Kirk possesses many high qualifications, and all interested in the study of the native Fowering Plants and Ferns will regard the completion of his work with satisfaction.

Many years ago the Government of the Colony spent a considerable sum in helping to bring out Sir Joseph Hooker's well-known Handbook, and we feel confident that the Government of the day will equally recognise the duty of providing the very modest subsidy which Mr. Kirk considers a sufficient reward for many years of loving and laborious preparation for this work.

The need of a new Flora will be disputed by no one who knows anything about the subject. Not only is Sir Joseph Hooker's Handbook out of print, and procurable only at a high premium on the original price, but since its publication the number of flowering plants has been augmented by nearly a third. The description of all these new species are scattered through the twenty-two volumes of the "Transactions of the N.Z. Institute," and a few other publications, and are practically inaccessible to young workers, as well as to all who do not live in or near the few populous centres where literary and scientific interests are actively cultivated. Nor is this all. We greatly need an authoritative revision of the new matter published in this sporadic fashion, such as Mr. Kirk, from his wide experience in the field and his ripe and extensive knowledge, is well qualified to give us. The extraordinarily numerous discoveries that have been made in the Hawke's Bay district in recent years evidently demand careful reconsideration, an ordeal that may very well result in a considerable reduction in the number of new species that will be permanently recognised from that district. The same process will be applied, doubtless on a much smaller scale, to the recent additions from other parts of the colony as well. In discharging this disagreeable but highly salutary duty to the goddess of Science, Mr. Kirk may certainly count on the sympathy and support of most of the botanical workers and students in the colony. Judicial revision of established species usually falls to the lot of a succeeding generation of workers, and this avoids the heartburning and disappointment by which the process is likely enough to be attended in the present case. We trust that no personal considerations will be allowed to interfere with a rigid performance of this scientific duty.

In compiling a new Flora of a region now fairly well explored, many improvements can be made on the arrangement and information in Hooker's Handbock. In the first place the naming of not a few genera and species will have to be corrected in consequence of the more accurate knowledge we now possess of their history and affinities. The genera will be brought into harmony with Bentham and Hooker's great work on the "Genera Plantarum," and the errors in the naming of species, chiefly caused by the admission of names that must give way to prior ones, which have been brought to light by the researches of Bentham and F. von Mueller, will be corrected. It is important that the synonymy should be fully worked out, but in the absence of a large botanical library of reference it may be doubted if this department of the work can at present be adequately carried out. Difficulties of the same kind will beset another point of great importance—the systematic working out of the geographical distribution beyond the colony of the genera and species of plants native to it. This is a task demanding for its adequate performance years of patient and laborious research as well as access to large libraries, and it cannot, we fear, be satisfactorily done by any botanist resident in our islands. But on the principle that half a loaf is better than no bread we shall welcome the incorporation of such an account of the facts of floral distribution as can be made out from the data available, and trust that in particular all endemic species will be noted as such.

It is usual in the Floras of Great Britain to indicate the pronunciation of the names of the genera and species, and Mr. Kirk will do well to follow this useful custom. The question of giving native or vernacular names by which the commoner species are known is beset by peculiar difficulties. In the North Island the Maori names are very generally used by those who take an interest in native plants, but in the South, chiefly because of the original sparseness of the native population these names are little known or used. Nor is this the only difficulty, for different popular names are attached to the same plant in different districts of the colony and even in different parts of the same district. The perversity with which the true 'beeches' have become popularly known as 'birches,' and different kinds of 'mapau' as 'maples'—a popular name which includes small trees of widely distinct Natural Orders, is enough to fill with despair any botanist who desires to foster a system of popular names that will be free from misleading and inaccurate suggestions. The Maori names are for the most part free from this taint, but the settlers' names often show it in its worst form. Even in naming trees of such economic importance as the native pines, usage varies not only between North and South, but even within the limits of so restricted an area as Otago and Southland. Many of the native names are certain to pass into permanent popular use, such for example as *tutu*, *rimu*, *hinau*, *raupo*, *ngaio*, &c.; and the same may be said of a small number of settlers' names, such as *spear-grass*, *ironwood*, *broadleaf*, *pepper tree*, &c. But the vast majority of conspicuous native plants are still practically destitute of vernacular names, and in fixing names for these, the influence of good judgment in selecting suitable names, where such exist, for such a work as a new popular Flora can hardly fail to be considerable. In a good many cases it should be possible to bring into popular use the ordinary generic names of botanists, such as Veronica, Olearia, Coprosma, &c., though there are obvious limits to this. Into this maze of difficulty and confusion we hope Mr. Kirk's labours will introduce some measure of order and light, and pave the way for greater improvement in years to come.

The list of foreign plants now widely naturalised in the colony is already very extensive, and to be in any way complete a new Flora must contain descriptions of these. We do not know whether it is the author's intention to include these, but it is plain that their omission will detract from the value and utility of his work. Such plants as *chickweeds*, *docks*, *thistles*, *cat's-ear*, *horehound*, and numerous grasses are now very plentiful in all the settled parts of the country, while not a few have invaded purely pastoral country and are as well established there, and to all appearance as permanent denizens of the country as most of the truly indigenous species. No doubt the inclusion of the chief introduced species will considerably swell the size of the volume and even add to its cost, but their omission would be a blunder of capital importance.

The geographic range of the species within the colony will certainly receive due notice from Mr. Kirk. On this subject his personal knowledge is unrivalled, and he will be a churlish worker who will not gladly help him with materials for working out the details of local distribution with the greatest possible accuracy and minuteness. The Handbook contains a great mass of valuable facts relating to local distribution; but the range there assigned to species is not unfrequently far wider than subsequent exploration will permit us to accept. *Poa anceps*, Forst., for example, seems to be unknown in the southern half of the South Island, though the Handbook says it is the common *Poa* of the islands; and many more facts of the same kind could be adduced. Mr. Kirk will correct for us errors of this kind, and he will also be able to establish a more extended range for many species recorded in the Handbook from a single locality or from restricted areas. A full and accurate knowledge of range and distribution of species will be one of the chief benefits which the new Flora will confer on botanical students. Such a knowledge will be of the utmost service for clearing up the characters and limits of the species in the large and variable genera, such as Veronica, Celmisia, Epilobium, and Pittosporum; it should throw some light on the existence or otherwise of hybrids in such variable genera; it should help us to see some little way into the history of the genesis of many of the species that now inhabit the colony; and it should aid us in indicating the channels by which particular species have migrated from their centres of greatest density. In fact no information which the new Flora may contain will have more importance for the elucidation of floral biological questions than a full account of the facts of local distribution. In this field much still remains for future generations to work out, but the few local workers have already garnered a harvest of minute information that is as creditable to their industry as it is likely to be fruitful in important conclusions.

There is but one more topic to which we need refer. In the preface to the third edition of Sir Joseph Hooker's "Students' Flora of the British Islands," he says—"I have ventured to introduce into "this edition, under the description of the flowers of various genera, "characters concerned in the process of fertilisation,—as, whether "wind-fertilised (anemophilous), insect fertilised (entomophilous), or "self-fertilised; also whether honey is secreted in the flower; and "whether the stamens and stigmas ripen together (homogamous), or "the anthers first (protrandrous), or the stigma first (proterogynous)." We shall be pleased to find that Mr. Kirk has not overlooked this very interesting group of characters, which offer special attraction to observers, and might lead many to take an interest in elucidating questions of this kind without having to acquire any profound knowledge of Botany. Mr. G. M. Thomson, F.L.S., has published an important paper on the subject, and additional observations have been made since it appeared, both by him and by other botanical workers. The results of these observations should, if possible, be incorporated in the forthcoming work.

We wish Mr. Kirk a continuance of good health to carry through this important work, and substantial support from students of science and the Government of the colony.

SOME NOTES ON THE OCCURRENCE OF THE TRAP-DOOR SPIDER (*Nemesia gilliesii**) AT LYTTELTON.

BY ROBT. M. LAING, B.Sc.

This spider seems to be very much more widely distributed, than was at first presumed. It has been found in Auckland and Nelson; but I am not aware that it has been hitherto described from Canterbury. Probably a closer search will show that it is common on hills and downs throughout the colony.

At Lyttelton it first came under my notice on a bank in a garden beneath some overhanging fruit trees. The ground in that situation must have been overturned at least several times during the last twenty years; but the locality seemed to suit the spider for I have counted there as many as seventeen trap doors in a square foot of ground under a gooseberry tree. However it is also common on the hills everywhere about the town from sea level up to a height of at least six or seven hundred feet. I have also obtained specimens from the neighbourhood of Sumner, Dyer's Pass, and the Bridle-path; and it will undoubtedly be met with elsewhere on the hills. The only place on the plains where I have found it is in the Heathcote Valley; but even there it was within a hundred yards of the hills, on the side of a dry ditch.

Unfortunately I have not been able to study the habits of the animal so closely as I should have liked to have done; but there are a few points, that I have noted, which may be of interest; and a few others in which I differ from the late Mr. Gillies, in his very full and able paper† upon the subject.

Mr. Gillies states that he only once found them on the southern or shady side of a slope. "In all other situations," he says, "where I have observed them, the nests are always on northern or sunny slopes of greater or less steepness, never in stony or rocky ground, and never

* I have to thank Mr. P. Goyen, Inspector of Schools, for the identification of my specimens.

† "Transactions of the New Zealand Institute," Vol. VIII., p. 222.

actually in the face of a bank so as to be the cause of the trap-door shutting to by its own weight; but always each nest on a little bit of flat, or almost flat ground."

My observations differ from those recorded here in several points. Near Lyttelton the nests are to be found on banks facing all points of the compass, and in shady as well as sunny spots. Some of the largest I have seen were in a small, moist, open-air fernery, overhung by trees, and facing eastward. Again all the ground around Lyttelton is more or less stony or rocky, and nests are frequently found in places where there are only a few inches of soil above the solid bed rock. They are frequently also to be found in the face of a bank; and more often than not their position is such that the force of gravity must assist the door in shutting. In fact it seems to me doubtful, whether the spider does ever instinctively choose or make a flat surface for the commencement of its nest.

The trap-door is almost invariably concealed, so that it can only be detected by a close observer. With practice however the majority can be recognised by their external appearance. In many cases the mud on the door forms a protuberance slightly higher than the surrounding surface. In one case I noticed as much as half an inch of soil upon the lid. This is generally of considerable assistance in enabling one to discover the nest in the naked soil; but it often occurs that one may suspect the presence of a nest from external indications, but cannot be certain of it until the door has been raised with a stick or straw. In ground covered with vegetation their discovery is rendered more difficult by plant growths which completely conceal the trap-door; but I cannot think with Mr. Gillies that the spider actually plants and cultivates these for the purposes of deception. One of the best concealed doors that I have seen was covered with moss, and so indistinguishable was it, that it could only have been discovered by accident; but of course there was a bed of moss covering the ground for a foot or two all round it.

With one exception all the doors, that I have found, have fitted over the mouth of the nest, and not into it like a cork or plug. In the exceptional case the hole was also peculiar, as it was the only one that I have seen, which sloped upward from its entrance. The majority, (particularly those on the sides of banks), make an acute angle with the surface on their lower sides, and after continuing in the same direction for two or three inches, bend nearly vertically downwards. None of any length appear to be straight. In the exceptional case already referred to, the hole was aftewards found to be only three inches long, and proportionately narrow. I removed the lid and found that on the following day it had been replaced by a similar one (*i.e.* one of the cork type). Unfortunately I did not obtain the spider itself. With regard to the renewal of the lid, I may say that I have observed it, in several cases. The work is generally done in a single night, occasionally in two. Once I observed the replacement in the course of a night of more than half a square inch of surface, that had been sheared from the side of a nest with a spade.

My observations with regard to the holes themselves agree very largely with those of Mr. Gillies. I found them to be from ten inches to a foot in length. The deepest one measured was fifteen inches. In order to trace their direction in dry, friable soil, I sometimes poured plaster of Paris in at the door; and I found this was of considerable assistance. In this way I obtained two spiders embedded in one hole.

I have observed plugging up of the holes on various occasions; but not to such a puzzling extent as Mr. Gillies has. I am not at all sure that it was the work of the spider. In some cases it seemed possible that it might have been caused by the washing down of the soil from above on to the lid. However I was not able to determine definitely that this had taken place in any particular instance. In one case on raising a trap-door, the mouth of the nest beneath it was found to be completely closed by a layer of cobweb. This was on March 28th, 1890. On the 13th April, on examining the same hole, I found a small opening in the web, but not large enough to admit of the exit of the spider. This small aperture had probably resulted from stress of weather, or some other natural causes. Being afraid that it might increase, and thus definite proof of the continued confinement of the spider might be lost, I dug out the nest, and found its owner at the bottom, at the depth of a little more than a foot, in a comatose condition. I kept this spider in an empty bottle for some hours, but it remained motionless, and it was not till it had been in spirits for a minute or two that it commenced to move*. It can scarcely have been a case of hibernation as the season was not far enough advanced for that; and the spiders certainly remain active until the end of June. Whatever may be the explanation of these closed nests, they are not unfrequently to be met with, and certainly require further investigation.

On the other hand, inhabited nests without doors of any kind, are sometimes to be found. A number of such occur on a hill slope on the east side of Mt. Pleasant, at an elevation of six or seven hundred feet. In the locality referred to the surface of the ground is covered to the depth of an inch or two with loose sticks and dried leaves, that have fallen from coprosmas and other shrubby plants growing near. Here several lidless nests were discovered coming up through the dead twigs. The spider had probably found it impossible to attach its door to the loose sticks; but in some cases, as a slight protection, the web was turned over at the edge and carried along the twigs for the distance of half an inch all round. A spider was taken from one of these holes: and where the ground was free from leaves close at hand, trap-door nests of the ordinary type were found.

I have only a few remarks to offer as to the habits of the animal. I have not seen them outside of their nests during the day. Apparently they seek their food only by night. After dark one evening in March, 1890, I took a light into the garden, and on approaching a particular trap-door that I had frequently noted before, I saw it quickly shut down through the space of about one-sixth of

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* (I am informed by a friend in the Oamaru district, that he has frequently seen trap-door spiders running along the ground, pursued by a small, black wasp—probably a species of *Pompilus*. These wasps sting the spiders, and by this means render them comatose. In this condition they are stored up in the wasp's nest, and serve as food for the larva. This may be the explanation of the fact mentioned by Mr. Laing.—*Edit.*)

an inch. On coming back to the same spot a minute or two afterwards, I found the door open to the same extent as before, and the body of the spider could be seen indistinctly beneath it. I caught a moth and killed it, and put it up towards the hole on the end of a stick. It was instantly seized and drawn in by the spider, and the door was completely closed. On raising it, the spider was seen with its prey an inch or two down the hole; but it speedily retreated still further. I repeatedly made similar experiments with this spider and one or two others. On one occasion I fastened the body of a specimen of the same species firmly to a stick and put it up towards the door of a nest. The owner of the nest came out and tugged at the stick, in a way that could be distinctly felt; but finally getting alarmed it retreated.

I watched several spiders until the middle of June, when change of residence put an end to my opportunities. They could always be seen peering out from beneath their doors after dark; and apparently were not at all alarmed by the light, nor at my presence, for they have frequently come out of their nests to seize an offered fly, and have remained out for several minutes. Apparently it is their habit to watch for insects from the inside of their doors, and dart out and seize them as they approach. They do not appear to come outside, except to seize their prey.

In addition to *Nemesia*, *Migas distinctus* and a probably undescribed species of *Ariadne*, both ground spiders, are to be found on the Lyttelton hills. The latter occurs at an altitude of 1,000 feet, in holes of an inch or two in length, one-quarter of an inch in diameter, without lids, and lined with a dense layer of white web. This spider takes advantage of cracks in the face of a bank for the commencement of its nest, enlarges them a little, and weaves a cylindrical web inside. They do not appear to be very common.

There are many problems of interest awaiting solution with regard to the distribution and habits of these spiders; and any one who lives in a neighbourhood where they occur will find in them a very interesting study.

AN EDIBLE FUNGUS OF NEW ZEALAND.

(*Hirneola polytricha*, Montagne).*

For some years an edible fungus, a product of the New Zealand forests, has become an important article of commerce between that colony and China. The fungus belongs to the same genus as the European Jews'-Ear (*Hirneola Auricula-judæ*), a tough but gelatinous fungus formerly in reputation as an ingredient of gargles. The New Zealand fungus now under notice (*Hirneola polytricha*), is well described by W. Colenso., F.R.S., in the "Transactions of the Penzance Natural History and Antiquarian Society, 1884-85" :—

* "Kew Bulletin,' October, 1890.

"*Hirneola polytricha* was first made known to science by Montagne as belonging to this genus, and as being an inhabitant of the East Indies and Java, though, like our two other species, it was first published as belonging to the closely allied genus *Exidia*, there being but a very small natural difference between these two genera. This species is thus briefly described by Berkeley (translated and abridged from Montagne): 'sub-hemispherical, cup-shaped, expanded, lobed, densely villous externally with grey hairs, disk purplish-brown.'

"It is of various sizes and, I might also add, of shapes; some measuring a few inches, and when wet filling a large teacup or small basin; a large dry specimen weighing only 2½ drams. It is found growing on the trunks of many trees, both on living and on rotten ones (especially on the latter while standing), particularly on *Corynocarpus lævigata* and on *Melicytus ramiflorus*, both of these trees being endemic as to genus as well as to species. The former tree is mostly confined to the sea-shore, where it often forms dense and continuous thickets. In such situations it is generally of small size, but when standing apart it is of much larger dimensions, and not unfrequently in suitable spots it wears an imposing appearance from its large, green, and glossy persistent laurel-like leaves. The latter tree is scattered plentifully throughout the country, and the foliage of both being evergreen, they are eagerly browsed on by cattle.

"The only market for this fungus is China. From official information obtained from Hongkong, we find that it is largely used by the Chinese in soups with farinaceous seeds, and also as a medicine, being highly esteemed. The Chinese have long been in the habit of using another species of this same genus that is indigenous in North China, and also of importing another species from other isles in the Pacific; so that the use of this kind of fungus as an article of food is not new with them. Who can say in this article of food, that Western pride may not again have to learn something more from this ancient, highly-civilised, and much-injured people?

. . . .

"At first, and for some time, our New Zealand fungus was only exported in small quantities. The demand, however, rapidly increasing, and the article being plentiful and obtained at little cost, save the easy and untaught labour of gathering and drying it, its export rapidly increased. The drying of it, if collected damp, was an easy matter—merely spreading it in the air and sun till dry, which soon takes place, when it is roughly packed in sacks, and if kept dry keeps good and sound for a very long time. The price paid to the collectors for it was originally small, only 1d. a pound; at this figure it remained for some time. It is now nominally 2½d. in some places, which sum, however, is often paid in barter*. It is said to be sold in the China shops at about 10d. or more retail. I am not aware of the actual price obtained by the exporter, but we find that its *declared* value at the Customs has ranged from £33 to nearly £53 per ton, which no doubt is much under the real value.

* I should, however, mention that in the spring of 1883, a large party of Maoris residing on the West Coast, near Mount Egmont, who had for some years been collecting and storing fungus there, sold the lot to an Auckland agent and dealer, but took the total sum, upwards of £425, in hard cash.

"During the last twelve years no less that 1,858 tons of this fungus have been exported, valued at £79,752, as is more particularly shown in the following return, which I have compiled from sources published in the Government statistical papers:—

Years.	Quantity. Tons.	Cwt.	Declared Value. £
1872	58	0	1927
1873	95	0	1195
1874	118	0	6226
1875	112	0	5744
1876	132	0	6224
1877	220	0	11318
1878	103	0	5178
1879	59	5	2744
1880	183	12	6123
1881	187	11	8192
1882	339	17	15581
1883	250	6	9300
	1,858	11	79,752

"I should observe that the official entries show that those exports are confined to the Northern island, and only from two ports there—viz.,Auckland and Wellington—except some small lots amounting to 7 tons, exported from Poverty Bay and Napier in the last two years, 1882 and 1883. The fungus, however, may have been extensively collected in the districts containing those two larger ports."

In order to test the value of the New Zealand fungus as an article of food, a supply of it was recently obtained for Kew, by Mr. Thomas Kirk, Chief Conservator of State Forests, Wellington, N.Z.

A portion of this supply was submitted for analysis to Professor Church, F.R.S., who has been good enough to furnish the following interesting note:—

Hirneola polytricha.

"A sample of this fungus, in the air-dried condition as received, was prepared for analysis by careful brushing and the removal of a few fragments of obviously foreign substances. It gave the following percentages:—

Water	17·0
Albuminoids (calculated from total Nitrogen)	6·8
Carbohydrates, digestible	70·5
Carbohydrates, indigestible	1·9
Fat (Ether extract)	1·5
Ash	2·3

A few remarks as to these figures will prove useful in appreciating the food-value of this fungus. First of all the nitrogen present does not all exist in the form of albuminoids. The coagulable albuminoids, as estimated by the phenol method, amount to 5·4 per cent.; the remainder of the nitrogen occurring chiefly as amides, is not nutritive. If this result be accepted, the proportion of albuminoids to digestible carbohydrates plus the starch—equivalent of the fat, becomes 1 : 13·7 instead of 1 : 10 9, as shown by the per-centages recorded above. Anyhow, this fungus is singularly poor in albuminoid or muscle-forming substances, and differs remarkably in this respect from the numerous edible fungi of which analyses have been previously made. In these analyses we find at least twice or thrice as much albuminoid matters, often more.

"The substance or group of substances which I have called "digestible carbohydrates" contains neither starch, nor inulin, nor cellulose. Its chief constituent is a gum-like body apparently allied to bassorin and well worthy of further examination. It swells up greatly in water and is soluble in dilute warm solutions of caustic alkalies. Its solutions gelatinize on cooling. I have observed what seems to be the same compound in other species of fungi, and it is probable that it has been described under several different names. The fungus now being discussed contains so large a proportion of this body that it presents a very convenient material for its isolation and the study of its composition and properties.

"The ash of this fungus is rich in potash and phosphoric acid. Of the former constituent the ash contains no less than 42·02 per cent.; of the latter 20·02. These proportions are exceeded in the ash of other species; moreover, the amount of ash in one hundred parts of this *Hirneola* is much lower than that recorded for other fungi.

"*(Signed)* A. H. CHURCH."

NEW CALEDONIA NICKEL ORES.*

BY THOMAS MOORE.

Amongst the many ore deposits and formations of this island few are probably of greater interest, either from a chemical or commercial point of view, than those of nickel. The nickeliferous ore commonly known as garnierite, is almost invariably found either in, or at least in close proximity to, those huge masses and mountains of serpentine which form a characteristic feature of the place, and are as diversified in their extent as in their richness, With but one or two exceptions it is found only on elevated positions, often at the very summits of these mountains, not unusually accompanied by chrome iron ore, and surrounded by a peculiar red earth rich in iron, which by being alternately deluged by the rains and baked by the sun has become hardened together into a compact mass. The nickeliferous mountains present a very bare, sombre and uninviting appearance; vegetation is extremely sparse and scanty, and the few stunted shrubs growing there seem only to intensify the barrenness of the dull and monotonous region, contrasting strangely with the profuse tropical growth on the lower levels. The colour of the ore varies from the blue green in the poorer specimens to a warm dark green in the richer, and passing by almost imperceptible shades to a light brown, and, finally, to a fine chocolate colour. The rich ore is generally a mechanical mixture of apparently homogeneous green or brown substance, with rounded pebbles of serpentine, forming a kind of agglomerate, or it is interstitially deposited between thin layers of quartz, steatite, and various hydrated silicates of magnesium.

Miners recognise three varieties of the ore, *i.e.* quartz rich green, magnesia rich green, and the brown ore. The first is characterised

* "Chemical News," October 10th, 1890.

by the large amount of silica it contains, generally as minute glistening crystals of quartz, or in the amorphous condition. The magnesia ore contains only a small quantity of quartz, but a very considerable amount of magnesium silicates, and has a paler green colour than the former. The brown ore is the least common variety, is very soft, and as a rule contains only small quantities of quartz and magnesia, but much ferric oxide. Generally speaking, however, they are classified into the green and the brown minerals.

From time to time analyses of the ore have been published, leading to a variety of formulæ with this feature only in common, that it is a hydrated silicate of nickel, in which the nickel is replaced to a greater or lesser extent by magnesia or oxide of iron. Perhaps the various complicated and somewhat contradictory formulæ devised may be accounted for by the difficulty in obtaining pure pieces, and that the finely intermixed quartz may have escaped observation, thus giving a percentage which does not truly represent the combined silica, but rather that of silica + quartz, for pieces of the ore which to the eye appear thoroughly homogeneous in the great majority of cases give an amount of insoluble silica varying from 2 to 10 per cent. Nevertheless, I have frequently observed that those ores containing much magnesia give differences in analysis which do not agree relatively to any distinct formulæ, but seem rather to indicate a mixture of silicates; as, however, the magnesia diminishes, these differences are gradually reduced, and the composition then becomes more constant, and more closely complies with the calculated numbers, except for the combined water, for which I have been unable to find a constant factor. Having excellent opportunities for procuring pure specimens, and from the many hundreds of analyses made of the same, there seems to be no doubt that both kinds of ore approach very nearly to hydrated sesqui-silicates of nickel giving a formula of 7 NiO, 6 SiO_2, x H_2O, part of the nickel in the green ore being replaced by magnesia, oxide of iron, or alumina, the magnesia predominating, whilst in the brown the oxide of iron is in excess. The following carefully executed analyses of both ores give only the amount of soluble silica, as in those cases when quartz was present it has been calculated out:—

	I.	II.	III.	IV.	V.	VI.
SiO_2	35·55	36·24	35·25	34·78	35·80	20·57
NiO	48·38	44·94	46·30	43·79	43·54	15·56
MgO	5·02	8·75	—	2·75	2·65	0·81
Fe_2O_3	1·41	0·21	9·00	6·30	10·73	49·03
Al_2O_3	1·09	1·03	—		—	—
Cr_2O_3	0·15	—	0·14	—	—	3.82
MnO	—	—	—	—	0·19	trace
H_2O	8·85	8·98	9·20	12·40	8·00	10·32
	100·45	100·15	99·89	100·02	100·91	100·11

Nos. 1 and 2 represent the composition of the green ore. The colour is a fine brilliant grass-green. Hardness, 2-3. Specific gravity, 3·00. Streak light green, waxy lustre, and slightly translucent at the thin edges. Before the blowpipe the colour darkens, becoming dark olive green; in presence of much ferric oxide, red.

Nos. 3, 4, 5 and 6 give the composition of different brown ores. The colour varies from light brown to a deep sometimes slightly translucent chocolate; streak yellow or brownish yellow; the fracture is conchoidal, with a very strong resinous lustre. Hardness and specific gravity about the same as the green ore, and rather more brittle. The very light brown species (No. 6), bear a great resemblance to limonite, and are so soft as to be easily marked by the nail. They, however, do not appear to belong to the same class of ores as mentioned above, as the silica fluctuates with the nickel and magnesium oxides, and is sometimes very low, as little as 5 per cent. being not unusual. A fact worth noting in connection with oxide of iron deposits is, that although containing oxide of chromium up to 8 per cent., they are easily and entirely soluble in warm dilute hydrochloric acid.

Exposed to the action of the weather all these ores gradually crumble to a powder, the brown exhibiting this to a more marked extent than the green. They are easily dissolved by hot hydrochloric acid, and the silica which separates out does not take the gelatinous condition. Up to the present no trace of crystalline character has been found, although some magnesia-rich specimens occasionally present an appearance similar to asbestos.

Thio, New Caledonia, July 20th, 1890.

ON THE DISCOVERY, MODE OF OCCURRENCE, AND DISTRIBUTION OF THE NICKEL-IRON ALLOY AWARUITE, ON THE WEST COAST OF THE SOUTH ISLAND OF NEW ZEALAND.*

BY PROFESSOR G. H. F. ULRICH, F.G.S.

In October 1885, Mr. W. Skey, Government Analyst, read a paper before the New Zealand Philosophical Society, Wellington, announcing the discovery of a Nickel-Iron Alloy, which he recognised as a new mineral species and named "Awaruite." The discovery was made in a collection of minerals sent to the Government Laboratory by Mr. Macfarlane, the Warden of the Jackson's Bay District, which includes Big Bay (Maori name, "Awarua"), Barn Bay, and other Bays in that part of the West Coast of the South Island. Mr. Skey found the new mineral as small grains or scales in a sample of heavy black sand, reported as saved by alluvial miners in Barn Bay; and he gave in his paper, besides descriptions of the physical character of the alloy and its mineral associates, interesting particulars concerning its behaviour towards a solution of cuprous sulphate acidulated with hydrochloric acid, and its quantitative chemical composition as :—$Ni = 67{\cdot}63$, $Co = 0{\cdot}70$, $Fe = 31{\cdot}02$, $S = 0{\cdot}22$, $SiO_2 = 0{\cdot}43$; Formula $= 2Ni + Fe$; Sp. Gr. $= 8{\cdot}1$; Hardness about 5. He considered the alloy as the *second* of its kind, of terrestrial origin, so far discovered, under the impression that the known Nickel-Iron "Oktibbehite" ($Ni + Fe$), which is a meteorite found in Oktibbeha City, North America†, was the *first* alloy of this

* From the "Quarterly Journal of the Geological Society," for November 1890, Vol. xlvi.

† Wadsworth's "Lithological Studies," Table II., page xiv.

kind of terrestrial origin; and he also suggested that the mineral would be found in some basic rock in the vicinity of Barn Bay. Mr. Skey's paper appeared in the Transactions of the New Zealand Institute for 1885, and was reprinted with some additions in the Annual Report, for 1885-86, of the Colonial Museum and Laboratory, Wellington. The additions concerned the results of Mr. Skey's examination of other three samples of heavy black sand: namely, No. 1, from Barn Bay, contained no Awaruite; No. 2, from Callery's Creek, contained 4 %, and No. 3, from the Gorge River, 45·36 %. Amongst other minerals sent with the samples of black sand Mr. Skey mentions a hydrous ferruginous serpentine; and in a footnote he states "this serpentine proves to be the matrix of the nickel-mineral Awaruite, in which it is dispersed in minute grains, in the same manner as metallic copper occurs in serpentine in Aniseed Valley near Nelson."

On seeing the notices about Mr. Skey's first paper (October 1885), giving full particulars regarding discovery, composition, &c., of the new mineral, in the daily newspapers, and being cognisant of the fact of Oktibbehite being a meteorite, and therefore Awaruite not being the *second* (as Mr. Skey supposed), but really the *first* nickel-iron alloy of telluric origin, a fact that greatly heightened the scientific interest attaching to it, I at once communicated with some friends at Hokitika and Ross on the West Coast, and was successful in procuring, through their agency, a small parcel of the nickeliferous sand. In order to gain information regarding the special locality of occurrence of the alloy, and what was of most importance, about the nature of the rocks in the vicinity from which it was likely to be derived, I also wrote to Mr. Gerhard Mueller, Chief Surveyor, Hokitika, and Mr. D. Macfarlane, Warden of Jackson's Bay, two men to whom before all others belongs the credit of having by dangerous explorations procured nearly all the reliable information we have of the topographical and geological features of that wild part of the West Coast in which the new mineral was found.

Mr. Mueller kindly responded by furnishing me with a copy of the topographical plan of the country under notice, which he had prepared from his surveys and explorations, and also with his Report thereon; while Mr. Macfarlane was good enough to inform me that the Red-hill mountain-complex and the Olivine Range, depicted on Mr. Mueller's plan, largely consisted of olivine-rock, which he was the first to recognise as such, and on account of which Mr. Mueller adopted the name Olivine Range. Regarding my request for specimens of the rocks from the locality where Awaruite occurs, he intimated his intention of shortly making a journey through the district, when he would specially collect for me the specimens asked for. This journey did not, however, take place, and no further information was received until the beginning of May 1886, when two of my students, Messrs. Henderson and Butement, submitted to me a small collection of rocks and mineral specimens which during the early part of the year they had brought from an exploring-trip extending from the head of Lake Wakatipu across the Dividing Range and through the Red Hill district down to the west coast of the Island. They had spent several weeks in exploring the wild, inhospitable region of the Red Hill, an enterprise only rendered possible through the fortunate circumstance that just at that time a well-equipped party of gold-prospectors were camping on the Red Hill, at a height of nearly 3,000 feet. To one of them, Capt. Malcolm, I am indebted for several rock-specimens mentioned further on. The collection mentioned, owing to difficulty of carriage, consisted mostly of chips and small pieces, amongst which varieties of peridotite and serpentine claimed most attention. The several specimens are more fully described in the sequel. They were obtained in various places on the Red Hill Range, along the red-weathered outcrop (hence the name "Red Hill") of the peridotite; but those of the serpentine varieties come principally from the slope of the range, falling towards the Jerry River, a tributary of the Gorge River. One of these latter specimens, of thin lamellar (antigorite-like) structure, was found to be impregnated with fine specks, of silvery-white colour and metallic lustre, which on examination proved to be the new mineral Awaruite. In most of the other serpentine specimens whitish metallic-looking specks were also discovered, but they all turned out to be pyrite, except in one piece of common dark green serpentine, which yielded after crushing and washing, from amongst a small amount of pyrite powder, a small hackly grain of the alloy.

Up to the time of this discovery of the matrix-rock of the Awaruite nothing was known or had been published about a similar discovery by anyone elsewhere*; but in answer to a letter I wrote to Mr. Macfarlane, pointing out the discovery and asking for any specimens of peridotite and serpentine he might have preserved from his previous explorations, he informed me that he had also noticed the metallic specks and would send a number of specimens containing them. These I received some months later, but found only two specimens (dark-green serpentine) with unmistakeable Awaruite in them, the metallic specks in the remainder proving to be pyrite. Considering the great scientific interest attaching to the discovery of the mineral and its matrix combined, because of the apparent close relationship of the occurrence to certain of the stony meteorites, and apprehending the find in danger of being quite overlooked, from the fact that, although made public in New Zealand nearly a year previous, no notice of it had up to that time appeared in "Nature" and other English and foreign scientific journals of eminence, I wrote letters to a number of distinguished authors, specially interested in the study of the peridotite rocks in England, America, and Germany, giving the main particulars of the occurrence of the mineral and the results of Mr. Skey's work. The President of the Geological Society at that time, Professor Judd, being one amongst the number, considered my communication of sufficient interest to be brought before the Society, and announced at the same time my intention of submitting a paper regarding the discovery, providing I was successful in procuring more detailed information about the geology of the country in which it was made, and more material to work upon†. In pursuance of this project I have

* Mr. Skey's footnote to his second paper in the "Annual Report of the Colonial Museum and Laboratory," quoted in the foregoing, appeared several months after my find became known.

† In the "Abstract of the Proceedings" of the Society at that Meeting, Quart. Journ. Geol. Soc. vol. xliii. 1887, *Proceed.* p. 3, the credit of having discovered the Awaruite is given to me, no doubt through some misunderstanding, whilst Mr. Skey, as the analyst and namer of it, is not mentioned; and it is further stated that I consider Awaruite and the meteorite Oktibbehite as identical in chemical composition.

since written to and interviewed a number of persons who, I thought, could aid me in the matter. The results of these endeavours have not, however, I am sorry to say, come up to my expectations, owing to loss and damage of specimens sent to me, and various other mishaps. Thus my hope that some, from amongst quite a little army of prospectors (about 150 men) who, aided by the Government, landed towards the end of 1886 in Big Bay, would collect and send specimens was quite disappointed, as not one of the party penetrated as far inland as the Red Hill. In fact they soon became so dissatisfied with the hard work of exploring the rough country that they hurriedly left the district in troops, and very soon after not one of them remained In 1887, I was, however, gratified in receiving from Mr. Macfarlane a larger sample of the Awaruite-bearing sand from the Gorge River, together with portions of a serpentine pebble of nephritic aspect, containing small specks of Awaruite. During the same year, and again in 1888, an intrepid, enterprising prospector, Mr. Robert Paulin, with several hired men, traversed the Red Hill district in various directions, prospecting the rivers and creeks; and from him I received last year, besides a few more specimens of serpentine and other rocks, some valuable notes, accompanied by a sketch-plan of the district, indicating the distribution of the Awaruite and the extent of the peridotite and serpentine rocks. The several small rock-samples so far enumerated, of which the collection brought by Messrs. Henderson and Butement was the most diversified and important, have thus been all the available material to work upon; whilst regarding the general geological structure of the country, and more especially the mode of occurrence and extent of the peridotite and derived serpentine rocks, I can only give an imperfect outline, gathered from the reports and notes received from Mr. Gerhard Mueller, Messrs. Henderson and Butement, Mr. Macfarlane, Capt. Malcolm, Mr. Paulin, and several other persons I met since who have traversed the district.

Regarding the general geological structure of the country it is reported that the ranges from near the sea-coast inland to the ice-clad Dividing Range, except where broken through by the peridotite and derived serpentine rocks, consist of metamorphic schists (gneiss, mica-schist, and chlorite-schist) with occasional massive protrusions and probably large dykes of granite and quartz porphyry. Judging from a few small specimens obtained from Mr. Paulin, the granite is medium-grained and rather felspathic (felspar flesh-coloured), with principally dark mica; whilst the gneiss and mica-schist are of ordinary character, showing also mainly dark mica. Where the spurs from the high ranges do not directly dip steep into the ocean, massive deposits of sandstone and shale and in some cases limestone, of probably older Tertiary age, overlie the old rocks along the coast to pretty high up the easy slopes of the spurs; whilst down the main river-valleys, mostly on both sides, descend extensive high terraces of boulder-drift and hard

In consequence of these mistakes Sir James Hector, the Director of the Geological Survey of New Zealand, in a letter in the March number of 'Nature' 1887, casts a suspicion of piracy upon me regarding the discovery of the mineral, and accuses me of ignorance as to the second point, although perfectly innocent on both these charges, as my letters to Professors Judd, Bonney, and others can prove. I have nevertheless considered it necessary to lay before the Society the foregoing succinct statements of facts relating to the matter, which will afford the explanation which Sir James Hector says the case requires.

conglomerates, of morainic character in the higher parts of the valleys. In the embouchures of the rivers there are generally bars or delta-like accumulations of more recent drift. The prospecting of the terrace-drifts for gold and tracing the gold to its original deposits (quartz-reefs) was the main object of the large prospecting party previously referred to.

Coming now to the peridotite and serpentine rocks, the following extracts are of importance. The Chief Surveyor, Mr. Gerhard Mueller, in his report of his explorations*, states on this head as follows:—"The most remarkable feature about the district appears to me to be that of the Olivine Range on the East of Cascade River. It is a red and violet looking mass, and, from about 1,000 feet above the river, devoid of almost every vestige of vegetation. It is of the same formation of which the Cascade Plateau and a great part of the country of the Gorge and Jerry valleys consist. The Red Hill (5,000–6,000 feet) itself is olivine-rock, whilst the spurs running therefrom are a sort of greyish slate with grey granite belts here and there through them. An extraordinary red granite belt is seen in the Jerry River a little above the proposed road-crossing. The olivine formation is traceable as far as tha Humboldt Mountains; the last indication of it I saw on the low saddle, from which the Barrier and Olivine Branches (Creeks) and the Hidden Falls Creek rise; the extent of it there does not exceed a couple of acres, but is very marked and distinct." In a letter to me, August 1st, 1889, Mr. R. Paulin, in explanation of his sketch-plan, states:—"The Red Hill formation (olivine and serpentine) occurs all over the parts I have marked with red lines. The Red Hill and Olivine Ranges are for the most part bare of timber, and the formation is very conspicuous, owing to the burnt-brick colour which the rock assumes where exposed to the atmosphere. Both the Olivine and Hope Ranges are very much broken and shattered, containing no mass of rock that has not cracks in all directions. This is not so much the case in the Red Hill Ranges."

From these extracts it will be seen that the rocks under notice compose, in the region of the Awaruite discovery, a complex of high massive ranges, the most prominent of which are the Red Hill and Olivine Ranges, and which comprise an area of about 25 miles in length north and south, and 16 miles in width east and west. The rocks, however, doubtless extend (probably with interruptions and for certain much contracted in width) much further southward, even beyond the point Mr. Mueller mentions near the Humboldt Mountains (about 6½ miles S. by W. from the junction of the Barrier Creek with the Pyke River). What leads to this conclusion is, that Messrs. Henderson and Butement saw conspicuously bare and red-coloured mountains and ridges (like those of the Red Hill Range) further southward, near Lake Harris Saddle, the watershed between the Route Burn (a tributary of the Dart River falling into Lake Wakatipu) and the Hollyford River; and that they found boulders of olivine rock and serpentine in one of the creeks rising near that saddle and falling into the Hollyford River. Still another important proof is that at the head of the Caples

* Report on West Coast between Cascade Plateau and Jackson's River on the North, and Lake M'Kerrow and Hollyford Valley on the South; in the "Report of the Survey Department of N.Z. for the year 1883–84," p. 73.

River (about 22 miles S. of the junction of Barrier Creek and Pyke River) there occurs in massive outcrops a dark-green serpentine, closely resembling that of the Red Hill and enclosing veins and bunches of compact talc (steatite).

With regard to the geological relations of the peridotite and serpentine rocks to the enclosing crystalline schists, there can be no doubt, according to Messrs. Henderson's and Butement's observations that the former are intrusive through the latter; several places having been observed by them where the strike of the schists was right against the peridotite and serpentine outcrops.

. . . .

Among the specimens from the Cascade River at the foot of the Olivine Range are pieces of a hard nephrite-like serpentine (bowenite?), containing small specks of Awaruite embedded in it. The specimens are evidently portions of rolled pebbles.

The first sample of the Awaruite-bearing black sand examined by Mr. Skey was supposed to have come from Barn Bay; but it was subsequently proved to have been washed from the drift of the Gorge River. The valley of this river has since generally been considered to be the only place of occurrence of the mineral, and is, indeed, the one in which it has so far been proved to exist in largest quantity. Mr. G. Mueller, the Chief Surveyor, in answer to my enquiries on this point, states :—"The mineral is found in the bed and the banks of the Gorge River, and the ground covered by the mineral-leases applied for with the view of working the nickel is marked in *red* on the lithograph-plan enclosed. These deposits have evidently been brought across the saddle into the Gorge River from the Olivine Range at the back of it."

As, in consideration of the large extent of the peridotite or serpentine rocks, it seemed to me very unlikely that the occurrence of the mineral should be confined to the Gorge River only, I specially requested Mr. R. Paulin, before he set out on his exploring and prospecting trip, to look out for the alloy in the olivine and serpentine rocks and the drift of the rivers and creeks he prospected. In his explanatory letter to me he states as follows :—"I have found small specks of nickel in the rocks of various localities, most conspicuous at Silver Creek (a tributary of the Jerry River rising in the Red Hill Range), and I think that it occurs throughout the whole formation. The free nickel found in different river-beds is much coarser than any I have seen in the stone. On the Red Hill itself I found nickel 2,400 feet above the sea-level." The area of distribution of the Awaruite is thus by Mr. Paulin's observations proved to be far more extensive than first imagined, and it may be larger still, for I see nothing unreasonable in his belief that the mineral occurs impregnated in the matrix throughout the whole extent of the peridotite and serpentine rocks; and, inferentially, in the liberated state in the drifts derived therefrom. The gradual gathering of practical proof of this, however, will, I fear, take a long time, owing to the great hardships and dangers connected with prospecting in that wild, inhospitable district. The supposed recognition of Awaruite distributed through the rock will also, in many cases, not be free from doubt, unless the specks be detached and specially tested. This is on account of the smallness of the specks, and their frequent association with, and general resemblance in colour to, grains of pyrite, which may therefore be easily mistaken for it. The simplest test in the case of detached specks is by application of the magnet, which energetically attracts the Awaruite specks, but leaves those of pyrite unaffected. The malleability of the specks affords another proof of their identity.

ON THE HISTORY OF THE KIWI.*

BY PROF. T. JEFFERY PARKER, F.R.S.

The development of the brain presents some points of interest. The brain of birds closely resembles that of reptiles, differing chiefly in the fact that owing to the increased size of the central hemispheres and cerebellum the optic lobes which in reptiles lie in contact with one another on the upper surface of the brain, are pushed outwards and come to lie, widely separated from each other, one on each side.

In the embryo of the kiwi, as in that of other birds, the brain is at one stage precisely like that of a reptile, having a pair of large optic lobes closely applied to one another, on the upper surface. As development goes on the optic lobes gradually separate from one another and take up a position on the sides of the brain, the cerebellum and cerebrum at the same time uniting between them. At this stage, therefore, the brain is precisely like that of an ordinary typical bird. Later on the eye undergoes a relative dimunition in size, the optic lobes also become smaller in proportion to the remaining part of the organ, and being overgrown by the cerebrum come to lie in the adult on the under surface of the brain, where they form a pair of insignificant elevations. It may also be mentioned that, apart from the optic lobes, the brain of Apteryx is by no means of a low type; the cerebral hemispheres are, in fact, as large in proportion to the brain as in a passerine bird.

So far, it will be seen, the study of the development of the kiwi certainly tends to show that its relation to ordinary or carinate birds is closer than would be expected from a study of the adult anatomy. There is, however, one very striking point of divergence.

The "tail" of a carinate bird consists of a variable number of tail-quills, covered above and below by smaller feathers or tail-coverts, and arranged in a half-circle round the true tail of the bird—the small conical projection known as the "parson's nose" or uropygium. In order to support these feathers the last few vertebræ are united into a strong conical mass or "ploughshare bone." In the kiwi there is never any trace of tail-quills, the uropygium being from its first formation to adult life a naked stump quite devoid of feathers.

Continued rom page 9.

Nevertheless a true though small ploughshare-bone is formed by the fusion of two or three vertebræ. As the only function of this bone is to support the tail-quills its presence in Apteryx seems to indicate that the ancestors of the bird had tail-quills to be supported.

On the whole it will be seen that the study of the development of the kiwi tends to lessen the gulf between it and ordinary birds, and to show that its ancestors probably possessed many of the more important and distinctive features which characterise the Carinatæ of to-day. The facts clearly indicate that the founder of the Apterygian house had interrupted plumage, functional wings, an ordinary avian tail, a keeled sternum, a double-headed quadrate, lateral optic lobes, and a pecten in the eye, in other words that the ancestors of the genus were typical flying birds and not bird-like reptiles. It would seem, therefore, that the facts tell strongly against hypothesis (1) of the origin of the Ratitæ (diagram p. 5*).

As to the relative probability of hypothesis (2) and (3) we have unfortunately only detached observations on the development of the other Ratitæ, and have therefore to rely mainly upon comparative anatomy.

Of the eight characters enumerated above (p. 3), as separating the Ratitæ from the Carinatæ it will be noticed that the first five are directly connected with the power of flight. We should expect to find such adaptive characters in purely cursorial birds whether they arose from a common stock or sprang separately from early flying birds, and as a matter of fact they occur to a greater or less extent in such flightless birds as the Dodo, Weka, Notornis, etc., which we know have no genetic connection with one another, but have independently acquired the characteristics of flightlessness. I think, therefore, that the possession of the characters referred to, by the whole of the Ratitæ is no argument for the common origin.

The peculiarity of the quadrate has been shown to be a secondary matter, and we have left only the characters of the base of the skull. These certainly form an excellent diagnostic character by which the whole of the Ratitæ are separated from the majority of the Carinatæ, but even here the distinction is not absolute for the Tinamous approach in many respects more nearly to the Ratitæ than to the rest of the Carinatæ. Still it seems probable that the various genera of Ratitæ must have diverged from the main line of descent at a comparatively early period, though perhaps not earlier than some of the existing orders of Carinatæ. The Penguins, for instance, are far more reptilian in their vertebral column and less typical in the structure of their wings than the Ratitæ. The Ostrich, however, shows the unique and very reptilian character of two claws on the wing, and the very general presence of wing-claws in the group is a distinctly primitive character.

Leaving the skull, in which the whole group shows primitive characters, and the wing and related parts in which the resemblances between the genera are largely adaptive, we find the range of variation in the Ratitæ to be very great indeed. Two genera (Apteryx and Dinornis) have a normal 4-toed foot; in three others (Cassowary,

* In this diagram (top of p. 5) the letter *r* should be placed *above* the origin of the line leading to *Ratitæ*.

Emu, and Rhea) the hind-toe or hallux has disappeared; while in another (Ostrich) only two toes are left. The pelvis of the kiwi and moa is of the simplest avian type, both pubis and ischia being free; in the cassowary and emu the ischium unites with the ilium; in the rhea the ischia unite with one another above the intestines—a unique arrangement; in the ostrich the pubis unite to form a sympophysis as in most of the higher vertebrates. The feathers have an after-shaft in the emu, cassowary and moa, none in the ostrich, or rhea, or kiwi. In no order of carinate birds do we find such a wide range of variation as this, and when we add to the characters enumerated the extraordinarily aberrant skull and the structure of the egg-shell of Apteryx, the total atrophy of the wings in Dinornis, and even of the shoulder-girdle in some species of the genus, and the striking differences between the sterna, the shoulder-girdle, and the wings of the various genera, we are forced to the conclusion that the existing or lately extinct cursorial birds now known to us are divisible into five well marked orders, each the equivalent of an entire order of Carinatæ. Of these one order contains the ostrich alone, another the rheas, a third the emu and the cassowaries, a fourth the moas, and a fifth the kiwis.

As to the relation of the kiwi to the other genera it has been shown to be most nearly allied as far as its skeleton is concerned, to the moa, differing from it however in many important respects. It must certainly have been isolated at a very distant period, and as far as we can see some of its more striking peculiarities are distinctly correlated to its method of feeding. Most nocturnal animals have large eyes suited for taking the utmost advantage of the semi-darkness, but the kiwi, finding its prey by scent alone, has developed an extraordinarily perfect olfactory sense, while at the same time, having no need to keep watch against beasts of prey, its eyes have diminished in size and efficiency to a degree elsewhere unknown in the bird class.

BOTANICAL NOTES.

BY D. PETRIE, M.A., F.L.S.

Carmichælia compacta, D. Petrie. This is by far the most showy of the 'native brooms' found in the South Island, and is hardly inferior in appearance to the beautiful *C. odorata*, Colenso, of the North Island. It has a strong and very agreeable scent, and in this respect has no rival in the genus. This species is well worthy of cultivation as an ornamental under-shrub, but I have had no success in my attempts to raise it from seed. A light sandy soil suits it very well, and in its native valleys it nowhere grows so luxuriantly as in such situations.

Tillæa purpurata, Hook, f. This species, hitherto known in our colony only from the North Island, has now been found in Otago. I gathered numerous young specimens in the neighbourhood of Pembroke (Lake Wanaka), in the last days of November of last year. It is a very small species, and from its inconspicuous character easily overlooked. No doubt it has a wide distribution over the South Island, and may be looked for in spots where temporary pools form in wet weather.

Acæna Buchanani, Hook, f. In the "Handbook of the New Zealand Flora" this species is said to have a single stamen I have long had doubts as to the accuracy of this statement, and an examination of a considerable number of specimens, gathered in the original habitat, shows that the number of stamens is constantly *two*. It has also two styles. The yellowish-green hue of the leaves, usually so characteristic of the plant in the valleys of the Upper Clutha, does not hold in other localities such as Spear Grass Flat and Ida Valley. I make this statement on the supposition that the species of *Acæna* from the latter localities is *A. Buchanani* (Hook, f.), as I have every reason to believe that it is.

Rhipogonum scandens, Forster. After examining a large series of the fruits of the 'supple-jack' I find that the berry is frequently 3-seeded with all the seeds of the ordinary size, and occasionally 4-seeded, in which case one or two of the seeds are smaller than usual. I have not had opportunity to examine the ovary, which is doubtless 3-celled, though more than one ovule must now and then occur in some of the cells. This point is well worth working out, and I hope some naturalist living near a piece of virgin bush will undertake its investigation.

Salicornia indica?, Will. In this our common littoral 'glass-wort,' some of the flowers are hermaphrodite. The perfect flowers are, I think, proterogynous. The number of stamens is constantly two. Many flower spikes are, I believe, purely pistillate without a trace of stamens, and in these the mature cones are smaller than those found on the hermaphrodite spikes. It would be well if these observations, made at Dunedin, were checked in some other part of the colony.

Gratiola nana, Bentham. In this species the stigma is bi-lamellate, and the lamellæ are very sensitive. When touched with the tip of a blade of grass they close at once. The movement begins very promptly and is, I think, confined to the inferior plate, which rises up so as to press against the immobile superior one. Most likely the lighting of pollen grains on the stigmatic surface would suffice to initiate the movement of closing, and its significance would in that case lie in its rendering the escape of pollen impossible. When mechanically irritated the closure of the lamellæ is not persistent but passes off in a few minutes.

Proterandry in the Gentians. I have always found the flowers of *Gentiana montana*, Forst., *G. pleurogynoides*, Griesb., and *G. saxosa*, Forst., strongly proterandrous. The stigmatic lobes are closely appressed and too immature for fertilisation when the pollen is shed from the anthers. This would prevent a single flower from fertilising itself, but it would not preclude different flowers in the same plant from fertilising one another. The extrorse position of the anthers is doubtless another adaptation for making self-fertilisation difficult.

Plagianthus Lyallii, Hook, f. This species of 'ribbon-wood' was formerly ranked in the genus *Hoheria*, A. Cunn., and there seem to be good reasons for doubting if that is not its proper position. Be this as it may, it is certain that the styles are not "stigmatiferous towards the apex along the inner face." The stigmas are constantly capitate, without a trace of the decurrence of the stigmatic surface along the style. The number of styles is twelve or by abortion less. When they are fewer than twelve, rudiments of the deficient styles are nearly always to be found. The perfect fruit has twelve compressed carpels, and I have never found this number exceeded. Three or more of these are usually barren, but in a perfect capsule the twelve are very plainly recognisable. These peculiarities do not accord well with the generic character of *Plagianthus*, and the plant is evidently on the border-land between *Hoheria* and that genus. If our plant is still to be ranked as a *Plagianthus* there seem to be very scanty reasons for maintaining *Hoheria* as a genus distinct from *Plagianthus*. This small tree is one of the most beautiful of the native shrubs. It is now pretty freely cultivated in private gardens in Dunedin, and is greatly admired for its copious clusters of scented flowers that look quite as gay as cherry-blossom. The season of flowering is Christmas time. It is easily propagated by cuttings, but seedlings are difficult to get, as the seeds are very generally eaten by the larva of some small insect. The seeds of *Hoheria populnea*, A. Cunn., are attacked in exactly the same way, probably by the same larva, and this is perhaps an additional reason for considering the plant a *Hoheria* rather than a *Plagianthus*.

Lepilæna, sp. Some years ago Mr. Thos. Kirk, F.L.S., noticed the occurrence of this genus in New Zealand. I have reason to think that our species is distinct from any of those found in Australia, and I propose for it the provisional name of *Lepilæna monandra*. It is very abundant in many fresh and brackish waters of Otago.

Sciropus (*Isolepis*) *basilaris*, Hook, f. This rare species, which has until recently been found only in one locality in Hawke's Bay, is now found to occur in Otago, near Coal Creek (Roxburgh). I have repeatedly collected it about a mile and a half to the north of Coal Creek on the road to Alexandra South, but until last year I was unable to get the fruit, and was therefo e uncertain about its identification. Though previously known only from low levels it will probably prove a sub-alpine plant, and be found in many localities between Otago and Hawke's Bay.

Zannichellia palustris, L. Though this species is given in the Handbook it has recently been suspected that Sir Joseph Hooker had mistaken the indigenous species of *Lepilæna* for it. This, however, is very improbable, as the true *Zannichellia palustris* L., grows in the lagoon at Waikouaiti, where I gathered it at the end of January last. The presence of a n ale flower at the base of the pistillate one, and the curious obliquely peltate stigmas at once distinguish it from the diæcious *Lepilæna*.

GENERAL NOTES.

Effects of Thunder on Milk.—A thunder-storm is generally believed to be a bad thing for a dairy. An Italian *savant*, Professor G. Tolomei, has made some experiments on the relation of electricity to the souring of milk. He found, according to *The Boston Medical and Surgical Journal*, that the passage of an electric current directly through the milk not only did not hasten, but actually delayed acidulation; milk so treated not becoming sour until from the sixth to the ninth day, whereas milk not so electrified became markedly acid on the third day. When, however, the surface of a quantity of milk was brought close under the two balls of a Holtz machine, the milk soon became sour, and this effect he attributes to the ozone generated.—("Science.")

Escallonia Macrantha and Bees.—This plant is very extensively grown about Dunedin both as an ornamental shrub and as a hedge-row plant in gardens. This season it has flowered profusely and has been visited by swarms both of humble- and honey-bees. These insects, however, appear seldom to visit the flowers in a legitimate manner, and consequently it almost never matures its ovary with us. The five red petals have long parallel claws standing edge to edge, and in very close contact except near the base where they are sufficiently separated to leave a narrow cleft. The bee lights on the side of the flower with its head directed towards the base of the calyx, and thrusting its proboscis between the petals, sips out the abundant nectar without ever touching either stigma or anthers. Bees appear to be so apt to learn dodges from one another, that all those in one neighbourhood may apparently acquire a habit which is not known elsewhere. It would be interesting, therefore, to learn whether the above mode of extracting the nectar from Escallonia flowers is universal, or whether it is only local.—G. M. T.

Fertilisation of Native Flowers by Honey-bees.—Out of the large number of plants indigenous to these islands, it is surprising how few of them are visited by hive-bees. I have kept a record for a long time past of all the flowers on which I have seen bees, and have also received from the members of the Otago Beekeepers' Association a list—accompanied by specimens—of the plants on which they have observed bees. The following is a tolerably complete list of those from which honey is collected in the neighbourhood of Dunedin :—

Clematis indivisa (probably for pollen only); White Mapau—*Pittosporum eugenioides*; Black Mapau—*Pittosporum tenuifolium*; Mako-mako—*Aristotelia racemosa*; Hina-hina—*Melicytus ramiflorus*; *Fuchsia excorticata*; Lawyer—*Rubus australis*; Kowhai—*Sophora tetraptera*; Manuka—*Leptospermum scoparium*; *Celmisia coriacea*; Myrtles—both *Myrtus obcordata* and *M. pedunculata*; *Convolvulus tuguriorum* (for pollen only); *Veronica traversii* and *Veronica salicornioides*. I shall be glad to have records of any others.—G. M. T.

On the Preservation of Solution of Sulphuretted Hydrogen.—On the 15th November last, I published in the "Chemical News" a note on the use of glycerin in preserving sulphuretted hydrogen in solution. The experiments I quoted showed most conclusively that glycerin is most beneficial in this way, and it occurred to me that certain other analogous substances would probably act in a similar manner. I have made rough qualitative trials, which prove this to be the case. About five months ago I sealed up bottles containing respectively—

(*a*) sulphuretted hydrogen water
(*b*) sulphuretted hydrogen water with sugar
(*c*) sulphuretted hydrogen water with salicylic acid.

I have opened these to-day, and find that solution (*a*) gives no reaction with lead acetate and is entirely free from odour; whilst solutions (*b*) and (*c*) have a strong odour of the gas, and yield copious precipitates with lead acetate. . . . . . . The amount of sugar used was 2 per cent., and of salicylic acid 1 per cent.—A. J. Shilton, F.C.S., in "Chemical News" of 10th October, 1890.

The Anatomy of a New Zealand Earth-worm.—In a notice of a paper "On the Homology between Genital Ducts and Nephridia in the Oligochæta," by Frank E. Beddard, M.A., Prosector of the Zoological Society, presented to the Royal Society on November 27th, the following occurs, (*Nature* of 4th December): --

"I have lately had the opportunity of studying the development of the New Zealand species *Acanthodrilus multiporus*. The sum of money which the Government Grant Committee of the Royal Society were good enough to place at my disposal has enabled me to defray the expenses of this investigation.

"In the young embryos of this worm each segment is furnished with a pair of nephridia, each opening by a ciliated funnel into the segment in front of that which carries the dorsally placed external pore. In later stages the funnels degenerate, and that portion of the tube which immediately follows the funnel becomes solid, losing its lumen; at the same time the nephridium branches, and communicates with the exterior by numerous pores. At a comparatively early stage, four pairs of gonads are developed in segments X.–XIII.; each of these is situated on the posterior wall of its segment, as in *Acanthodrilus annectens*, and not on the anterior wall, as in the majority of earthworms. When the gonads first appear, the nephridial funnels, with which they are in close contact, are still ciliated, and their lumen is prolonged into the nephridium for a short distance. Later the cilia are lost, and the funnels increase greatly in size, while those of the neighbouring segments—in fact, all the remaining funnels—remain stationary for a time, and then become more and more degenerate. The arge funnels of the genital segments become the funnels of the vasa differentia and oviducts; it will be observed that the number of ovaries and oviducal funnels (*two* pairs) at first corresponds to that of the testes and sperm duct funnels; subsequently the gonads and commencing oviducts of segment XII. atrophy. Each of these large funnels is continued into a solid rod which passes back through the septum, and then becomes continuous with a coiled tuft of tubules, in which there is an evident lumen, and which is a part of the nephridium of its segment. In the segments in front of and behind the genital segments, the rudimentary funnels communicate in the same way with a solid rod of cells which runs straight for a short distance and then becomes coiled and twisted upon itself and provided with a distinct lumen. In fact, apart from the relative size of the funnels and the presence of the gonads, it would be impossible to state from which segment a given section through the terminal portion of a nephridium had been taken. In a later stage the large funnels of the genital segments become ciliated, but this ciliation takes place before there is any marked change in the tube which is connected with the funnel.

"In the young worm which has just escaped from the cocoon the funnels are ciliated, and they are each of them connected by a short tube, in which a lumen has been developed, but which ends blindly in close proximity to a coil of nephridia. No trace of any nephridial tube other than the sperm duct or oviduct could be observed, whereas in the preceding and succeeding segments the rudimentary nephridial funnel, and a straight tube leading from it direct to the body wall, was perfectly plain. Dr. Bergh has figured, in his account of the development of the generative organs of *Lumbricus*, a nephridial funnel in close contact with the funnel of the genital duct. It may be suggested that a corresponding funnel has been overlooked in the embryo *Acanthodrilus*; the continuity of a structure, identical (at first) with the nephridia of the segments in front and behind, with the genital funnels, seems to show that a search for a small nephridial funnel would be fruitless.

"I can only explain these facts by the supposition that *in Acanthodrilus multiporus the genital funnels and a portion at least of the ducts are formed out of nephridia.* This mode of development is a confirmation, to me unexpected, of Balfour's suggestion that in the Oligochæta the nephridium is broken up into a genital and an excretory portion.

"In the comparison of the facts, briefly described here, with the apparently independent origin of the generative ducts in other Oligochæta, it must be borne in mind that in *Acanthodrilus* the segregation of the nephridium into several almost detached tracts communicating with the exterior by their own ducts precedes the formation of the genital ducts."

Recent Papers on the Natural History of New Zealand.—

Maskell, W. M., "*Icerya Purchasii*, and its insect-enemies in New Zealand." Entom. Monthly Mag. (2). Vol. I., No. 1, p. 17–19.

Hudson, G. V., "The life-history of *Simaethis combinata*, Walk." Entom. Monthly Mag. (2). Vol. I , No. 1, p. 22–23.

Hudson, G. V., "On the flight of *Atta antarctica.*" Entom. Monthly Mag. (2). Vol. I., No. 1, p. 23.

Smith, W. W., "On *Mecyna polygonalis*, Treitschke, in New Zealand." Entom. Monthly Mag. (2). Vol. I., No. 2, p. 51–52.

Meyrick, E., "*Mecyna polygonalis*, Tr. in New Zealand." Entom. Monthly Mag. (2). Vol. I., No. 3, p. 87–88.

Hudson, G. V., "Abundance of *Vanessa cardui* in New Zealand." Entomologist, Vol. 23, Apr., p. 133.

Occurrence of Glow-worms in a Deep Cave,—Mr. A. Philpott of Mt. Linton station sends the following interesting note on the occurrence of glow-worms in the limestone caves near Clifden station, Waiu river, Southland. He visited the caves in November last, with two companions. He says:—"Having visited the cave, we were returning and were within a few chains of the mouth when one of us noticed a light at the end of one of the numerous alleys running off from the main cave. Thinking it was an outlet from the cave I went towards it, but as I drew nearer, the light became smaller changing from a pale yellow to blue, till when I had got right up to it, it appeared as a small but brilliant blue spot and I saw that it proceeded from a worm which seemed to be fixed to the wall by a few silken threads. Near it was a second worm, but I do not remember whether it emitted a light or not. The worms were about one inch long, flesh-coloured, and light apparently came from near the head. They seemed to have the power of putting out the light at will, for after I had regained my companions no light could be seen. The change in the colour of the lighted may have been due to my approaching it with a lighted candle.

Humble-Bees.—Mr. L. Cockayne of Dilcoosha, Styx, near Christchurch, who is well known as a collector of Alpine plants, and a cultivator and introducer of European Alpines, sends the following notes of plants visited by humble-bees, in addition to those mentioned in Mr. Thomson's paper, p. 16:—

Ranunculaceæ.

Aquilegia chrysantha.
Nigella damascena.

Papaveraceæ.

Papaver alpinum. On the red-flowered, but never on the white variety.
Bartonia aurea.
Argemone mexicana.
Bocconia cordata.

Geraniaceæ.

Erodium manescavi.
Geranium pratense.

Rosaceæ.

Spiræa, two shrubby species.
Rubus idæus fl. pl. One of the few white-flowered plants on which humble-bees have been observed.

Compositæ.

Centaurea austriaca.
Dahlia Juarezi, and its varieties.
Helianthus multiflorus. The flowers of this species of Sunflower intoxicate the bees.

Solaneæ.

Nicotiana affinis—another of the white flowers visited.

Scrophularineæ.

Linaria anticaria.
Linaria macedonica.

LABIATAE.

Dracocephalum Ruprechti. The bees are very fond of the flowers of this plant, the nectar of which completely intoxicates or stupefies them. Mr. Cockayne says :—"I took three bees off the flowers at the same time, all in a helpless state, and put them under a tumbler. In an hour's time one had recovered and was able to fly away, another died during the day, and the third was, on the next day, as weak as when captured."

Mrs. Mason of Paradise, Glenorchy, reports that since the cutting-down of the broom—which was almost the only plant visited in that district, humble-bees have not been seen this season until very recently, when one or two have been observed on the flowers of the honeysuckle.

To the list given in my paper on p. 16, I have to add the following :—

RANUNCULACEÆ.

Nigella damascena.

CARYOPHYLLEÆ.

Dianthus fimbriatus.

IRIDEÆ.

Gladiolus, a crimson hybrid.

COMMELYNEÆ.

Tradescantia virginica, on the blue, but not on the white-flowered variety.

On all these only small bees were seen, and these sparingly.—G. M. T.

AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

CHRISTCHURCH MEETING.

The third meeting of the Australasian Association was opened in Christchurch, on Thursday, 15th January, and was formally brought to a close on the 22nd. From every point of view the meeting was a success. The arrangements were excellent throughout, numerous matters of great interest were brought forward and discussed in the various sections, the attendance of members and their friends was very good, while the kindness and hospitality of the people of Christchurch made the stay of the visitors very pleasant. Not only were there numerous eminent representatives from all the Australian colonies, but the meeting was honoured by the presence of Professor Goodale, Professor of Botany in Harvard University, and President of the American Association for the Advancement of Science, which body had commissioned him to convey fraternal greetings to the Australasian Association. To crown all the weather was favourable, by no means too warm, and characterised by the absence of the hot winds which had been so prevalent throughout the earlier part of the summer. The Canterbury College Board of Governors had placed the College, the Boys' High School and the School of Art at the disposal of the local committee. All the various section rooms were therefore in such close and convenient proximity, that members could step out of one and into another, without that waste of time and energy which seemed to harass visitors so much at the Melbourne meeting. The credit for carrying the meeting to such a successful issue is mainly due to the local secretary, Professor Hutton, who appears to have spared no trouble to bring things into complete order. Everything went like clockwork from start to finish.

On the opening day the first meeting was that of the General Committee, under the chairmanship of Baron F. von Mueller, the retiring President. A very enthusiastic vote of thanks was passed to Professor Hutton for his services as local secretary, and to Professor Liversidge as general secretary.

The following were appointed office-bearers for the 1892 meeting:—President, Sir R. Hamilton (Governor of Tasmania and President of the Royal Society of Tasmania); General Secretary, Mr. Alex Morton; General Treasurer, Mr. H. C. Russsell, C.M.G., F.R.S. (Sydney); Local Secretaries, Professor Baldwin Spencer (Victoria), F. Wright (South Australia), J. Shirley (Queensland), Professor Parker, F.R.S., Otago University (New Zealand).

It was resolved to hold the fifth meeting in Adelaide, the date of it to be fixed at the Hobart meeting. The report of the Committee appointed to draft a revised code of laws for the Association was brought up, and the proposals for amendment were distributed amongst the members of the Committee for consideration.

In the afternoon Sir James and Lady Hector received the members of the Association and their friends in the grounds of Christ's College.

In the evening the annual public meeting of the Association was held in the Provincial Council Chamber, an elegant and suitable room, which was crowded in every part. The chair was occupied by the retiring President, Baron von Mueller. He was supported on his right by his Excellency the Governor, and on his left by Sir James Hector, the President-elect.

Baron von Mueller having introduced his successor to the meeting, vacated the chair, which was then taken by Sir James Hector.

His Excellency the Governor then said:—Sir James Hector, ladies and gentlemen, before proceeding to any further business this evening I am going to ask your permission to say a few words of welcome to those who are strangers in our midst. Upon the occasion of their visiting New Zealand I think nothing strikes the English visitor to the colonies more than the constant recurrence of institutions similar to those which he has left behind him in England. He finds that the colonies have grafted on to their social system those institutions which the experience of nine centuries has enabled England to bring to their present perfection. At the same time you have carefully striven to prevent, and at their first appearance to uproot, those evils from which the Mother Country has not yet been able to free herself. Thus you find the same beautiful forms of Divine worship in Christchurch Cathedral, in your churches and chapels, as we have at Home. The youth of all classes have the advantages of elementary education as they have at Home, with this difference, that here it is without direct cost to the parents, who are relieved of the charge of their children during the troublesome years of infancy, and who, by leaving them at school till riper years, may obtain for them something more than an education which is elementary. You have public schools on the lines of those of Eton and Harrow, to whose agency illustrious statesmen and warriors have attributed much of England's pre-eminence among nations; and you possess richly endowed institutions for training adults, not only in intellectual pursuits, but also in those arts which enable men to subdue the wilderness, and to make the earth bring forth her increase. Let me, in passing, pay a warm tribute to the valuable work carried on by the University of New Zealand, whose career and position, both in respect of curriculum and number of students, compare favourably with the older institutions of Sydney and Melbourne. The ladies present will not forget that recognition is due from their sex to the liberal-minded action of this University in having been the first to open its doors to women students by conferring on them equality with men in the matter of degrees. On the other hand, you have not allowed that great social question which is convulsing Europe, the disposal of the indigent poor, to become a source of discontent and disturbance. You have avoided the pauper workhouses where the State grudgingly gives a maintenance to the aged life-long worker, under conditions the least agreeable in life lest any should be found to wish to go and do likewise. What wonder, then, that such an institution as the British Association should have its counterpart in Australasia, an Association eminently fitted to flourish in such communities as these, removing science from the pursuit only of the few and marking the democracy of knowledge, by sympathy begetting knowledge and adding again to sympathy. You have chosen as your place of meeting this year the colony over which I have the honour to preside in the name of her Majesty, and, in my dual capacity as the Queen's representative (for does not your very name denote a bond of Imperial unity in its purpose?), and as the mouthpiece of this important community, I bid you a hearty welcome to our shores. If a layman may express an opinion on such a point, I would say that I think the selection has been eminently a wise one, and that there are reasons why this meeting should be the most interesting yet held by the Association, for in New Zealand you may find objects of scientific interest which will, I believe, amply repay you for your voyage of 1,200 miles, as I have found them repay my less cultured mind for its voyage of 12,000. Certain I am that no word of regret ever fell from any member of the British Association that that Association should have transferred its sphere of operations in 1884 from Great Britain to one of the younger members of the British Empire; and, if in Canada, why, at some future time, with our present improved steam communication, should not the British Association meet in Australia, or even in New Zealand? On that occasion, Lord Landsowne, Governor-General of Canada, commented on the difficulty with which Science would have to contend in competing with material activity in a young country. No doubt the leisured class is less numerous, till recently had no existence in the colonies, and is of slow growth, being constantly depleted by those who, having earned their leisure, choose to spend it elsewhere. There is much truth in his remark; but, on the other hand, the outdoor life of a very large section of the community is conducive to a knowledge of and interest in Nature and Natural History. The toil here is not so unremitting or so unremunerative as in other older communities, and more spare moments can be devoted to the observation and study of living forms and natural features. It is in this respect I apprehend that you welcome among you so large an admixture of the popular, or, if I may so distinguish it, "lay" element, and especially may I say of ladies whose time is likely to be more at their own disposal, and who can take an active and seemly interest in scientific research. I venture to think that the Association should urge upon this "lay" class particularly, the value, not only of the acquisition and diffusion of knowledge, but also of scientific method. Scientific method is of special value in these days, because information is so easily acquired from text books, popular lectures, and magazine articles, that people are tempted to plume themselves on the possession of scientific knowledge, whereas they are in reality acquiring slipshod habits of thought and study. Moreover, with more careful direction their talents might enable them to act as guides and instructors in science to those who must be trained from its elements. Again, in a country like New Zealand, where there exist so many new varieties of life, how desirable is accuracy of observation; what to observe, when to observe, and how to take notes of our observations, are habits specially needful of acquisition. It is better to err on the side of noting something which may have been already observed, than to risk missing an opportunity of contributing information concerning the structure and habits of those plants and animals as to which science is still in a state of infantile ignorance. Although our President is a gentleman of the first rank in the field of scientific research, and although we have among us many eminent men who devote themselves to the study of various phenomena, there are many problems still unsolved. But we entertain high expectations that the assembling of so many men of science from other parts of the world will illumine our efforts to fathom some of the mysteries with which nature has surrounded this, to us, new world of life. I think, ladies and gentlemen, that both in respect of scenery and natural phenomena you will find much that is not only interesting, but unique, in New Zealand. No matter to which special branch of science you may have devoted yourself, you will find something to study in New Zealand, and in New Zealand alone. Meteorologists will find something remarkable in the diversities of climate over a country containing from semi-tropical Auckland to antarctic Southland, but 100,000 square miles. They will note the action produced on the rainfall by our great central range of Alps, and the wonderful difference within a few miles in the vegetation and appearance of the country. On the western side dense green forests, and on the eastern side vast brown plains; and they will, perhaps, be able to explain to us why Cook's Strait has earned the reputation of being the blast-pipe of the Pacific. The naturalist will have ample opportunity to study the marvellously successful results of acclimatisation. The Australian members will be specially interested to compare whether those results have been most successful here or on the Continent in the cases of the rabbit and the sparrow. Interesting and curious also are our deep sea fish, such as the frost fish, which never allows man to catch it, but which occasionally offers himself as a voluntary sacrifice on the gastronomic altar. As regards New Zealand quadrupeds, the labours of the naturalist will be considerably lightened by the knowledge that but one existed, and that that one is believed to be extinct. He may, however, be able to enlighten us as to the true character of the vegetable caterpillar, which, going into the ground a grub, ought, according to European ideas, to emerge as a perfect insect, but in a very antipodean fashion, appears to become a plant instead. The ornithologist, under the able guidance of Sir Walter Buller, will be able to study our so-called wingless birds, and to tell us what prospect they have, now that men and dogs have come to chase them, of recovering the use of those limbs of which long desuetude appears to have deprived them; and whether there is any chance of curing the kea of his acquired taste for sheep fat, which has turned a comical and interesting parrot into one of the anathematised class of native pests. The botanist should revel in our wealth of ferns and alpine plants, and may perhaps decide for us whether that complete illustration of parasitical growth, the rata, initiates its all-devouring embrace as a suppliant at the feet of its victim or round the neck of the devoted object of its affection. Also, may not our farmers look to the botanist for some help in the pursuit of agriculture, to learn something new of plant life, of suitability of soils and of insect pests, so that not only our moral but also our material position may be the better for this meeting. The geologist will find an opportunity for studying the effects of volcanic eruption, of which Tarawera offers an example hardly to be equalled within easy reach of civilisation. The Australian mineralogists may find an opportunity for comparing their more continuous auriferous reefs with our rich but sadly broken strata in New Zealand. The palæontologists will find a curious remnant of otherwise extinct reptiles in the Tuatara lizard, and, close at hand, in the admirably arranged Museum at Christchurch, materials for a study of the extinct moa. Possibly they may give us some contribution to the controversy respecting the co-existence in New Zealand of that gigantic bird with man. The anthropologist will find in the Maories a most interesting example of the advanced civilisation of a Native race, and will be able to witness, not only the effects of their participation in the advantages enjoyed by Europeans, but also the results of an admixture of the races in all classes of society. Statisticians and social economists at Home will look with interest for some fresh light on the interesting thoughts suggested by Mr. Ravenstein at Leeds concerning the future of the human race, as to the period of time which may be estimated to elapse before the world will cease to be able, under present conditions, to support its increasing population. These are only a few subjects of interest which strike the least scientific among you, and without doubt many more will reveal themselves to the searching eye of science in New Zealand. Your labours should teach us that neither in the case of nations nor of individuals do the pleasures of life consist solely in the making of money, and that there are many who, disregarding selfish considerations of material wealth, prefer to devote their talents to the pursuit of knowledge and the discussion of its results. These philosophers have embraced the principles which Plato, in his "Republic" counsels us to adopt towards our rulers and guardians, the people, that they "may grow up, not amid images of deformity which will gradually poison and corrupt their souls, but in a land of health and beauty, where they will drink in from every object sweet and harmonious influences."

A vote of thanks to the retiring President, Baron von Mueller, moved by Mr. Morton of Hobart, and seconded by Professor W. H. Warren of Sydney, was carried by acclamation.

The Chairman then invited Professor Goodale, President of the American Association for the Advancement of Science, to address the meeting.

Professor Goodale, who was received with loud and continued applause, said—Mr. President, your Excellency, ladies and gentlemen, —My first duty is to thank you heartily Sir James, and you, my dear Baron, for the very warm welcome you have extended to me. Be assured that these cordial expressions are most sincerely appreciated. My second duty is to bring to you greetings from the American Association for the Advancement of Science. When, a few years ago, we learned that one of your most energetic professors had taken in hand the formation of an Australasian Association, somewhat on the lines of the British Association and our own, we took the deepest interest in the plans, for we hoped that you would realise what we have secured. In these days of extreme specialism there is need of a broad general association, so that specialists might confer together; that they can widen the outlook and that those who are cultivating small portions of the field can see that the ground near to the fence is not neglected. Now, under a general association like this, specialists can meet and confer together, and they can preserve that which they certainly hope to preserve. Then again we have found, and I have no doubt you will find, that general meetings of associations like this diminish, if they don't fully prevent and remove personal misunderstandings. Sometimes these misunderstandings are allowed to grow until at last they are intensified. In associations like the British Association and our own we find the tendency to anything like personal differences to diminish and disappear, and I hope you will find the same. We have found that the British Association and our own have always done good, by their visits, to the community where the meetings were held. A good many have criticised unfavourably this migratory tendency, holding that it is better to have the meetings in some central place. But it seems that in this the old fable comes back, that "strength seems to be restored every time we touch new ground." This migratory tendency is the survival of the migratory tendency inherited from our ancestors. I feel very sure if you were to put it to the vote in the British Association you would not receive a single positive vote in favour of substituting for these missions, as we may call them, one resident place. Now, when we heard that an Australasian Association was to be formed in this manner, our hopes and best wishes went out to you, and when the opportunity came to present felicitations on your success it was most eagerly accepted; so that I have now great pleasure in presenting, on behalf of the Association I represent, our congratulations upon the pronounced success of the Australasian

Association. The American Association is not limited to the United States. As his Excellency the Governor has told you, the British Association met on Canadian soil. Some of our meetings are also held in the large centres of the Dominion of Canada, and the meeting of the British Association was really a joint meeting of the two Associations. We sometimes think that blood is thicker than water. Now, my honoured colleagues, through me, extend to you an invitation to visit our Association. Do not regard it as one of those general invitations which means just drop in as you pass by; but if you find you can be present at any of our meetings just inform our General Secretary, and when you did meet, then the general invitation, you would find would be converted into a specific one. I again thank you for your cordial welcome, and, congratulating the Association upon its past and present success, I have only now to express on behalf of our Association, and on my own behalf, our best wishes for Australasia and the Australasian Association.

Sir James Hector then delivered the following presidential address —When I rashly replied in the affirmative to the cablegram which I received from our Secretary in Melbourne, asking me to undertake the honourable and responsible duties which I have to commence this evening, I fear I did not fully realise the difficulties of the position, but since then the sense of my unfitnesss for the task has become very oppressive. To address an assembly of this kind on general science must involve unusual difficulties, owing to the audience being largely composed of those who, only taking a casual interest in scientific discussions, look chiefly to the results; while, at the same time, there are present specialists in almost every branch of knowledge. I feel that on this occasion I must be ruled by the interest of the majority, and claim the forbearance of my fellow workers in science if I have to refer in a sketchy way to subjects in which they are deeply interested, and far more learned than I profess to be. Seeing that I am addressing a Christchurch audience I hope I may be permitted, in the first place, to say a word concerning one whose scientific services should, without doubt, have obtained for him the position of first President in New Zealand of the Australasian Association. We naturally recall the name of Sir Julius Von Haast on this occasion, and mourn for the loss the colony has sustained of one who for thirty years occupied a most prominent position. His early researches in the North Island in company with Von Hochstetter, were followed by the exploration of the remote districts on the west coast of Nelson, after which Canterbury secured his distinguished services, and enabled him to leave that monument of varied scientific knowledge, shrewd capacity and indefatigable industry which is to be found in the Canterbury Museum. There are others of our fellow-colonists whose wide range of experience would have peculiarly fitted them to act as your President, and I am able to say that had our veteran colonist and explorer Sir George Grey felt more assured in health and strength it would have been your pleasure this evening to listen to a flood of eloquence on all scientific topics that relate to the future development of Australasia. There is another name I feel must be mentioned as one who should have been in this position had his health permitted. I refer to the Rev. William Colenso, who is not only the greatest authority on the folk-lore of the Maoris, on whom he was among the first to confer a printed literature in their own language. His long-continued work as a field naturalist, and especially as a botanist, is exceedingly interesting, seeing that it forms a connecting link that has continued the early spirit of natural history research in New Zealand, that commenced with Banks and Solander, and was continued by Menzies, Lesson, the two Cunninghams, and Sir Joseph Hooker, prior to the arrival of colonists. Thus we still have in my esteemed friend, Mr. Colenso, an active veteran naturalist of what we may call the old school of explorers. It is wonderful to reflect that little more than fifty years ago this European colony was represented by a few fishing hamlets on the seaboard of a country occupied by a considerable native population. To the early explorers, and even down to a much later date, the obstacles that beset their path were very different from those of the present time; often obstructive Natives, no roads, no steamers, no railways. Had an Association then existed and desired to promote science by giving our visitors an opportunity of visiting the remote parts of the islands, the same excursions which have on this occasion been planned to occupy a few days, would have occupied as many months, and then be accomplished only with great hardship and difficulty. I must ask the young and rising generation of colonial naturalists to bear this in mind when they have to criticise and add to the work of their predecessors. Such names of early colonists as Bidwill, Sinclair, Monro, Mantell, Travers, and many others should ever be held in esteem as those who, amidst all the arduous trials of early colonisation, never lost sight of their duty towards the advancement of science in New Zealand. I will not attempt to particularise other names from amongst our existing, and, though small in number, very active corps of scientific workers. They are here, or should be, to speak for themselves in the sectional work; and I have no doubt some of those who did me the great honour of placing me in my present position are secretly congratulating themselves that they have secured for themselves the position of free lances on this occasion. This is now the third annual gathering of this Association, and New Zealand should feel honoured that it has at so early a date in the Association's history been selected to the turn in rotation as the place of meeting among so many divisions of the great colony of Australasia. The two volumes of the Transactions of the Association, already in the hands of members, are quite sufficient to prove that the hopes of its founders—or rather, I may almost say, the founder—Professor Liversidge of Sydney, have been amply fulfilled. The papers read before the different sections, and the addresses delivered, have in my opinion, to a most remarkable extent, embodied information and discussions which were not likely to be produced as the result of any of our local scientific organisations. The authors seemed to have felt it incumbent on them to place their subjects in the environment of Australasia, and not in relation to the colony they represent. This, I take it, is the first truly effective step towards Federation which has yet been achieved, and I trust that all our members will continue to be imbued with this spirit. Politicians should take this well to heart. Let them continue to aid all efforts that will tend to bring scientific accumulations in these colonies into a common store, so that each may discover for what purpose it has been best adapted by nature, and of paying proper political respect in fiscal policy to one another, each may prosper to the full extent of its natural advantages. But it is not alone in the value of the papers communicated that the Association contributes to advance true civilisation in the colonies. The face to face conference, the personal contact of the active workers in different lines of scientific work, must greatly facilitate the more thorough understanding of the work which has been done and which is still undone. A vague idea, simmering in the brain of one scientist who thinks light of it because it has no special application in his particular environment, may, by personal converse, flash into important results in the mind of another who has had the difficulties facing him, but without the happy thought occurring. It would be rather interesting for someone with leisure to endeavour to recount how many great discoveries have eventuated in this manner. In casting my thoughts for a particular subject on which to address the Association I felt perplexed. Presidents of similar Associations in the Old World, who are in constant contact with the actual progress in scientific thought, feel that a mere recital of the achievements during their previous term is sufficient to command interest; but in the colonies most of us are cut off from personal converse with the leading minds by whom the scientific afflatus is communicated; and in our suspense for the tardy arrival of the official publications of the societies, we have to feed our minds with science from periodical literature. But even in this respect my own current education is very defective, as I reside in the capital city of New Zealand, which has no college with a professional staff whose duty, pleasure and interest it is to maintain themselves on a level with the different branches of knowledge they represent. I therefore decided that instead of endeavouring to review what had been done in the way of scientific progress, even in Australasia, it would be better to confine my remarks to New Zealand—the more so that this is the first occasion that there has been a gathering of what must, to some extent, be considered to be an outside audience for the colony. To endeavour to describe, even briefly, the progress made in the science of a new country is, however, almost like writing its minute history. Every step in its reclamation from a wild state of nature has depended on the application of scientific knowledge, and the reason for the rapid advance in these colonies is chiefly to be attributed to their having had the advantage of all modern resources to hand. As in most other matters in New Zealand there is a sharp line dividing the progress into two distinct periods, the first before and the second after the formation of the colony in 1840. With reference to the former period it is not requisite that much should be said on this occasion. From the time of Captain Cook's voyages, owing to his attractive narrative, New Zealand acquired intense interest for naturalists. His descriptions of the country and its productions, seeing that he only gathered them from a few places where he landed on the coast, are singularly accurate. But I think rather too much is sometimes endeavoured to be proved from the negative evidence of his not having observed certain objects. As an instance, it has been asserted that if any of the many forms of the moa still survived, Captain Cook must have been informed of the fact. Yet we find that he lay for weeks in Queen Charlotte Sound and in Dusky Sound, where all night long the cry of the kiwi must have been heard just as now, and that he also obtained and took Home mats and other articles of Native manufacture, trimmed with kiwi's skins; and that most likely the mouse-coloured quadruped which was seen at Dusky

Sound by his men when clearing the bush was only a grey kiwi; and yet the discovery of this interesting bird was not made till forty years after Cook's visit. As a scientific geographer Cook stands unrivalled, considering the appliances at his disposal. His longitudes of New Zealand are wonderfully accurate, especially those computed from what he called his "rated watches," the first type of the modern marine chronometer, which he was almost the first navigator to use. The result of a recent measurement of the meridian difference from Greenwich by magnetic signals is only two geographical miles east of Captain Cook's longitude. He also observed the variation and dip of the magnetic needle, and from his record it would appear that during the hundred years which elapsed up to the time of the Challenger's visit, the south-seeking end of the needle had changed its position 2½ deg. westward, and inclines 1½ deg. more towards the South magnetic pole. Captain Cook also recorded an interesting fact, which, so far as I am aware, has not been since repeated or verified in New Zealand. He found that the pendulum of his astronomical clock, the length of which had been adjusted to swing true seconds at Greenwich, lost at the rate of 46 sec. daily at Ship Cove in Queen Charlotte Sound. This is, I believe, an indication of a greater loss of the attraction of gravity than would occur in a corresponding North latitude. The additions to our scientific knowledge of New Zealand, acquired through the visits of the other exploring ships of early navigators, the settlement of sealers and whalers on the coast, and of pakeha Maories in the interior were all useful, but of too slight a character to require special mention. The greatest additions to science were made by the missionaries, who in the work of spreading Christianity among the Natives, had the service of able and zealous men who mastered the Native dialects, reduced them to a written language, collected and placed on record the traditional knowledge of the interesting Maori, and had among their numbers some industrious naturalists who never lost an opportunity of collecting natural objects. The history of how the country, under the mixed influences for good and for evil which prevailed almost without Government control till 1840, gradually was ripened for the colonist, is familiar to all. The new era may be said to have begun with Dieffenbach, a naturalist who was employed by the New Zealand Company. He travelled and obtained much information, but did not collect to any great extent, and, in fact, appears not to have anticipated that much remained to be discovered. For his conclusion is that the smallness of the number of the species of animals and plants then known—about one-tenth of our present lists—was not due to want of acquaintance with the country, but to paucity of life forms. The chief scientific value of his published work is the appendix, giving the first systematic list of the fauna and flora of the country, the former being compiled by the late Dr. Gray of the British Museum. The next great scientific work done for New Zealand was the Admirality survey of the coast line, which is a perfect marvel of accurate topography, and one of the greatest boons the colony has received from the Mother Country. The enormous labour and expense which was incurred on this survey at an early date in the history of the colony is a substantial evidence of the confidence in its future development and commercial requirements which animated the Home Goverment. On the visit of the Austrian exploring ship "Novara" to Anckland in 1859, Von Hochstetter was left behind, at the request of the Government, to make a prolonged excursion to the North Island and in Nelson; and he it was who laid the foundation of our knowledge of the stratigraphical geology of New Zealand. Since then the work of scientific research has been chiefly the result of State surveys, aided materially by the zeal of members of the New Zealand Institute, and of late years by an increasing band of young students, who are fast coming to the front under the careful science training that is afforded by our University Colleges. In the epoch of their development the Australasian colonies have been singularly fortunate. The period that applies to New Zealand is contemporaneous with the reign of Her Majesty, which has been signalised by enormous strides in science. It has been a period of gathering into working form immense stores of previously-acquired observation and experiment, and of an escape of the scientific mind from the trammels of superstition and hazy speculation regarding what may be termed common things. Laborious work has been done and many grand generalisations have been arrived at in physical science; but still, in the work of bringing things to the actual experiment, investigators were bound by imperfect and feeble hypotheses and supposed natural barriers among the sciences. But science is one and indivisible, and its subdivisions, such as physics, chemistry, biology, are only matters of convenience for study. The methods are the same in all, and their common object is the discovery of the great laws of order under which this universe has been evoked by the great Supreme Power. The great fundamental advance during the last fifty years has been the achievement of far reaching generalisations, which have provided the scientific worker with powerful weapons of research. Thus the modern "atomic theory," with its new and clearer conceptions of the intimate nature of the elements and their compounds that constitute the earth and all that it supports, has given rise to a new chemistry, in which the synthetical or building-up method of proof is already working marvels in its application to manufactures. It is, moreover, creating a growing belief that all matter is one, and reviving the old idea that the inorganic elementary units are merely centres of motion specialised in a homogeneous medium, and that these units have been continued on through time, but with such individual variations as give rise to derivative groups, just as we find has been the case in the field of organic creations. The idea embodied in this speculation likens the molecule to the vortex rings which Helmholtz found must continue to exist for ever, if in a perfect fluid free from all friction they are once generated, as a result of impacting motion. There is something very attractive in this theory of the constitution of matter which has been advocated by Sir William Thomson. He illustrates it by likening the form of atoms to smoke rings in the atmosphere, which, were they only formed under circumstances such as above described, must continue to move without changing form, distinguished only from the surrounding medium by their motion. As long as the original conditions of the liquid exist they must continue to revolve. Nothing can separate, divide, or destroy them, and no new units can be formed in the liquid without a fresh application of the creative impact. The doctrine of the conservation of energy is a second powerful instrument of research that has developed within our own times. How it has cleared away the cobwebs that formerly encrusted our ideas about the simplest agencies that are at work around us. How it has so simplified the teaching of the laws that order the conversion of internal motions of bodies into phases which represent light, heat, electricity, is abundantly proved by the facility with which the mechanicians are every day snatching the protean forms of energy for the service of man with increasing economy. These great strides which have been made in physical science have not as yet incited much original work in this colony. But now that physical laboratories are established in some degree at the various college centres, we will be expected, ere long, to contribute our mite to the vast store. In practical works of physical research we miss in New Zealand the stimulus the sister colonies receive from their first-class observatories, supplied with all the most modern instruments of research, wielded by such distinguished astronomers as Ellery, Russell, and Todd, whose discoveries secure renown for their separate colonies. I am quite prepared to admit that the reduplication of observatories in about the same latitude, merely for the study of the heavenly bodies, would be rather a matter of scientific luxury. The few degrees of additional elevation of the South Polar region which would be gained by an observatory situated even in the extreme south of New Zealand could hardly be expected to disclose phenomena that would escape the vigilance of the Melbourne observatory. But star gazing is only one branch of the routine work of an observatory. It is true we have a moderate but efficient observatory establishment in New Zealand sufficient for distributing correct mean time, and that our meridian distance from Greenwich has been satisfactorily determined by telegraph; also, thanks to the energy and skill of the Survey Department, despite most formidable natural obstructions, the major triangulation and meridian circuits have established the basis of our land survey maps on a satisfactory footing, so that the sub-divisions of the land for settlement and the adoption and blending of the excellent work done by the Provincial Governments of the colony is being rapidly overtaken. Further, I have already recalled how much the colony is indebted to the Mother Country for the completeness and detail of the coastal and harbour charts. But there is much work that should be controlled by a physical observatory that is really urgently required. I may give a few illustrations. The tidal movements round the coast are still imperfectly ascertained, and the causes of their irregular variation can never be understood until we have a synchronous system of tide meters, and a more widely extended series of deep-sea soundings. Excepting the Challenger soundings on the line of the Sydney cable, and a few casts taken by the United State ship "Enterprise," the depths of the ocean surrounding New Zealand have not been ascertained with that accuracy which many interesting problems in physical geography and geology demand. It is supposed to be the culmination of a great submarine plateau; but how far that plateau extends, connecting the southern islands towards the great Antarctic land, and how far to the eastward, is still an unsolved question. Then, again, the direction and intensity of the magnetic currents in and around New Zealand require further close investigation, which can only be controlled from an observatory. Even in the matter of secular changes in the variation of the compass we find that the marine charts instruct that an allowance of increased easterly variation of 2 min. per annum must be made, and as this has now accumulated since 1850 it involves a very sensible correction to be adopted by a shipmaster in making the land or standing along the coast, but we find from the recently published work of the "Challenger" that this tendency to change has for some time back ceased to affect the New Zealand area, and as the deduction appears only to have been founded on a single triplet observation of the dip taken at Wellington and one azimuth observation taken at Cape Palliser, it would be well to have this fact verified. With regard to the local variation in the magnetic currents on land and close in shore, the requirement for exact survey is even more imperative. Captain Creak, in his splendid essay, quotes the observations made by the late Surveyor-General Mr J. T. Thomson, at the Bluff Hill, which indicate that a compass on the north side was deflected more than 9 deg. to the west, while on the east side of the hill the deflection is 46 deg. to the east of the average deviation in Foveaux Strait. He adds that if a similar island-like hill happened to occur on the coast, but submerged beneath the sea to a sufficient depth for navigation, serious accidents might take place, and he instances a case near Cossack, on the north coast of Australia, when H.M. "Medea," sailing on a straight course in eight fathoms of water, experienced a compass deflection of 30 deg. for the distance of a mile. A glance at the variation entered on the meridian circuit maps of New Zealand shows that on land we have extraordinary differences between different trig. stations at short distances apart. For instance, in our close vicinity, at Mount Pleasant, behind Godley Head lighthouse, at the entrance to Lyttelton harbour, the variation is only 9 deg. 3 min. east, or 6 deg. less than the normal; while at Rolleston it is 15 deg. 33 min., and at Lake Coleridge 14 deg. 2 min. In Otago we have still greater differences recorded, for we find on Flagstaff Hill, which is an igneous formation, 14 deg. 34 min., while at Nenthorn, thirty miles to the North, in a schist formation, we find an entry of 35 deg 41 min. In view of the fact that attention has been recently directed to the marked effects on the direction and intensity of the terrestrial magnetic currents of great lines of fault along which movements have taken place, such as those which bring widely different geological formations into discordant contact, with the probable production of mineral veins, this subject of special magnetic surveys is deserving of being undertaken in New Zealand. In Japan and in the United States of America the results have already proved highly suggestive. A comparison between this country and Japan by such observations, especially if combined with systematic and synchronous records by modern seismographic instruments would be of great service to the physical geologist. There are many features in common, and many quite reversed in the orographic and other physical features of these two countries. Both are formed by the crests of great earth waves lying north-east and south-west, and parallel to, but distant from continental areas, and both are traversed by great longitudinal faults and fissures, and each by one great transverse fault. Dr. Nauman, in a recent paper, alludes to this in Japan as the *Fossa Magna*, and it corresponds in position in relation to Japan with Cook Strait in relation to New Zealand. But the *Fossa Magna* of Japan has been filled up with volcanic products, and is the seat of the loftiest active volcano in Japan. In Cook Strait and its vicinity, as you are aware, there are no volcanic rocks, but there and southward, through the Kaikouras, evidence of fault movements on a large scale is apparent, and it would be most interesting to ascertain if the remarkable deviation from the normal in direction and force of the magnetic currents, which are experienced in Japan, are also found in New Zealand. For it is evident that if they are in any way related to the strain of cross fractures in the earth's crust, the observation would tend to eliminate the local influence of the volcanic rocks which are present in one case and absent in the other. With reference to earthquakes also, few, if any, but very local shocks experienced in New Zealand have originated from any volcanic focus we are acquainted with, while a westerly propagation of the ordinary vibrations rarely passes the great fault that marks the line of active volcanic disturbance. In Japan, also, out of about 480 shocks which are felt each year in that country, each of which, on average, shakes about one thousand square miles, there are many that cannot be ascribed to volcanic origin. There are many other problems of practical importance that can only be studied from the base line of a properly equipped observatory. These will readily occur to physical students, who are better acquainted with the subject than I am. I can only express the hope that the improved circumstances of the colony will soon permit some steps to be taken. Already in this city, I understand some funds have been subscribed. As an educational institution, to give practical application to our students in physical science, geodesy, and navigation, it would clearly have a specific value that would greatly benefit the colony. Another great branch of physical science, chemistry, should be of intense interest to colonists in a new country. Much useful work has been done, though not by many workers. The chief application of this science has been naturally to promote the development of mineral wealth, to assist agriculture, and for the regulation of mercantile contracts. I cannot refrain from mentioning the name of William Skey, analyst to the Geological Survey, as the chemist whose researches during the last twenty-eight years have far surpassed any other in New Zealand. Outside his laborious official duties he has found time to make about sixty original contributions to chemical science, such as researches into the electrical properties of metallic sulphides—the discovery of the ferro-nickel alloy *awaruite* in the ultra-basic rocks of West Otago, which is highly interesting as it is the first recognition of this meteoric-like iron as native to our planet—the discovery that the hydrocarbon in the gas shales is chemically and not merely mechanically combined with the clay base—of a remarkable colour test for the presence of magnesia and the isolation of the poisonous principle in many of our native shrubs. His recent discovery, that the fatty oils treated with aniline form alkaloids, also hints at an important new departure in organic chemistry. His suggestion of the hot-air blow pipe, and of the application of cyanide of potassium to the saving of gold, and many other practical applications of his chemical knowledge, are distinguished services to science, of which New Zealand should be proud. In connection with the subject of chemistry, there is a point of vast importance to the future of the pastoral and agricultural interests of New Zealand, to which attention was directed some years ago by Mr. Pond, of Auckland. That is the rapid deterioration which the soil must be undergoing by the steady export of the constituents on which plant and animal life must depend for nourishment. He calculated that in 1883 the intrinsic value of the fixed nitrogen and phosphoric acid and potash sent out annually was £592,000, taking into account the wool and the wheat alone. Now that we have to add to that the exported carcases of beef and mutton, bones and all, the annual loss must be immensely greater. The proper cure, would, of course, be to bring back return cargoes of artificial manure, but even then its application to most of our pastoral lands would be out of the question. I sincerely hope that the problem will be taken in hand by the Agricultural College at Lincoln as a matter deserving of practical study and investigation. I have already referred to several great generalisations which have exercised a powerful influence in advancing science during the period I marked out for review, but so far as influencing the general current of thought, and almost entirely revolutionising the prevalent notions of scientific workers in every department of knowledge, the most potent of the period has been the establishment of what has been termed the doctrine of evolution. The simple conception of the relation of all created things by the bond of continuous inheritance has given life to the dead bones of an accumulated mass of observed facts, each valuable in itself, but, as a whole, breaking down by its own weight. Before this master-key was provided by the lucid instruction of Darwin and Wallace, it was beyond the power of the human mind to grasp and use in biological research the great wealth of minute anatomical and physiological details. The previous ideas of the independent creation of each species of animal and plant in a little Garden of Eden of its own must appear puerile and absurd to the young naturalist of the present day; but in my own College days to have expressed any doubts on the subject would have involved a sure and certain pluck from the examiner. I remember well that I first obtained a copy of Darwin's "Origin of Species" in San Francisco when on my way home from a three years' sojourn among the Red Indians in the Rocky Mountains. Having heard nothing of the controversies, I received the teaching with enthusiasm, and felt very much surprised on returning to my *alma mater* to find that I was treated as a heretic and a backslider. Nowadays it is difficult to realise what all the fuss and fierce controversy was about, and the rising school of naturalists have much cause for congratulation that they can start fair on a well-assured logical basis of thought, and steer clear of the many complicated and purely ideal systems which were formerly in vogue for explaining the intentions of the Creator and for torturing the unfortunate students. The doctrine of evolution was the simple-minded acceptance of the invariability of cause and effect in the organic world as in the inorganic; and to understand his subject in any branch of natural science, the learner has now only to apply himself to trace in minutest detail the successive steps in the development of the phenomena he desires to study. With energetic leaders educated in such views, and who, after their arrival in the colony, felt less controversial restraint, it is not wonderful that natural history, and especially biology, should have attracted so many ardent workers, and that the results should have been so good. A rough test may be applied by comparing the number of species of animals and plants which had been described before the foundation of the colony and those up to the present time. In 1840, Dr. Gray's list in Deiffenbach's work gives the number of described species of animals as 594. The number now recognised and described is 5,498. The number of mammalia has been doubled through the more accurate study of our seals, whales, and dolphins. Then the list of birds has been increased from eighty-four to 195, chiefly through the exertions of Sir Walter Buller, whose great standard work on our avifauna has gained credit and renown for the whole colony. The number of fishes and mollusca has been more than trebled, almost wholly by the indefatigable work of our Secretary, Professor Hutton. But the greatest increase is in the group which Dr. Gray placed as Annulosa, which, chiefly through the discovery of new forms of insect life, has risen from 156 in 1840, to 4,295, of which over 2,000 are new beetles described by Captain Broun, of Auckland. When we turn to botany we find that Deiffenbach, who appears to have carefully collected all the references to date in 1840, states the flora to comprise 632 plants of all kinds, and, as I have already mentioned, did not expect that any more would be found. But by the time of the publication of Hooker's "Flora of New Zealand" (1863), a work which has been of inestimable value to our colonists, we find the number of indigenous plants described had been increased to 2450. Armed with the invaluable guidance afforded by Hooker's "Handbook," our colonial botanists have renewed the search, and have since then discovered 1,469 new species, so that our plant census at the present date gives a total of 3,919 species. It would be impossible to make mention of all who have contributed to this result as collectors, and hardly even to indicate more than a few of those to whom science is indebted for the description of the plants. The history of our post-Hookerian botany is scattered about in scientific periodical literature, and as Hooker's Handbook is now quite out of print, it is obvious that, as the new discoveries constitute more than one-third of the total flora, it is most important that our young botanists should be fully equipped with all that has been ascertained by those who have preceded them. I am glad to be able to announce that such a work, in the form of a new edition of the "Handbook of the Flora of New Zealand," approved by Sir Joseph Hooker, is now in an advanced state of preparation by Professor Thomas Kirk, who has already distinguished himself as the author of our "Forest Flora." Mr. Kirk's long experience as a systematic botanist and his personal knowledge of the flora of every part of the colony, acquired during the exercise of his duties as Conservator of Forests, point to him as the fitting man to undertake the task. But quite apart from the work of increasing the local collections which bear on biological studies, New Zealand stands out prominently in all discussions on the subject of geographical biology. It stands as a lone zoological area, minute in area, but on equal terms as far as regards the antiquity and peculiar features of its fauna, with nearly all the larger continents in the aggregate. In consequence of this, many philosophical essays—such, for instance, as Hooker's introductory essay to the early folio edition of the "Flora," the essays by Hutton, Travers, and others and also the New Zealand references in Wallace's works, have all contributed essentially to the vital question of the causes which have brought about the distribution and geographical affinities of plants and animals, and have thus been of use in hastening the adoption of the doctrine of evolution. But much still remains to be done. Both as regards its fauna and its flora, New Zealand has always been treated as too much of a whole quantity, and in consequence percentage schedules prepared for comparing with the fauna and flora of other areas fail from this cause. It is absolutely necessary to discriminate not only localities, but also to study more carefully the relative abundance of individuals as well as of species before instituting comparisons. The facility and rapidity with which change is effected at the present time should put as against rashly accepting species which may have been accidental intruders, though wafted by natural causes, as belonging to the original endemic fauna and flora. Further close and extended study, especially of our marine fauna, is urgently required. We have little knowledge beyond the littoral zone, except when a great storm heaves up a gathering of nondescript or rare treasure from the deep. Of dredging we have had but little done, and only in shallow waters, with the exception of a few casts of the deep sea trawl from the "Challenger." When funds permit, a zoological station for the study of the habits of our sea fishes and for the propagation of such introductions as the lobster and the crab would be advantatageous. I observe that lately such an establishment has been placed on the Island of Mull, in Scotland, at a cost of £400, and that it is expected to be nearly self-supporting. With respect to food fishes, and still more with respect to some terrestrial forms of life, we, in common with all the Australasian colonies, require a more scientific and a less casual system of acclimatisation than we have had in the past. One must talk with bated breath of the injuries that have been inflicted on these colonies by the rash disturbance of the balance of nature Had our enthusiasm been properly controlled by foresight, our settlers would probably not have to grieve over the losses they now suffer through many insect pests, through small birds and rabbits, and which they will in the future suffer through the vermin that are now being spread in all directions.

. . . .

There are many other points that I intended to touch upon, but all have been forestalled by the remarks of his Excellency the Governor and Mr. Goodale. I am the better pleased that these gentlemen have spoken upon them, as they were remarks relating to the advantages of the Association. I feel, however, that I would have liked to have given a description of what had been ascertained relating to the geology of New Zealand. I might state that the early explorers appeared to have had only the most vague ideas of the geologies of the countries they explored. Indeed, the whole science of geology seemed to have been almost brought into existence during the last fifty or fifty-five years. It existed only as drawing its knowledge from other branches of science; it barely existed as a science until these branches had become established. In New Zealand our geological explorations have been made since the matters I have referred to have been settled, and the result has been that we have attained competent and tolerably complete knowledge of the structure of the country. New Zealand is probably the outcrop of a great earth-wave, the hollow of which formed the submarine plateau lying to the east. New Zealand appears to have first originated as dry land in the palæozoic times, merely as volcanic islands rising in a sea of moderate depth. After the palæozoic period there appears to have been a great blank in the geological formation. It was a period during which no deposits took place, and it is probable that all which had been deposited were removed."

Sir James Hector then went on to trace the various formations, referred to the first traces found of the moa at Timaru, and then leaving that subject stated that at the sectional meeting on ethnology there would be presented to the Associations the first proof-sheets of a great lexicon of the languages spoken in the Pacific Islands, especially by the natives in the Sandwich Islands, of Tongo, and of New Zealand. It was being prepared by Mr. Tregear, one of the most profound workers in New Zealand in Maori mythology.

"There is another subject on which I would like to touch. It is concerning the great Antarctic continent, but as I understand Baron von Mueller wishes the discussion of the question to be deferred for Saturday forenoon, I will say no more upon it. I have to apologise for the very feeble manner in which I have attempted to perform my duties, though I have the most perfect confidencei n the success of the Association. I think it is about twenty-four years since Mr. Travers got the Act passed which established the New Zealand Institute, In a very small way it was an association of scientists, and it was founded to absorb and render permanent the active endeavours in all part of the colony to advance the interests of science. How well it has succeeded is known by all. Baron Mueller has kindly attributed its success to me, but I must really disclaim that and say its success was due to the wise framer of the special Act. I hope to see the colonies united together as one whole in this matter ; the whole of the Australasian colonies are not too large to combine for the purpose, and I hope that the inclusion of New Zealand in the magic circle will come about in time. In conclusion I will express the wish that the visitors may have a pleasant sojourn in New Zealand. I trust that I have succeeded in proving the claims of this colony as a place for the meeting of the Association, and that I have shown there is enough scientific work to merit such recognition as we have received, and I think I have shown that New Zealand has great capabilities for scientific research, and that there is still a great deal to be done."

Mr. F. de C. Malet moved, and the Mayor of Christchurch seconded the following resolution, which was carried by acclamation—"That the best thanks of the Australasian Association for the Advancement of Science be accorded to his Excellency the Governor for the distinction he has conferred upon the Association by his presence here this evening."

NOTES OF THE MEETING.

(1). THE PRESERVATION OF THE NATIVE FAUNA AND FLORA OF NEW ZEALAND.

(Read before Section D (Biology).)

BY PROFESSOR A. P. W. THOMAS, M.A., F.L.S.,
UNIVERSITY COLLEGE, AUCKLAND.

"The preservation of the native Fauna and Flora of New Zealand is an object which will command the interest and sympathy of the Australasian Association, and an expression of opinion on their part may do much to forward this object.

"The Little Barrier Island in the Hauraki Gulf, appears to be a suitable locality for the formation of one or more Reserves where the fauna (and also the flora) could be protected from the destruction which, it is well known, is overtaking so many of the rarer and more interesting species.

"The island is of little or no value for settlement as it is very rugged and quite inaccessible except in the finest weather. On the other hand it would be a very suitable place for the preservation of the native fauna. It is of sufficient size, being some 5 miles across, and rising as it does to the height of 3,300 feet it affords a considerable variety of climatic conditions. Its isolation and the difficulty of landing will render it secure from marauders and from the danger of bush-fires, so great everywhere on the main-land. Moreover it is still well covered with mixed native forest and a number of the rarer of our native animals occur there.

"Similar reasons point to the suitability of Resolution Island, Dusky Sound, for the preservation of characteristic forms from the South Island.

"The purchase of Little Barrier Island is, I believe, now being effected by the Crown Lands Department, and I wish to suggest that on the completion of the purchase the island should be declared a Forest reserve and regulations framed forbidding the destruction of the native plants or animals on the island.

"It might, perhaps, be found desirable to give the Council of the Auckland Institute some share in the supervision of the island, as they have already taken much interest in the matter.

"I wish therefore to propose the following resolutions :—

"1. That in the interests of Science it is most desirable that some step should be taken to establish one or more Reserves where the native flora and fauna of New Zealand may be preserved from destruction.

"2. That the Little Barrier Island and Resolution Island, Dusky Sound, appear to be most suitable localities for such Reserves.

"3. That a copy of the above resolutions be forwarded to the Hon. the Minister of Lands."

The resolutions were seconded by Mr. Geo. M. Thomson, F.L.S, and were carried unanimously.

(2.) THE "BULL ROARER" OF SOME AUSTRALIAN TRIBES.

In his presidential address to Section G (Anthropology), Mr. A. W. Howitt makes the following reference to the use of this curious instrument :—

"One of the most remarkable facts brought out by the comparison of initiation ceremonies is the universality of the use in them, or in connection with them, of a wooden instrument, which is a child's toy in England, and which is there known as a "bull roarer." As I remember to have made and used one as a child, it was about eight inches in length by three in width, which when whirled round at the end of a cord caused a loud humming or roaring sound. Throughout Australia, so far as my investigations have extended, it is one of the most sacred and secret objects appertaining to the ceremonies. It is not permitted to women or children, I may say to the uninitiated generally, to see it, under pain of death. The novices were told that if they made it known to women or children their punishment would be death, either by actual violence or by magic. So secret was this object kept among the Kumai, that intimately as I was acquainted with them it was not exhibited to me at their Bora, until the old men had been fully satisfied that I had been present at that of their neighbours, the Murring, and that I had then seen it, had become acquainted with its use, and were convincingly told I had possession of one which had been used in their ceremonies. The reverential awe with which one of these sacred objects is viewed by the initiated when carried round to authenticate the message calling a ceremonial assemby is most striking. I have not observed it merely once but many times, and cannot feel any doubt about the depth of feeling of reverence in the minds of the Aborigines in regard to it. A peculiar sacredness is attached to it from several reasons, among which the principal are that it is taught that the first one was made by the Supernatural Being who first instituted the ceremonies, and the roar emitted by it when in use is his voice calling upon those assembled to perform the rites. It is the voice of Baraine, Daramulun, Mungan, however he may be called in the several languages, but in those tribes with whose ceremonies I have acquaintance he is also more familiarly called 'our father.' The universality of its use, and under the same conditions in world-wide localities, is one of the most puzzling questions in this branch of anthropology, and can only, as it seems to me, point to the extreme antiquity of its use. As I have said, it is used universally in Australia. Its use is recorded at the West Coast of Africa, where it is called 'the voice of Oro.' The Maories, the Zulus, the Navajoes use it in their ceremonies, and it has been pointed out by Andrew Lang that its use in the Dionysiac Mysteries is clearly indicated by a a passage in the scholiast, M. Clemens, of Alexandria. In his interesting chapter on the bull roarer in 'Custom and Myth,' Mr. Lang well says that in all probability the presence of this implement in Greek Mysteries was a survival from the time 'when the Greeks were in the social condition of Australians.'"

MEETINGS OF SOCIETIES.

LINNEAN SOCIETY OF NEW SOUTH WALES.

Annual Meeting.

Sydney, 28th January, 1891.—Dr. J. C. Cox, Vice-President, in the chair.

The Chairman delivered the Annual Address, first alluding to the exceptional and melancholy circumstances in which he was called upon to preside, for which reason he should confine his remarks almost entirely to the consideration of matters which directly or indirectly concerned Science in this colony. He then proceeded to review the affairs and progress of the Society during the past year, referring at length to the loss sustained by it in the lamented death of Professor Stephens. He then passed to the consideration of the official recognition of the claims of Agriculture and Forestry to be dealt with in accordance with the teachings of modern science, and of the good, from an educational point of view, likely to accrue from the establishment of country museums. Finally, after pointing out that Australia offered an unrivalled opportunity of working up completely, and under the most favourable circumstances, the flora and fauna, specially interesting in itself, of one of the great tracts of the globe, he proceeded to inquire how it was that with such a splendid harvest still waiting to be gathered, in spite of all that has yet been accomplished, the number of workers was relatively so few; this question being too complex for exhaustive treatment on that occasion, he offered some remarks on a threefold aspect of it, attributing the slow increase in the number of enthusiastic amateur naturalists partly to defective educational methods which leave our children blind to the beauties and attractions of Nature which surround them on every hand; and partly to the want of descriptive catalogues, and well-illustrated handbooks written from the Australian standpoint; while the very slender inducement to our young men to qualify themselves for the serious pursuit of Science sufficiently accounted for the smallness of the number who did so, the matter resolving itself into a question, as Huxley puts it, "of living or starving."

The Hon. Dr. Norton, Hon. Treasurer, laid before the Meeting his financial statement, and concluded by saying "I have further to report that by deed of 5th December, 1890, Sir William Macleay has transferred to the Society the Linnean Hall, with the land on which it stands having a frontage of 179 feet to Bay Street by a depth of 120 feet; and that by deed of the same date Sir William has transferred to the Society by way of endowment a mortgage of £14,000 bearing interest at the rate of £5 per cent. per annum. The deeds by which these transfers have been effected are now in my hands."

On the motion of Mr. R. Etheridge it was unanimously and most gratefully resolved that the heartiest vote of thanks possible be accorded to Sir William Macleay in recognition of the latest of his many munificent benefactions to the Society; and that the Chairman be requested to give effect to the resolution.

The following gentlemen were elected Office-bearers and Council for 1891.—President: Professor W. A. Haswell, M.A., D.Sc. Vice-Presidents: James C. Cox, M.D., F.L.S., C. S. Wilkinson, F.L.S., F.G.S., Rev. W. Woolls, Ph.D., F.L.S. Honorary Secretaries: The Hon. Sir. William Macleay, Kt., M.L.C., F.L.S., and P. N. Trebeck, J.P. Honorary Treasurer: The Hon. James Norton. LL.D., M.L.C. Director and Librarian: J. J. Fletcher, M.A., B.Sc. Council: Messrs. John Brazier, F.L.S., T. W. Edgeworth David, B.A., F.G.S., H. Deane, M.A., C.E., Thomas Dixson, M.B., Ch.M., Robert Etheridge, Junr., J. H. Maiden, F.L.S., F.C.S., E. G. W. Palmer, Percival R. Pedley, and Thomas Whitelegge, F.R.M S.

ORDINARY MEETING.

Dr. J. C. Cox, Vice-President, in the chair.

New Member.—Mr. Walter S. Duncan, Inverell.

Paper.—"Notes on the Occurrence of Stilbite in the eruptive rocks of Jamberoo, N.S.W." By B. G. Engelhardt.

Mr. David remarked that the occurrence of stilbite at Kiama was very interesting. He too had noticed the presence of the same mineral with remarkable persistence in the lavas which are interbedded with the productive coal-measures of Raymond Terrace, Maitland, and Greta, which lavas are probably of near about the same age as those of Kiama. Mr. R. L. Jack, F.G.S., the Govt. Geologist of Queensland, has recorded the occurrence of a similar mineral in the lavas which there underlie the Bowen River coal-field. This is the first record however, of the occurrence of stilbite at Kiama.

Mr. Brazier exhibited a lamp of native pottery from the Pelew Islands, collected by. Dr. John Rabe. Also on behalf of Mr. R. C. Rossiter, Corr. Member, of Noumea, New Caledonia, two very fine examples of *Cypræa tigris*, Linné, having the dorsal surface of a fine bright yellow colour with very few spots, the margins having the spots very small and of a beautiful cream colour.

Mr. Froggatt exhibited two specimens of a grasshopper (Fam. *Gryllidæ*), taken at Double Bay, which frequents the flowers of *Eucalyptus corymbosa* in order to capture the common honey bees (*Apis mellifica*) visiting the blossoms.

Also, a few specimens of Hymenoptera received from the Rev. T. Blackburn, B.A., who captured them on the snow at altitudes of from 5,000 to 6,100 feet, during his trip to the Australian Alps, Victoria, last November.

Mr. Musson exhibited on behalf of Mr. Moseley of Narrabri, an example of the freckled duck, *Anas nævosa*, Gould, obtained at Narran, near Angledool, not far from the Queensland border, early in December last.

The Rev. R. Collie showed an interesting collection of sponges from Wollongong, and a fine specimen of *Gorgonia* from Thursday Island.

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DEVOTED TO THE FURTHERANCE OF PURE AND APPLIED SCIENCE THROUGHOUT THE COLONY.

Judicio perpende: et si tibi vera videntur
Dede manus: aut si falsum est, adcingere contra.

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THE MOA IN AUSTRALIA.

BY C. W. DE VIS, M.A., Queensland Museum.

Recent discovery in Lord Howe's Island has proved that post-tertiary Australia extended far to the east of its present shores. Still it remains true that if among the results of enquiry into the past phases of Australian life there be one suggestive of the possible inter-relation of faunas apparently as distinct in history as in location, it is the discovery of a bird identical with the Moas of New Zealand, and of others so near akin to them as to have been pardonably mistaken for them by acute observers. Fossils so like Moa bones as the latter must necessarily have been, clearly show that the evolution of these grand birds was not initiated in their recent island home, but that it had already made considerable progress in that portion of a far-reaching continent which we now name Australia, when a period was put to the Nototherian age by desolating outflows of lava over the greater part of the land. Having regard to the improbability of birds so organized effecting a passage over sea under any ordinary circumstances, we can hardly escape the further conclusion that New Zealand's entire separation from the continental area was brought about in time not more remote than that era of intense volcanic activity; one is even tempted to surmise, and it appears very possible to do so without absurdity, that it was one among the consequences of that very manifestation of energy. But this is an instance of speaking without book on a question which should be rigorously, as it may be confidently, left for decision in the hands of New Zealand geologists. Cumulative evidence to the same effect but still more explicit in kind is yielded by a relic of a true Dinornis. From it we gather that the process of evolution had in the self-same place and time accomplished more than we could have justly anticipated without such warrant—the production of that more complete departure from the rest of the *Struthionidæ* which we recognize in the Moa type. And again, as the 'wolves' and 'devils' of Tasmania, the 'crowned pigeons' of New Guinea, and the 'wallabies' of those and other Pacific islands have been cut off from the common ancestral seat of their genera, so also have the Moas.

It is indeed somewhat strange that the notion of the same genus of birds existing at one time in Australia and at a later period in New Zealand should ever have been thought inadmissable—yet it is difficult to see what other conception of the case could have been in the mind of Sir Richard Owen when he spoke of the advent of an Australian moa as 'an exceptional extension of a New Zealand genus to Australia.' At the same time it is by no means to be regretted that Owen did take this view, and that in consequence he regarded with suspicion any Australian claim to Moa rank, however well accredited It is to the stimulation of his critical faculty by incredulity that we owe the full assurance that there has existed a bird which, though not Dinornis, had much in it pertaining to Dinornis, a degree of affinity which under the circumstances could not have been overstated, but, as stated, is quite sufficient to shew that Australia was the nursery of the sept.

But let us quit generalities for the more immediate object in hand, viz., a brief review of the recorded occurrences of the Moa stock in Australian deposits. As if to excite a hope that such occurrences would be frequent, the first of all the extinct birds of Australia to be drawn from those deposits and made known to science was a struthious bird dwarfing in size not only existing Cassowaries and Emus, but the Emu which was contemporary with it. A thighbone of this bird was discovered in the year 1836 by Sir Thomas Mitchell in a brecchia cave in Wellington Valley, New South Wales. It was examined by Sir Richard Owen and figured by him in an appendix to Mitchell's 'Three Expeditions into the Interior of Eastern Australia,' 1838. At that time, as we are subsequently informed, Owen determined the bone 'to belong to a large bird probably from its size struthious or brevipennate, but not presenting in its femur characters which justified him in suggesting closer affinities.' The study of Moa bones in after years enabled him, he says, to perceive that in some features of importance the cave femur 'resembles that bone in the Emu rather than in Dinornis.' We learn further that 'the length of this fossil was 13 inches, the breadth of the middle of the shaft not quite 3 inches'—measurements which are noteworthy, as they render it apparent that in its dilated proportions the bone was much more like the Dinornis femur than that of the Emu which has a breadth of only $1\frac{1}{4}$ inches to a length of $8\frac{3}{4}$ inches.

Thirty-three years elapsed before any further light was thrown upon a problem which was sufficiently obscure. It then issued from the Peak Downs, near the centre of Queensland, where in 1869 a well was being sunk. The workmen passed through thirty feet of the residuum of basaltic decomposition, the 'black soil' characteristic of 'Downs' country, then through 150 feet of drift pebbles and boulders. Lying on one of the boulders, at 180 feet from the surface, they met with a short thick femur, which was happily preserved from the usual fate experienced by such finds, and more happily, passed into the hands of the well-known geologist, the Rev. W. B. Clarke. In concert with Mr. G. Krefft, then Curator of the Australian Museum, Mr. Clarke compared it with moa bones, with the result that he felt himself justified in announcing the discovery in the *Geological Magazine* of that year in a letter entitled 'Dinornis an Australian genus.' At Sir R. Owen's solicitation a cast of this bone was sent to him by the Trustees of the Australian Museum, and this, in 1872, formed the subject of a communication from Owen to the Geographical Society (Trans., vol. 8, p. 381). After pointing out at length the characters in which this femur resembles Dinornis and Dromæus (Emu) respectively, the examiner decides "that in its essential characters it resembles more that bone in the Emu than in the Moa, and that the characters in which it more resembles Dinornis are concomitant with and related to the more general strength and robustness of the bone, from which we may infer that the species manifested dinornithic strength and proportions of the hind limbs combined with characters of closer affinity to the existing more slender limbed and swifter wingless bird peculiar to the Australian continent." To the bird represented by the fossil Owen gave the name Dromornis, a name significant of his conception of the paramount affinity displayed by its femur. If with that judgment a succeeding observer finds it impossible to completely harmonize his own conclusion, and says so, it is because in this case compulsion rides roughshod over peril. That the Dromornis bone has important features which relate it to the Emu rather than to the Moa is a position which is unassailable—but that these alone are its 'essential' characters is a postulate and one that has no right to command assent. Essential they are among the Dromæan features of the bone; but of the compound Dromornis bone as a whole they form but a part of the essentials. The absence of the air-duct communicating with the interior of the bone, a characteristic dinornithic feature, seems quite as important as a structural index to habit as the Dromæan set of the head of the bone, and being strictly dinorthic, it is not 'related to the general strength and robustness of the bone' but to its comparative solidity. Again the 'dinornithic strength and proportions of the hind-limbs' is a reminder which should carry more weight than it was probably intended to bear, but is nevertheless but a partial statement of the fact—for it leaves out of consideration the great difference in the relative proportions of the bone under examination. It is not that the bone is altogether larger or smaller in the same ratios of length and breadth but in different ratios—the Dromornis and Dinornis ratio being much the same. The Dromornis femur is but one-third longer than that of the Emu, yet its shaft is twice as thick transversely, and its upper end is more than twice as broad. With such bones the bird would probably have the general appearance, the gait and habits of a Moa rather than those of an Emu. In short, Dromornis exhibits at the least an intermediate form between the Moa and Emu, probably a nearer approximation to the former than to the latter.

After another interval of fifteen years a third dinornithic bone was picked up in King's Creek, on the Darling Downs, by Mr. Daniels, and by him presented with other contemporaneous fossils to the Queensland Museum. This again presents the upper end of a thighbone, but minus the upper part of the great trochanter, which appears to have been shorn off by the abrading action of drift sand while the bone projected from the bed of a watercourse—in other respects it is in excellent preservation. Repeated comparison of this bone with species of Dinornis, with Dromornis, Casuarius, Dromæus, Struthio and Rhea has removed from the mind of its describer all doubt of the former existence of the typical Moa in Australia. To him it appears to resemble as closely any one of the femurs from New Zealand as any two of these, specifically different, resemble each other, a view which of course implies the absence from it of features notably present in the Emu bone. The most important of these is one to which reference has already been made. The 'head' of the bone or that hemispherical projection which fits into the corresponding cavity of the hip-bone stands out prominently in the Moas in consequence of the neck behind it being somewhat long and of considerably diminished diameter, whereas in the Emu the neck is short and thick, so that the limits of the head, especially on its upper surface, are less distinguishable. In this feature, easier to recognize by inspection than by description, Dromornis agrees with the Emu, while the Queensland Moa exhibits the comparatively slender neck and well-defined head of its New Zealand successors. It is not necessary at this moment to insist upon the value of the several characters which aid in the generic identification of this bone with Dinornis—they are to be found by anyone sufficiently interested in the matter in the Proceedings of the Royal Society of Queensland for 1884—to others a recapitulation of them would be tedious.

Unfortunately the identification has not yet been supported by further testimony, a circumstance which can hardly be thought surprising when the extreme slowness with which dinornithic remains have been brought to light is borne in mind—three bones in over half-a-century has been the rate of discovery hitherto. Adding to these three, others from which no precise information can be derived, viz., two ribs provisionally referred to Dromornis and the shaft of a femur too imperfect for determination, but certainly not Dromornis, and in all probability, not Dinornis, all the fossils of this kind known to the writer have been mentioned. In a fairly numerous collection of bones of contemporary birds the paucity of such fossils is conspicuous, but it would hardly be safe to infer from that circumstance that the birds themselves were rare. The most we can say is that they were not among the ordinary frequenters of the lower levels in which the ossiferous drifts of the period were accumulating. Is is therefore with sustained eagerness that every fresh tribute of bones is received and inspected, since the hope is always present that it may contain some further proof of the reality of the Queensland Moa as convincing to others as it would be welcome to its assertor.

Be it at the same time observed that there is no reason why a greater amount of proof should be demanded in this case than in others. There is no inherent improbability involved by it so great as to justify inordinate doubt, since the passage of Dromornis into Dinornis is not so long and difficult a matter as to require for its accomplishment a new home and a geological remove. The only objection to be raised against it is that it confirms and accentuates the antecedent difficulty created by Dromornis itself, the difficulty of accounting for the presence of Moas in New Zealand under their lately existing circumstances. It is not a mystery that they should have been there at all since it is anything but incredible that a subsidence of ten or twelve thousand feet should during a geological age which has seen the whole Australian fauna profoundly changed, have taken place in an area liable to volcanic disturbance such as we see effects of in Australia and feel the throes of in New Zealand. Before that subsidence, Mount Cook from a height about equal to the Cordilleran peak of elevation, Aconcagua, would have looked down and over continuous land as far as the snowcapped mountains of Queensland, the view unhindered by the intervening peak of Lord Howe's Island, the refuge of Meiolanian reptiles once in communication with their kinsfolk in Australia. The true difficulty is not the isolation of New Zealand from Australia, but the strange isolation of the Moas from all other forms peculiar to Australian life. Why should their stock alone have escaped to an eminence of the sinking surface, or alone been introduced into the insulated land, or alone survived some change in its life conditions fatal to the rest? The Moa in New Zealand is the question that calls for an explanation, and in proof that it does call for an explanation and is not to be dismissed as a voiceless phantasy, we point to Dromornis followed (structurally) by Dinornis in Australia, and we wait for its solution in the work of New Zealand's naturalists.

FURTHER NOTES ON *NEMESIA GILLIESII.*

The interesting notes by Mr. R. M. Laing "On the occurrence of the Trap-door Spider at Lyttelton," which appeared in the March number of this Journal, add considerably to our knowledge of the habits, economy, and distribution of the species. As it is not uncommon here about the terraces and river flats, and in neglected gardens, it certainly coincides with Mr. Laing's remark that the spider "seems to be much more widely distributed than was at first presumed." A few years ago I examined numbers of their nests in the Waiareka valley, near Oamaru, the locality, I believe, where the original specimens were obtained, but all the specimens and their nests that I have observed here, are much smaller than those occurring near Oamaru. The various habitats and positions of the nests observed by Mr. Laing at Lyttelton, would apply in most instances here, but I observe that the lining or web, covering the walls of the nests, varies greatly in texture according to the loose or binding nature of the soil in which they occur. When the nests are constructed in fine sandy soil they are frequently lined with a thick white web, which doubtless prevents the nests from caving in, and probably affords warmth and makes them more impervious to wet. In this district they are found commonly in the open among low herbage growing on the river flats, and on the slopes of the terraces at various grades, but in the Waiareka valley, Oamaru, I found them more numerous in a long belt of gum trees than on the open downs. This was probably due to the ground not being disturbed by the plough, or by sheep and cattle depasturing on it, as well as its forming the chief haunt of nocturnal insects in a district where the native vegetation is very scant.

Mr. Laing's remarks on the structure of the trap-doors, and the difficulty of detecting them in some situations, would appear to indicate the presence of mimetic resemblances, yet under certain conditions the nests are at times very easily detected. For instance, when any nests occurring on bare ground and that are more or less covered with fine loose earth have the trap-doors moved on damp nights or after rain, the first sunshine afterwards soon dries the fine loose soil covering the doors, and leaves conspicuous rings or circular patches of dry soil over and around them. Such indications of the spider's presence may sometimes possibly enable their enemies, the highly sensitive and keen-eyed *Pompilus* to capture them. Where the nests occur among moss as mentioned by Mr. Laing, or among low, close-growing vegetation their presence is at all times more difficult to detect. I think Mr. Laing's description of the form and structure of the trap-doors is most probably the right one, as I have invariably found them to be flat, or very slightly arched, but never plug-shaped. Of course there may occasionally be exceptions, but such may sometimes be the result of accident, caused by any weight resting or falling on the lid. I however, think that the flat-door would naturally be more serviceable to the spiders, in enabling them to insert their claws between the top of the nest and the door when opening it. In the case of the exceptional nest with a "cork-type" door, it is to be regretted that Mr. Laing did not capture the spider within it.

In regard to the editorial footnote to Mr. Laing's paper (page 54) on the subject of wasps stinging spiders, and rendering them for a time comatose, I may here briefly refer to the habits of *Pompilus (Priocnemis) fugax*, one of the handsomest of our native wasps. Unlike many indigenous Hymenoptera in New Zealand, it appears to increase slowly in numbers in cultivated districts. This appears to be due to the presence of a common spider* (*Cambridgea fasciata*), which it captures and stores in its nest to feed its larva. Like the introduced humble-bee it generally builds its nest in dry cavities or cracks in raised sod-banks beneath gorse hedges. The nests are built with soft clay, which apparently undergoes some process of refinement by the wasps during their elaboration. The wasps appear here about the middle of November, and until the middle of January may occasionally be seen hunting vigorously for their prey about gorse hedges, and clumps of young Manuka (*Leptospermum scoparium*). The motions of the wasps when in search of spiders are rapid and wary. When hunting on the ground they run and leap a few paces alternately—the antennæ and wings meanwhile quivering rapidly. Although I have never observed a wasp seize a spider when running over the low herbage, I am inclined to think that they are in search of spiders that inhabit or conceal themselves in such situations. When the wasps are hunting in gorse hedges, it is remarkable how swiftly they move through or over the plants, stopping suddenly at intervals, and remaining motionless for a few seconds, as if listening cautiously for sounds or movements of their prey. I have never seen a wasp actually seize and kill a spider, but I have on several occasions seen them dragging the insensible and dead spiders to their nest. If the spider is a large one, the wasp walks backwards dragging it along by a succession of jerks. They sometimes mutilate the spiders before plastering them up in the egg cells, as I have found the mutilated limbs of several spiders in different cells.† According to

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* Lately named for me by Mr. Goyen, of the Otago Education Department.

† In a paper "On New Species of New Zealand Araneæ" (Trans. N.Z. Institute, vol. XXII., p. 269) Mr. Goyen mentions the difficulty of capturing swift-running, long-limbed spiders intact. It is possible that the wasps, in seizing these spiders, may occasionally detach a limb in the struggle, without succeeding in stinging the spider, which may sometimes account for the presence of their limbs in certain cells.

my experience with the nests the number of egg-cells or chambers in each is from five to eight, and they vary considerably in size. I may add that on December 26th last, I was stung between the fingers by one of these wasps, but the sting was neither so sore or painful as the sting of the humble-bee (*Apis mellifica*). I may also add that two other species of spider-hunting wasps, viz., *P. monachus* and *P. carbonarias*, are both common in the Waiareka valley, the locality where the trap-door spider exists in great numbers.

W. W. Smith.

THE MAORI-POLYNESIAN COMPARATIVE DICTIONARY.

BY EDWARD TREGEAR.

Lyon & Blair, Wellington, 1891.

Carl Abel in one of his Essays says—"If two or more languages are contrasted, each being previously analysed, this comparison of thoroughly prepared materials will have paved the way to realise national peculiarities of thought. As there are hardly any words in any two languages completely representing each other, the amount of conscious knowledge to be gained by the comparison of what exists half unconsciously in every land, cannot be overestimated. . . It seems to us, that linguistic science, psychologically conceived, contains a wealth of the most interesting and important tasks scarcely dreamt of till now."

In the book now before us Mr. Tregear has presented to the scientific world a mine of precious material, much of it new, some till now buried in little known works, all of it interesting. The words of Carl Abel quoted above are fully justified by the results now laid before us of a comparison of Polynesian words and ideas. The Maori student in particular will welcome the opportunity now afforded to him of comparing the forms and equivalent values of cognate words in the great Polynesian area, and not only does the author extend the facilities for linguistic comparisons, but he now for the first time presents a Comparative Mythology of Oceania. This has long been needed and will be warmly welcomed. The thorough way in which the author works may be well seen under the word Haiwaiki—there is in this article alone the material for a volume. See also the hero-god—Wenuku, the story of his eventful life and of his magical powers would furnish the *motif* for an epic of Homeric interest. Then again the Hina myth is not only a celebrated one in Maori lore but variants, all telling of the doings of Hina "lovely blossom, whose home is in the sky," are found in Hawaii, Manahiki, Samoa, and Mangaia (possibly the original home of Cockneys, as there they persistently drop the letter h). Here also we make the acquaintance of the great Hine-mu-te-po, the goddess of the realm of night, in trying to pass through whose domain, to deliver the souls of men from death, Maiu was slain. At page 558 we find the New Zealand Deluge Legends, and also the very curious Marquesan version of Te Tai Toko, or the Flood, with its remarkable parallelism with the Chaldean accounts.

The materials here indicated are carefully put together and the needful references duly given. One very useful part of the book is the list of works consulted by the author, as it gives in a handy form a list of the chief authorities on the general Ethnology of the South Seas. The whole of the readers of this Journal will, I am sure, sympathise with Mr. Tregear's note on page XII., concerning Mr. Colenso's great Lexicon of the Maori language, and will, with him, continue to hope that the patient, earnest and scholarly labour of a long and well spent life will yet be "born into the world of letters." Although dealing more strictly with the word forms of the Maori language, Mr. Colenso's Maori Lexicon must contain much of that special knowledge of the Maori race, of which, in New Zealand, he is the sole possessor.

Of the philological value of the kindred words brought together by Mr. Tregear, it will be for the student of philology to judge in the light of the ever advancing knowledge of the national psychology of the races of the Pacific. From the great island of New Guinea we may expect much valuable material for the philologist, as that area seems to be a definite point of contact between a conquering and a conquered race. We are as yet only in the dawn of the light which will be thrown by philological research on the race problems of existing nations.

Turning to another branch of the enquiry we find that at the end of the book are given "endless genealogies"—extracts from the "Burke and Debrett" of Polynesia. Beside these lines of ancestry, those who "came over with the Conqueror" are mushrooms indeed. Look at that of Minirapa Tamahiwaki of the Chatham Islands, who proudly counts 180 generations of forefathers; of Reha of the Uriwera tribe, with 135 ancestors; of the Chiefs of Hawaii, and of the Kings of Rarotonga and Raiatea. Here we have linguistic monuments of past ages equal in interest to the dynasties of Egypt, and lights though dim, on the childhood of the world.

As a contribution to the general history of the Maori people the book is of special value, and now that the author of the "History of the Maori" has passed to his rest, it is to be hoped that the Government will see their way to place the remainder of the work of the late Mr. John White in the hands of Mr. Tregear for publication. It is to be desired however, that at some future time the volumes already issued of that work will be re-edited, and the plates which at present disgrace the work be replaced by some more suited to its character.

Mr. Tregear, and the public generally, are much indebted to the publishers for the extremely creditable form in which the Maori Comparative Dictionary is issued; considering the difficulties of the work the errors and defects are trifling, and its publication marks an era in the literary history of the colony.

Mr. Tregear's patient labour of many years is thus launched on the sea of literature, but before leaving the subject it will be as well to direct the attention of all interested in Maori matters to a paper on

"The Maoris of New Zealand," by Mr. Tregear, published in volume XIX. of the "Anthropological Institute of Great Britain, 1890." The paper has been written in reply to the code of "Questions" published in the "Journal of the Anthropological Institute," volume XVIII.; and next to the essay by the Rev. W. Colenso, on the Maoris, published in the first volume of the "Transactions of the New Zealand Institute," contains the fullest and best account of the Natives of these Islands.

A. H.

WHAT CAUSED THE OBLIQUITY OF THE ECLIPTIC.

The following letter by T. A. Bereman, of Mt. Pleasant, Io., appeared in *Science* of 13th February. In view of the attention now being given to the subject of Antarctic Exploration, it is interesting and suggestive:—

"It is difficult to bring the mind to believe that there ever was a time when there were no seasons,—spring, summer, autumn, and winter, —as now. In attempting to account for natural phenomena, we have nearly always assumed that the axis of the earth was originally inclined to the plane of the ecliptic at an angle of $23\frac{1}{2}°$, as we now find it, and of course we in consequence have formed in our minds the idea of the annual recurrence of the seasons through all geological time; but the elimination of the seasons from the early history of the earth has been forced upon us by the accumulation of facts from the geological record. There is abundant evidence to prove the existence of tropical or sub-tropical animals and plants in Arctic latitudes as late as the tertiary. In Professor Dana's "Manual of Geology" (third edition, p. 352) that author says, 'If we draw any conclusion from the facts, it must be that temperature of the Arctic zone differed little from that of Europe and America. Through the whole hemisphere, and we may say world, there was a genial atmosphere for one uniform type of vegetables, and there were genial waters for corals and brachiopods.' Scarcely any one now, who is conversant with the facts, will deny that the early history of the earth was marked with a uniform, or nearly uniform, temperature, in all latitudes, prior to and including most of the tertiary. The main difference of opinion existing now among scientific men is how to account for such uniform, world climate.

"So of the glacial period. Every one admits that the great array of facts justifies the conclusion that the poles of the earth were, since the tertiary, covered with great ice caps or sheets several thousand feet thick, and reaching down to the 40th parallel of latitude, constituting the great glacial period. There is a wide divergence of opinion, however, as to the origin or cause of this glacial cold. Mr. Croll, in his 'Climate and Time,' has formulated a theory, derived from the secular changes in the eccentricity of the earth's orbit, through which he finds a place for the glacial period; but this theory, if true, must provide for alternation of warm and cold periods at the poles throughout all geological time. Professor James Geikie of Scotland, in his 'Great Ice Age,' indorses this theory, and attempts to find evidences of former glacial action, not only in the tertiary, but also in mesozoic and paleozoic times. But the weight of the evidence seems to be against this theory, and Mr. Geikie himself admits that that much of his 'evidence' is 'not very convincing.'

"The best and most satisfactory explanation of the warm and cold periods at the poles has been made by Professor C. B. Warring, in a paper read by him before the New York Academy of Science, and published in the *Popular Science Monthly* for July, 1886. This paper merits a much more extended notice than it has apparently received, for its author has very strongly fortified his several propositions. Briefly, his argument is this: The existence of tropical vegetables in Arctic latitudes cannot be supported upon the theory of a warm temperature only. Light was as necessary as heat; and this light must also have been uniform and unbroken by long periods of darkness, for if there had been a long night of four months in every year, as now, it would have been fatal to all plants, and even many or most of the animals. Therefore, down to nearly the close of the tertiary, the axis of the earth was perpendicular to the ecliptic, and the days and nights were everywhere and always equal. The temperature was kept up by means of the carbonic acid and aqueous vapor in the atmosphere, which formed a sort of 'double blanket,' and served to retain the heat radiated from the sun. After a long period the carbonic acid was most of it taken up from the atmosphere to form our coal-beds, peat, petroleum, graphite, etc. This process was followed by a thinning of the retaining cover. The heat from the sun was not all retained, but was lost again by escaping into stellar space. 'Holes in the blanket' appeared at the poles, ice and snow began to accumulate there, and eventually the glacial epoch was inaugurated. Furthermore, he shows, that, according to the nebular hypothesis, the axes of the earth and moon ought to have been, in their normal condition, parallel with each other, and both perpendicular to the plane of the ecliptic; but instead, the earth's axis is inclined $23\frac{1}{2}°$, while the moon's axis is practically perpendicular, it being inclined only 1° 30′. The change, therefore, was with that of the earth, and was effected since the moon's separation from the earth. 'In view of all these facts,' he says, 'it seems most probable that in that blank interval the glacial epoch, or more largely between the end of the miocene and the beginning of the Champlain, that movement occurred which gave the earth seasons, unequal days and nights, and greatly enlarged its limits of inhabitability. . . . When the axis became oblique, more solar heat fell within the polar circle, these regions became warmer, and the glacial epoch departed. If these conditions—a perpendicular axis and high uplifts—could be to-day restored, the atmosphere remaining as it is, the glacial epoch would return.'

"It is the purpose of the present article to emphasise the reasons for believing the direction of the earth's axis was changed about the time stated above, and also to suggest the probable cause of the change. In order to do this more intelligently, we must take a more comprehensive view of the glacial epoch and all its attendant phenomena than is usually found in any one or many of the text-books, or papers, reports, and lectures, upon the subject. Of all the geological changes and revolutions in the earth, ont of which has been evolved the present world of animal and plant life, the glacial epoch is certainly the most unique, and full of interest to the scientific observer. What caused the glacial cold has been the constant inquiry, but never answered, ever since it was first proposed some forty or fifty years ago. Why should corals live in security in Spitzbergen, and the red-woods of California and the cypress-trees of the southern United States flourish in the north of Greenland as late as tertiary times, where now are the almost constant rigors of an Arctic winter? What caused the recession of the glaciers, and why may we not have a recurrence of them? What influence, if any, did the polar ice-caps exert upon the ocean-level and ocean-currents? Were the ice-caps equal in magnitude; and if not, what effects, if any, followed such inequality, from the attraction of the sun and moon upon the mass of the earth, thus abnormally distributed? These questions and kindred ones must be considered before we are prepared to comprehend the full significance and consequence of the glacial epoch.

"It seems incredible that a great ice-cap, several thousand feet thick, should accumulate, and remain throughout the summer, in the temperate zones, if the ecliptic were as oblique in those times as now. The sun on the 21st of June would be nearly perpendicular to the southern limit of the glacier, and would certainly exert a powerful influence in preventing its formation or accumulation south of the northern limits of Minnesota. On the other hand, hower, if we place the sun continuously perpendicular at the equator, the temperate zone would be characterized by continual spring weather similar to that occurring in April at the present time. In such case we may readily conclude that the precipitations of snow might be greater than that melted by the slanting rays of the vernal sun, and hence might continue to increase, and form a glacier of ice.

"It appears that the polar ice-caps in glacial times extended as far as the 30th parallel of latitude from either pole; in some places the north glacier in the United States extended as far south as the 39th and even to the 38th parallel; and in South America Professor Agassiz found evidences of glacial action as far north as the 37th parallel. Mr. D. Forbes informed Mr. Darwin that he had seen ice-worn rocks and scratched stones at about 12,000 feet height, between 13° and 30° south latitude. There seems also some evidence of glacial action in the south-east corner of Australia. In northern Asia, owing to the great extent of land surface, it may be reasonably inferred that the southern limit of the glacier was much beyond that in the United States. The mountain ranges in both hemispheres doubtless were covered with a much greater accumulation of snow and ice than they are at present, extending at that time to within the tropics, and perhaps to the equator. But from the whole record, we may safely assume 40° as the average limit of each, the southern being the more widely extended of the two. There are many evidences that these ice-sheets were not confined to the land, but that they crossed gulfs, seas, and even oceans. Professor H. Carvill

Lewis, in a lecture published in the *Journal of the Franklin Institute* for April, 1883, says, 'It probably also filled the bed of the Atlantic with ice far south of Greenland, the edge of the glacier reaching from Newfoundland to southern Ireland in a concave line;' and Professor Geikie says the German Ocean was entirely filled with ice. Similar evidence has been found as to the antarctic glacier. We have therefore two magnificent circular polar ice-caps, each of them nearly 7,000 miles in diameter, and the two covering about 61,000,000 square miles of the earth's surface, leaving a zone of non-glaciated surface at the equator of abont 130,000,000 square miles; so that, at the culmination of the glacial epoch, nearly one-third of the earth's surface was covered with ice.

"If, now, we could ascertain the thickness of these great glaciers, we could easily estimate the amount of the earth's mass taken up in the form of aqueous vapour, transferred to the polar areas, and there deposited in the form of snow and ice. While admitting the incompleteness of the record, the weight of the evidence at present is to the effect that the antarctic glacier was much larger than the arctic. Upon general reasoning, this ought to have been true; for three-fourths of the land surface of the earth are in the northern hemisphere, and the amount of water suface in the southern and northern hemispheres respectively is in the ratio of 85 to 60. In the southern hemisphere, therefore, there ought to have been a greater amount of evaporation; and, in the absence of any known air-currents to carry this evaporation to the north of the equator, there would necessarily be a greater amount of precipitation in the southern hemisphere, and consequently a greater accumulation of ice. That such was the fact in glacial times, seems to be indicated by what is conceded to be an imperfect record. Professor Dana, in his 'Manual of Geology,' estimates the thickness of the northern glacier in America to have been 11,500 feet on the watershed of Canada. Professor Le Conte, in his 'Elements of Geology,' says, 'The archæan region of Canada seems to have been . . . covered with a general ice mantle 3,000 to 6,000 feet thick;' and Professor James Geikie says the Scandinavian ice-sheet 'could hardly have been less than 6,000 or 7,000 feet thick.' As Norway extends nearly to the 72nd parallel of north latitude, it is not probable that the northern glacier exceeded two miles in thickness at its greatest height. Professor Le Conte says, 'Greenland is apparently entirely covered with an immense sheet of ice, several thousand feet thick, which moves slowly seaward, and enters the ocean through immense fiords. Judging from the immense barrier of icebergs found by Capt. Wilkes on its coast, the antarctic continent is probably even more thickly covered with ice than Greenland.' Sir James Clark Ross reports having sailed for several hundred miles along a perpendicular wall of ice 180 to 200 feet high in the antarctic continent, and found only one place where the top of the ice could be seen from the mast-head of his ship; and Capts. Cook and Wilkes both confirm the report of a large ice-sheet in that part of the world. Professor Croll, in 'Climate and Time,' estimates from all the data at hand, that the thickness of the southern ice-cap at its greatest height is no less than twelve miles. It is not probable that the antarctic glacier was much, if any, higher than this in glacial times; for it will be readily understood, that, after the glaciation had proceeded so far as to place the south pole in the midst of a vast ice-plain, the incoming clouds from the surrounding oceans would deposit most of their moisture before reaching the centre, and the glacier would be built up at or near its circumference. Hence we should expect to find the glacier, instead of thinning gradually from twelve miles at the centre to nothing at its outward edges, would present more the appearance of a great section of a hollow sphere of nearly uniform thickness, laid over the earth at the pole.

"Further confirmation of this view is found in the fact that the southern hemisphere has a cooler mean annual temperature than the northern. Mr. Croll says this is due to the constant transference of heat to the north by means of ocean-currents, nearly all the great currents originating south of the equator; while Sir Charles Lyell thinks the true cause lies in the fact of the smaller extent of land surface in the south. It is also true that from March 20 to Sept. 22—the duration of the sun's northern declination—there are 186 days, while from the autumnal to the vernal equinox there are only 179 days: the northern summer is therefore seven days longer than the southern summer, and the southern winter is that much longer than the northern. If this inequality in the length of the summer and winter in the two hemispheres had its origin during the glacial epoch, it would at least have the effect of melting the ice in the north more rapidly than in the southern hemisphere; and if it existed before glacial times, the effect would have been to accelerate the growth of the southern ice-cap more rapidly than that of the northern.

"At the culmination of the glacial epoch, therefore, we may assume that the northern glacier was of an average thickness of 1 mile, and in extent about 25,000,000 square miles, making 25,000,000 cubic miles of ice: that the area covered by the southern glacier was about 30,000,000 square miles, and 5 miles of average thickness, making 150,000,000 cubic miles of ice; and the two extending over more than one-fourth of the earth's surface, and aggregating 175,000,000 cubic miles of ice. These two gigantic 'fossils' would be equal in size to about one-thirtieth part of the bulk of the moon, and would represent an amount of evaporation from the water surface of the earth sufficient to lower the sea-level more than 5,000 feet, or about one mile.

"Now, I submit that the attraction of the sun and moon upon this mass of ice would, if continued for a long time, be sufficient to effect some change in the direction of the earth's axis. Just how much that change would be, I have not determined; but that there would be some change seems to be evident from the bare statement of the proposition. When we consider that this matter has been removed to the poles from the equatorial regions, the inequality of distribution of the earth's mass would be greatly augmented. The action and re-action of the sun and moon and the planets on the protuberant mass of matter about the equator produce what is called 'nutation,' and the precession of the equinoxes. Now, this mass being equally distributed around the earth like a ring at the equator, only the nutation, or nodding, of the axis is produced. But in case of the antarctic ice-cap the result of the attraction would be somewhat different; for, this being largely at one side of at the pole, and the mean attraction of the moon being in the plane of the ecliptic, its tendency would be to draw the mass towards the ecliptic —so far, at least, until an equilibrium should be found.

"That the relative magnitudes of the two polar ice-sheets should always remain the same, would hardly be presumed. The sinking of the ice to the bottom of the Northern Atlantic would necessarily cut off the Gulf Stream, and prevent its further progress northward, if it existed in preglacial times. Even if the ice extended only a few hundred feet below the surface, it would materially interfere with that current, since it is a broad shallow stream, flowing upon the top of the ocean. Similar conditions in the southern ocean might have aided the causes already named in effecting a change or changes in the relative sizes of the two great glaciers. During such changes, therefore, if any existed, oscillations of the earth's axis may have occurred before it became fixed as at present. We should therefore expect to find pauses in the recession, and perhaps a re-advance, of the northern glacier; and such we do actually find from an examination of the great Kettle Moraine in the northern United States, and of the reindeer epoch in Europe.

"As already stated, the ocean-level would be very materially lowered. Thus we can account, in part at least, for the land elevations in high latitudes, to which all geologists resort for a partial explanation of glacial phenomena. True, this lowering of the level would be co-extensive with the entire ocean surface; and the old shore-lines would be found, if discovered at all, below the present water-level. But, as Professor Dana says, 'elevations of land do not leave accessible records like subsidences.' One of the strongest evidences of land elevation is the existence of numerous extensive fiords, which Professor Dana says are 'valleys of erosion,' and which Professor Le Conte calls 'half-submerged glacial valleys.' But, as the ice did not exist at sea-level in low latitudes, these fiords are not found there as fossil remains to mark the degree of elevation. But we know that England was united to the continent of Europe by dry land, that the Mediterranean sea was an interlocked fresh-water lake, that the delta of the Mississippi was at least 400 feet higher than it is at present, and that many of the islands of the Pacific Ocean were at a higher level. Professor Winchell, in his 'Pre-Adamites,' says that probably the now sunken continent of Lemuria, in the Indian Ocean, was dry land during the glacial period, as were also some of the Malay Islands and others. Professor Le Conte says, 'The boldness of the whole Pacific coast, especially in high latitudes, indicates a previous more elevated condition of the land surface [during the quaternary] than now exists;' and Mr. Darwin thinks that 'at this period of extreme cold the climate under the equator at the level of the sea was about the same with that now felt there at the height of six or seven thousand feet.'

"Moreover, if this inequality in the amount of the accumulation at the two poles existed as intimated, it would be sufficient to remove the centre of gravity of the earth a little to the southward of its former position. This would be followed by a greater flow of water from the north polar regions; and here we would have another cause of land elevation in high northern latitudes, since lowering the water is equivalent to an elevation of the land. While there may have been local elevations and subsidences of the land surface in high latitudes during the glacial and Champlain periods, there seems to be strong reason for believing that the growth and decay of the two great ice-barriers added materially to such changes of level by alternately lowering and elevating the general ocean surface. This lowering of the sea-level might be taken into account in considering the question of the geographical distribution of plants and animals; but it is not my design to pursue that branch of the subject here.

"The suggestion here made that the large accumulation of the earth's mass at the south pole was one of the contributive causes of the change in the direction of the earth's axis, is but a corollary to Dr. Warring's statement, that 'between the end of the miocene and the beginning of the Champlain, that movement occurred which gave the earth seasons, unequal days and nights, and greatly enlarged its limits of inhabitability.'"

SCIENTIFIC METALLURGY AND MINING.

The inaugural address of the present session of the Otago University was delivered by Mr. David Wilkinson, Fellow of the Royal School of Mines, who is the newly appointed lecturer on Metallurgy. We reproduce the conclusion of Mr. Wilkinson's address, which dealt with the importance of scientific metallurgy and mining from a commercial as well as an educational point of view.

"We are now arriving at the conclusion that the training of the workshop and of the mine, however valuable, can each be advantageously supplemented by the training to be obtained in the laboratory and the lecture room. It is noticeable here how extremely utilitarian we are becoming. We are not now entirely satisfied with the elegance, suavity and refinement that is undoubtedly imparted by contact with the classical authors. The slow, easy-going times of the beginning of this century have passed away in the eternal competition of nations and of individuals. We can no longer afford to let those chances of advancement slip which have been so readily taken advantage of by other people. Thus we arrive at the Englishman's unfailing query, do the benefits to be derived from the training you speak of more than counterbalance the expenditure of money and energy required for this purpose? The advantage to the individual at anyrate is unquestionable. To confine ourselves again to illustrations from the mining world. How often has it been pointed out that the tendency of the purely practical man is to suppose that the methods he has learnt in his particular district are applicable to all conditions. I may say, without fear of contradiction, that the man who knows his work, by the training of his hands and the education of his mind, must possess greater adaptability than the man who works only by rule of thumb. His education has been obtained in a small school, and unless he possesses rare intelligence his knowledge will be correspondingly narrow. It would not be difficult to give you many examples of this from that most conservative of English counties—Cornwall. From the younger miners there one hears continually the observation: We are 20 years behind the Americans in mining methods. Yet the Cornish miner, as an individual, is not surpassed by any other miner in the world. One could not point to better examples for illustrating this than those which can be seen or read of in the United States. Disregarding these, however, for the moment, I should like to give you two examples which are now historical. For the appreciation of our first example it is necessary to understand how gold occurs in the lodes from which it can be economically extracted. Gold may be said to occur in two conditions—first, as a native metal; and, second, in intimate combination with other metallic compounds. When found native, gold readily alloys with mercury, forming an amalgam. Advantage is taken of this fact in the ordinary separation of gold from its veinstuff. In this case mercury is used as a collecting agent, as owing to its affinity for gold it readily absorbs any fine particles which are brought into contact with it. When sufficiently saturated, the mercury with the alloyed gold is collected, placed in a retort and heated. By this treatment the mercury is distilled from the gold and can be used again for the same purpose. Thus its extraction is comparatively simple. The only important question being how much there is of it. But when gold occurs in combination with metallic compounds like ordinary mundic, it will not readily alloy itself with mercury, and the ordinary treatment fails to extract it. The cause of this failure does not seem to have been fully recognised until one of those patient and ingenious men, known as German professors, not only saw the reason of this difficulty, but completely surmounted it. The substance in which gold is most generally found in this obstreperous condition is a compound of iron and sulphur. Now, Plattner reasoned thus: Either the gold is in some form of chemical combination with the sulphur of the pyrites, or it occurs as plates of almost infinitesimal thickness between the crystalline plates of the mineral. In other words, it is occluded by the mineral. Whatever the condition may be, the crystalline character of the mundic will be destroyed by roasting it, and so the gold will be liberated. Then possibly one may be able to extract the gold with mercury. But here a new difficulty is found. By roasting this mundic, an oxide of iron is formed, and it is found that this iron oxide has a deleterious effect on the mercury. In gold-mining phraseology, it "sickens" it. Thus it was necessary to tack about for a new method, and finally he hit upon the plan of treating this refractory gold with chlorine and then dissolving the chlorinated gold in water. By these means Plattner first solved the economical extraction of ore from pyrites. His plan has been largely adopted in America and Australia, and is now the source of considerable profit to gold mining companies. The Mount Morgan ore is, I believe, entirely treated by this process. May I ask your attention while I give you another example of this adaptability, one that has exerted a tremendous influence upon a still more important industry. At the British Association meeting in 1865, Sir H. Bessemer announced, amid considerable surprise and consternation, the fact that he had discovered a new method of producing steel direct from pig iron. The general practice to produce steel at this time was first by converting pig iron into wrought iron, and then by a slow and expensive process to change wrought iron into steel. This was a very circuitous way of ultimately making steel, for steel, speaking roughly, is intermediate in comparison with pig iron on the one hand and wrought iron on the other. The old process is something analagous to the action of the man who wishes to travel from Dunedin to Wellington, and who, to faciltate matters, goes first to Auckland. Bessemer saw this very clearly, and not only this, but the fact that steel could not be applied to many ordinary purposes unless some other process were invented. To convert pig into wrought iron a puddling furnace is used. In this furnace the iron is melted and exposed for a considerable time to the oxygen of the atmosphere and to the influence of a special furnace lining composed of oxide of iron, by this means the various impurities in the iron are burnt out. In this process considerable fuel is used to keep the iron in a molten state. With characteristic boldness Bessemer said in effect, why should not the heat given out in burning these impurities be used for keeping the iron in a molten state. If instead of passing the air over the surface of the metal, it could be urged through the metal so that the oxygen could come into contact with every particle almost simultaneously, then the process that now requires considerable labour and time could be completed much more efficaciously in a few minutes and with very little labour. For boldness of conception such a suggestion has perhaps never been equalled in the metallurgical art. The thought of urging air through tons of molten iron was rash enough to frighten the most courageous of iron smelters. How will the iron be kept molten, how will you prevent the burning of the iron and its consequent utter deterioration? Bessemer heeded not these gloomy forebodings, but for 15 years worked at his great invention, and ultimately overcame those enormous mechanical difficulties which beset every proposed change in the treatment of large masses of metal, and particularly so, when that metal has a high melting point. The effects of this invention upon the steel industry were simply marvellous. Steel at this time was selling at more than £50 per ton, and could only be obtained in small quantities. The price has since fallen to £10 per ton, and the increase in its use is most extraordinary. There is perhaps no article of commerce the use of which has increased so rapidly. It is said that at the time of this invention, 51,000 tons of steel were produced annually in Sheffield. Now the production has to be estimated by millions of tons. Steel is thus rapidly replacing cast and wrought iron for all conditions where strength and homogeneity are required. It would require a considerable length of time to enumerate the many ways in which this invention has benefited the engineering profession. How it has given to them greater possibilities, and a much wider field for their ingenuity I will merely mention one that you are all familiar with. The Forth bridge may, perhaps be regarded as one of the finest structures erected during this century, and one of which Scotland may justly be proud. I am not overstepping the mark, indeed, I am only repeating the words of a great authority on this subject, when I say that it could never have been built if the inventions of Bessemer, and of his equally famous contemporary Sir C. W. Siemens, had not been accomplished facts. Indeed, it would be extremely difficult to exaggerate the influence that these inventions have had upon the progress of mankind. It was not many years after Bessemer had perfected his invention that Dr. Percy pointed out the fact that in the Bessemer process, as then practised, one objectionable ingredient was not eliminated. This was phosphorus, and its presence in steel caused the metal to be brittle, and, for some purposes, totally untrustworthy. Dr. Percy's warning was for some time disregarded, until 'true as steel' became a phrase of no meaning, if certain kinds of metal were included in this category. Thus there appeared to be no possibility of applying this extraordinary process to the pig iron produced from the cheapest and most abundant ores —because they contained too much phosphorus. This process that had so revolutionised the steel industry appeared to be strictly limited in its application. It was no doubt with considerable pride that the late Dr. Percy could in his later years point to the fact that this difficulty had been completely solved by three of his own pupils. The solution of this problem is without doubt one of the strongest evidences of the value of scientific education. The cause of the retention of the phosphorus was carefully traced. Experiments were tried time after time to discover a method of getting rid of this element without damaging the metal; and at last, after months of patient toil a process was discovered and placed upon a working basis. Without the assistance of the analytical chemist progress in this direction would have been hopeless. The exact relation between the method of producing the steel, its composition, and its resulting physical properties, can only be traced by most accurate analyses. This statement is also true of all metallurgical industries. Unless the battery manager can accurately determine the average value of his ore and also of his tailings, how can he possibly estimate the success of his work or the direction in which the waste of gold is taking place. If again, the lead smelter is unable to estimate the silver and lead in his slag or by analysis to gauge the fusibility of the extraneous material he wishes to flux, how will he be sure that he is not allowing the precious metal to run to waste, or that he is not in great danger of having his furnace choked. I believe we should not have to travel far to find instances of this kind. The same statements are also true of the more speculative and uncertain mining industry. If to an always risky industry like that of mining there are added the mistakes due to careless or inefficient workmanship, or the misleading statements of professional speculators, is it any wonder that this otherwise interesting and lucrative profession ofttimes shows unmistakable symptoms of decay. By endeavouring to raise the standard of intelligence in this special direction, we are only attempting what we have successfully achieved in medicine, in literature, and in many other branches of art and science. It is interesting and encouraging to know that we are not alone in this respect. Passing through the United States one is astonished at the extraordinary vigour of this movement. Boston can boast the finest institute of technology in the world. New York State, Pennsylvania, Michigan, Colorado, California, and many other States are well equipped, not only with universities, but also with technical colleges, and mining with its attendant sciences is, without doubt, the most important branch of technology taught in these institutions. In crossing the States I had the privilege of visiting two of these schools. The first was the one joined to Columbia College, New York city, and the second was the University of California. It is noticeable that in the formation of our curriculum, except in one or two particulars, we have consciously or unconsciously copied these two most prominent of American colleges. At Columbia College no student, unless he is a graduate, is allowed to dabble with the separate subjects. He is compelled to pass through a systematic course of study extending over four years, this rule being ostensibly framed for the purpose of making the education as trustworthy and as complete as possible. Perhaps the most noticeable fact in the Californian School of Mines is the thorough equipment of the laboratories. Here one can see a gold extraction plant, second perhaps to none in the States for efficiency in the working of small parcels of ore. With this machinery at his command the student can make himself familiar with the peculiarities of the ores from different counties, and with the difficulties met with in the winning of the precious metal from them. Let us here observe that many of these instiutions are State paid. So much fcr America. Turning now to the old world we find that notwithstanding the proverbial slowness of our countrymen in the adoption of new methods, there has been for 40 years a Royal School of Mines in London. Some of the most eminent British geologists, metallurgists, chemists, and mining engineers have passed through this school. To-day there are nearly 300 individual students on the books. I say individual advisedly, for, owing to the great demand for admission, a doubling of the laboratory accomodation is contemplated. But though there are so many in attendance at this place, it is worth our while to notice that there is an average of only 26 turned out each year from the mining and metallurgical branches. It is noteworthy also that in this instance the school is supported by the State, although every reasonable effort is made to render it self-supporting. In Cornwall, also, a school of mines was established a few years ago, and bids fair to occupy a high position in this pluckiest of mining countries. In France there is the Ecole des Mines, and in Germany there are more of these academies than in any other country in Europe. To Germany doubtless belongs the credit of having first recognised the importance of technical training; and both Englishmen and Americans have largely availed themselves of the superior training to be obtained at such places as Wiesbaden, Heidelberg, Clausthal, and Freiberg. It would indeed be strange if in a continent like Australia, possessing such vast stores of mineral wealth and so many vigorous sons to gather it, it would indeed be strange if a movement of a similar nature had not been successfully advocated. But it is not so. New South Wales, Victoria, and South Australia have all established schools of mines, and to us also, belongs the credit of recognising the importance of this innovation on our old educational establishments. Perhaps it would not be out of place if I were to give a brief account of what we have done and what we wish to do in the future. In accordance with the practice of the most notable institutions, the mining student is first educated in those fundamental sciences, without a knowledge of which no man can hope to study any subject in a scientific manner. These are mathematics, physics, chemistry, and mechanics. They must always form the basis of a truly scientific education, and there is much wisdom in insisting upon the study of them. Then, as subjects more especially adapted to their work, we have the courses of geology, mineralogy, applied mechanics, mining geology, mining and metallurgy; and as practical work there are the courses of mine surveying, practical mineralogy, including petrography and blowpipe analysis, and also assaying. Thus you see the training is intended to be sufficiently broad and comprehensive. In thus making so many subjects compulsory we are only following the advice of the most eminent educational authorities, which is: 'Do not specialise too soon, for each man has a faculty for some separate branch, and he will ultimately be attracted strongly, and will probably devote himself almost entirely to this branch. If he does this too early in life, he will feel the need of a broad or liberal education before he has advanced very far; for the sciences are so intertwined that it is impossible to study one for any length of time without requiring the knowledge of half a dozen more.' There is just one more remark to make upon this subject. The opinion of most men who have been connected for years with large scientific institutions is, that there is nothing so stimulating to an advanced student as the struggle for the elucidation of some problem. In this kind of work his power of applying the principles of the sciences he has learned, and his manipulative abilities are tested ofttimes to their utmost, and it is in this kind of work that he discovers, so to speak, his grit. Hence, though we are at the beginning, really, only of our work, yet we may hope in the not distant future to approach and to overcome those problems of mining and metallurgical interest which are always to be found in a comparatively young country like New Zealand. . . . . The thorough investigation as to the acquisition of its mineral wealth is to the State as a whole of paramount importance. Excuse me for again referring to the United States, I do so because I know of no better example. The rapid growth of the States in population and wealth is a fact patent to all. Now, however much we may be opposed to a rapid increase in population, and particularly of an increase due to the mixture of such heterogeneous people as those of the States, yet we are by no means averse to a similar increase of wealth. It would not be difficult to prove that this unparalleled development is largely due to the opening up of vast mineral resources. Thus the production of the valuable fuels and metals has increased at a rate unprecedented in the history of mankind. The output of coal for example in the year 1860 was 15,000,000 tons, but the output in 1889 was 132,500,000 tons. In the year 1852 the output of copper was only 1,000 tons, in 1890 it was 121,560 tons, or half that of the total output of the world. The production of gold even now is almost equal to that of the whole of Australasia. But the increase in the production of iron is, perhaps, the most marvellous of all, for while in 1852 only 541,990 tons of pig iron were made, in 1890 the output reached the gigantic total of 10,250,000. For many years it has beaten all other countries in the production of silver, and last year the enormous total of 4,167,000lb troy was obtained. We can form no proper estimate of this stupendous quantity. Just as this acquisition of wealth from the working of mineral deposits has been the greatest factor in the growth of the States, so also it was this which caused the rapid colonisation of New South Wales, of Victoria, and of New Zealand. Since those early and successful efforts to work the gold deposits of this country there has been a long lull in this industry, and we hope that we are now at the nadir of our decrease. It seems to me that when the improvement does come, it will be in the form, either of the discovery of lodes other than in our gold reefs, or beds other than those of coal, or, as is perhaps more likely, of the successful working of our present low grade ores. It has been stated that the greatest wealth, mineralogically speaking, of a country is to be found in her poorest ores, and though at first sight this may seem a paradox, experience has proved it to be true. In conclusion, let us notice that the success of our educational institutions does not rest entirely with the staff, or even with the students. Unless we have the sympathy of an enlightened public opinion we shall be hampered in our endeavours. We expect, we claim this sympathy, and I believe that in this also, we shall not be disappointed."

AN EXPERIMENT CONCERNING THE ABSENCE OF COLOUR FROM THE LOWER SIDES OF FLAT FISHES.

BY J. T. CUNNINGHAM, M.A., Naturalist to the Marine Biological Association.
"Zoologischer Anzeiger," 18th January, 1891, No. 354, p. 27.

One of the most interesting questions which biological research has still to decide is whether adaptations in organisms are due to the natural selection of indefinite variations or to the definite influence of the conditions of life. One school of evolutionists, that of which Weismann is one of the most eminent leaders, maintains that every character in animals is an adaptation and every adaptation is sufficiently explained by indefinite variation and natural selection. Another school believes that many things are not adaptations and that those characters which are adapted are due to the definite influence of conditions. The former school would I suppose maintain that the whiteness of the lower sides of flat-fishes was an adaptation, and was due to selection. What is the especial advantage of this character to flat fishes I am unable to perceive. But it seems to me more probable that it is due in some way to the fact that little or no light can fall on the lower sides of these fishes, because these sides are generally in contact with the ground.

The following experiment seems to me to support very strongly the latter views; it was carried out in the Plymouth Laboratory of the Marine Biological Association.

At the beginning of last May I received from Mevagissey in Cornwall a large number of young flounders (*Pleuronectes flesus*) in process of metamorphosis. They were very transparent and measured 11.5 to 12.7 mm in length. In a few the metamorphosis was almost complete the left eye having reached the edge of the head but in the majority the left eye though it had commenced its "migration" was still on the lower side. The little fish had already developed the habit of lying on the bottom on the left side. Nearly all the pigment, *i.e.* the chromatophores had disappeared from the lower side, where only a few scattered black and yellow cells remained: on the upper side the pigmentation was considerable, but not so fully developed as in the adult.

On May 8th I took about 15 or 16 of these small flounders and placed them in a glass vessel without sand. This vessel I placed on a plate of glass supported at the ends by two supports. Beneath the glass plate I arranged a mirror about 15 inches by 12, sloping it at an angle of 45°. The top and sides of the vessel containing the fish were covered with opaque material, and through the cover were passed a jet delivering water and an outflow pipe connected with an overflowing bottle a little distance off, so that a constant circulation of sea water was maintained in the vessel while the level of the water in it remained constant. The whole apparatus was placed in front of a south window from which the light fell on the mirror and was reflected vertically upwards on to the bottom of the vessel containing the fish: as the fish were usually resting on this bottom their lower sides were illuminated while their upper sides were kept in the dark.

At the same time I kept a large number of the same young flounders living under ordinary conditions in table-tanks at the bottom of which was a layer of fine sand.

I fed these young flounders first with minute crustacea sifted out from weeds gathered on the shore, and afterwards with minced worm, and they all throve well and grew rapidly.

On June 21st I took out one of the specimens from the mirror-apparatus and examined it. It was 2.7 cm in length. Another specimen taken from an ordinary tank for comparison was 2.6 cm long. The difference between the lower sides of these two was as follows: In the mirror-specimen there was an opaque white layer all over the wall of the abdominal cavity, the rest of the skin being translucent. In the normal specimen this coating was confined to the edges of the same area. There were a few scattered black chromatophores on the lower side of the head in each specimen, but rather more in the mirror specimen than in the other.

It is evident that these differences are not very important, and I think it is reasonable to conclude that at this time, one month and a half after the commencement of the experiment, the lower sides of the mirror-specimens had become, by inherited tendency, as destitute of pigment as those of the specimens under the ordinary conditions.

But two months afterwards namely on August 27th all the flounders in the mirror apparatus died. The cause of death was this. After my return from Norway on August 13th I noticed that the fish in the apparatus very frequently clung to the sides of the vessel instead of lying on the bottom, and as the sides were darkened, while they were in this position their upper sides only were exposed to the light from the mirror. In order to prevent this I introduced a horizontal partition of network so as to keep the fish on the bottom of the vessel; but the netting soon got obstructed with remains of the food, and the water below the partition was thus cut off from the circulation so that the fish were asphyxiated.

The following are the notes I made from my examination of the fish immediately after their death :—

1. 3.2 cm in length : black and yellow chromatophores on the lower surface of the longitudinal fins and in a broad band on each side of the lower surface of the body ; also on the edges of the lower side of the head.

2. 3.7 cm in length. Normal pigment all over the same band at the edges of the body on the lower side : also in the angle behind the operculum and on the lower pectoral.

3. 3.2 cm in length. Pigmentation on the lower sides as in 1 and 2 but not quite so much of it.

4. 6.3 cm in length. A small patch of chromatophores both black and yellow in the area covered by the lower pectoral, and extending beyond that area.

5. 4.2 cm in length. Little pigment on the lower side ; a little on the pectoral, on the edges of the head, and near the ventral edge behind the operculum.

6. 5.7 cm in length. Pigment on the rays of the lower pectoral, and on the dorsal edge of the head.

7. 5.3 cm in length. Pigment on lower side of head near edges ; on lower branchiostegal membrane a good deal.

8. 4.3 cm in length. Scattered black chromatophores behind body cavity.

9. 5.8 cm in length. A few black chromatophores near dorsal edge of lower side of the head.

10. 5.5 cm in length. A few scattered black chromatophores over the lower side, especially behind the body cavity on the ventral half.

11. 5.3 cm in length. No pigment on lower side except on lower surface of the tail.

12. 5.8 cm in length. No pigment on lower side.

13. 3.3 cm in length. No pigment on the under side.

At the same time I examined 4 of the specimens which had been kept during the same time on a sandy bottom in the aquarium and found no pigment on the lower sides of either. I have also frequently had occasion to examine other of these specimens of the young flounders of the same age kept in the tanks since last May, and have never seen any pigment on the lower sides of any.

To show the significance of this experiment it must be mentioned that the colours of flat-fishes always depend on three and only three kinds of cellular elements, namely the black chromatophores, yellow or orange-yellow chromatophores, both of which are capable of expansion and contraction, and thirdly the iridocytes which are strongly reflecting and white or slightly iridescent, and which are fixed in shape and size. The iridocytes are alone present on the lower sides of normal flat-fishes, and give them their opaque white appearance.

Of the above 13 specimens whose lower sides had been exposed to light for less than 4 months only three had failed to devolope black and yellow chromatophores in the skin of those sides. Three showed very well developed bands of pigment quite similar to that of the upper side over the area occupied by the muscles of the longitudinal fins. The other 7 specimens possessed a less quantity of pigment on the lower it is true, but chromatophores were present in one part or another where they are not present in the specimens living in the ordinary way on sand.

The question of course arises, how are these pigment cells developed, by migration from the upper side? from wandering lymphatic cells? or from unpigmented cells already present in the same position before? These questions I cannot at present answer, but am now endeavouring to find replies to them. I think the third suggestion the most probable. The chromatophores in flat-fishes are situated in the derma between the surface of the scales and the epidermis.

Of course I am well aware that specimens of flounders and other flat-fishes are occasionally taken from the sea in which both sides are coloured, or in which there are coloured spots on the lower side. But I scarcely think any one will maintain that the condition of the specimens in my experiment can be supposed to be a case of accidental variation. On the other hand it is always possible that abnormal pigmentation on the lower sides of free-living specimens is due to peculiarities of environment or habit.

I have other experiments in progress which I hope will further elucidate the relation of the pigmentation of the flat-fishes to the action of light. For the present I will conclude with a brief summary of what previous writers have said as to the causes of the absence of chromatophores from the lower side. Prof. Alexander Agassiz in his paper on the "Development of the Flounders" * published in 1878, says that the attempt which he made of placing the glass dish containing young flat-fishes at a height over a table, and thus allowing the light to come from below as well as from all other sides, failed in arresting the transfer of the eye, and also produced no effect in retaining the pigment spots of the blind side longer than in specimens struck by the light only normally from above. Prof. Agassiz in the first place did not use a mirror, and in the second place he evidently expected that the effect if any would be to arrest the metamorphosis. The idea on which I found my experiments is that the inherited tendency will cause the metamorphosis to take place even when the conditions are reversed, but that when the reversed conditions are kept up long enough a new metamorphosis will be induced in the opposite direction to the first.

Prof. Agassiz refers in the same paper to Pouchet's researches on chromatophores† saying that they point most plainly to the partial atrophy of the great sympathetic nerve, effected during the passage of the eye from the right to the left or vice versa, as the cause of the absence of chromatophores from the lower sides of flat-fishes. I have read Pouchet's paper referred to below, and can find no mention whatever of any suggested cause of the absence of colour on the lower sides of flat-fishes. Pouchet found that section of the great sympathetic put an end to the changes of colour under the influence of light, but he

* Proceedings Amer. Acad. Arts and Sc. Vol. XIV.

† G. Pouchet, Des Changements de Coloration sous l'Influence des Nerfs. Arch. de Physiol. et d'Anat. 1876.

distinctly says that it made no difference whether the left or the right eye was extirpated in the turbot. In either case the changes of colour went on as before when the fish was changed from one bottom to another, but when both eyes were extirpated the changes ceased.

Finally I must refer to the remarks of Prof. Semper in his "Animal Life" * who says that the absence of colour in animals is certainly not to be ascribed to the absence of light, since we know that animal pigment like vegetable pigment can be developed in total darkness, and in fact is so developed normally in many animals.

MARRIAGE AMONG DEAF-MUTES.

An Address delivered by ALEXANDER GRAHAM BELL, on March 6th, 1891.
("Science," Vol. XVII., p. 160).

It always gives me pleasure to respond to the invitation of the members of the Literary Society of Kendall Green, and it will always be my object in addressing you to choose subjects that will be of interest and importance to you in your future lives. You have come together here from every part of the United States to receive in the National College for Deaf-Mutes that higher education which you cannot obtain in the States from which you came.

In a very little while—it may be in one year, or two years, or more—you will separate from one another, and each go back singly to the places from which you came, to begin the battle of life. You will go out into the great world,—the world of hearing and speaking people, a world of people who cannot spell upon their fingers or make signs. Are you prepared for that change, and what is to be your position in that world?

I would have you all remember that you yourselves are a part of that great world of hearing and speaking people. You are not a race distinct and apart, and you must fulfil the duties of life, and make your way to honourable positions among hearing and speaking people.

Now, I have considered what subject I could bring to your attention to-night the consideration of which would be of assistance to you when you go out into the world; and there is no subject, I am sure, that lies closer to your hearts than the subject of marriage.

It is a very difficult thing for me to speak to you upon that subject, because I know that an idea has gone forth, and is very generally believed in by the deaf of this country, that I want to prevent you from marrying as you choose, and that I have tried to pass a law to interfere with your marriages. But, my friends, it is not true. I have never done such a thing, nor do I intend to; and before I speak upon this subject I want you distinctly to understand that I have no intention of interfering with your liberty of marriage.

* Natural conditions of Existence as they affect Animal Life. 2nd edit., p. 90.

You can marry whom you choose, and I hope you will be happy. It is not for me to blame you for marrying to suit yourselves; for you all know that I myself, the son of a deaf mother, have married a deaf wife.

I think, however, that it is the duty of every good man and every good woman to remember that children follow marriage, and I am sure that there is no one among the deaf who desires to have his affliction handed down to his children. You all know that I have devoted considerable study and thought to the subject of the inheritance of deafness, and if you will put away prejudice out of your minds, and take up my researches relating to the deaf, you will find something that may be of value to you all.

We all know that some of the deaf have deaf children,—not all, not even the majority, but some,—a comparatively small number. In the vast majority of cases there are no deaf offspring, but in the remaining cases the proportion of offspring born deaf is very large,—so large as to cause alarm to thoughtful minds. Will it not be of interest and importance to you to find out why these few have deaf offspring. It may not be of much importance to you to inquire whether by and by, in a hundred years or so, we may have a deaf variety of the human race. That is a matter of great interest to scientific men, but not of special value to you. What you want to know, and what you are interested in, is this: are you yourself liable to have deaf offspring? Now, one value that you will find in my researches is this: that you can gain information that may assure you that you may increase your liability to have deaf offspring or diminish it, according to the way in which you marry.

The Rev. W. W. Turner of Hartford was the first, I think, who showed that those who are born deaf have a greater liability to have deaf offspring than those who are not. He showed, that where a person born deaf marries another person born deaf, in this case about one-third of the children are deaf. Mr. Job Williams, the present principal of the Hartford Institution, has still more recently examined the subject; and, in a letter published in *Science* a short time ago, he arrives at the same conclusion,—about one-third are born deaf. In 1888, Mr. Connor, the principal of the Georgia Institution, made an examination of the results of the marriages of his pupils, and his statistics are published in "Facts and Opinions relating to the Deaf." He also comes to the same conclusion,—about one-third are born deaf.

The following table will show you the exact figures:—

TABLE I.—*Concerning the Offspring of Couples Both of Whom were born Deaf.*

Authority.	Total Number of Families.	Total Number of Children.	Number of Deaf Children.	Percentage of Children who are deaf.	Number of Deaf Children to every 100 Families.
Turner (1868)	24	57	17	29·8	70·8
Connor (1888)	16	59	19	32·4	118·7
Williams (1891) ...	52	151	48	31·8	92·3

It is obvious that persons born deaf run considerable risk of having deaf offspring if they marry persons who are also born deaf.

If we take all the marriages of congenitally deaf persons, without reference to whether they married deaf or hearing persons, we have five independent sets of statistics from which we may derive information regarding the effects upon the offspring. (1) My own researches indicate that where one or both of the parties were born deaf there will be fifteen deaf children in every hundred families; Dr. Gillett's statistics give eighteen deaf children to every hundred families; (3) Dr. Turner's, thirty-two; (4) Mr. Williams's, forty-seven; and (5) Mr. Connor's, ninety-five.

TABLE II.—*Concerning the Offspring of Couples One or Both of Whom were born Deaf.*

Authority.	Total Number of Families.	Total Number of Deaf Children.	Percentage. Number of Deaf Children to every 100 Families.
Turner (1868)	190	61	32·1
Bell (1883)	360	56	15·5
Connor (1888)	22	21	95·4
Gillett (1891)	71	13	18·3
Williams (1891)	211	101	47·8

Persons who are reported deaf from birth, as a class, exhibit a tendency to transmit the defect; and yet when we come to individual cases we cannot decide with absolute certainty that any one was born deaf. Some who are reported deaf from birth probably lost hearing in infancy; others reported deaf in infancy were probably born deaf. For educational purposes the distinction may be immaterial, but in the study of inheritance it makes all the difference in the world whether the deafness occurred before or after birth. Now, in my researches I think I have found a surer and more safe guide to those cases that are liable to transmit the defect.

The new guide that I would give you is this: look at the family rather than at the individual. You will find in certain families that one child is deaf and all the rest hearing, the ancestors and other relatives also being free from deafness. This is what is known as a "sporadic" case of deafness,—deafness which afflicts one only in a family.

Well, the deafness in such cases may be accidental. There is no proof that such deafness is liable to be inherited, excepting where the person is reported deaf from birth. In the vast majority of cases reported deaf from birth there is an undoubted tendency to inheritance; but where the deafness is caused by meningitis, scarlet-fever, or like causes, and no other case of deafness exists in the family, there is probably little, if any, tendency to inheritance. But when you have two members of your family deaf, or three, or four, or five, there you have the proof that a tendency to deafness exists in the family. What I term "family deafness" exists there. Something has been transmitted from the parents to the children that has caused deafness, or helped to cause it. I remember a case in which there were four children in one family deaf, and none of them were born deaf. One child became deaf, perhaps, from measles, another from scarlet-fever, etc, I do not now remember exactly what causes were stated. They became deaf, however, at different times, and from apparently accidental causes. But can we consider that it was accidental that there should have been four children in one family deaf? The fact that a number of children in the same family are deaf points to an inherited tendency to deafness in the family. One result of my researches is to show the great importance of studying the results of marriages of persons who come from families of that kind. My results, however, until verified by other observers, should be received as probable only, and not certainly proved.

So far as I can find out, the hereditary character of the defect in a family is roughly indicated by the proportion of the family who are deaf. If you make a fraction, and place the number of deaf children above as the numerator, and the total number of children below as the denominator, for example, $\frac{1}{6}$, that fraction will give you some idea of the tendency to deafness in that family: one child in six is deaf. Again, take a case in which three out of six are deaf ($\frac{3}{6}$). Now, the tendency to transmit the deafness in this family ($\frac{3}{6}$) will be greater than in that ($\frac{1}{6}$). Every member of the first family ($\frac{3}{6}$), whether deaf or hearing, will have a greater tendency to have deaf children than the members of the other ($\frac{1}{6}$). In general, the tendency to transmit deafness is greatest in those families that have the largest proportion of deaf members, and smallest in those that have the least. This conclusion is exceedingly probable, and should therefore be taken as a guide by those who desire to avoid the production of deaf offspring. If you marry a hearing person who has three or four deaf brothers and sisters, the probability of your having deaf children will be greater than if you marry a deaf person (not born deaf) who has no deaf relatives.

The statistics collated by me ("Memoir," p. 25) indicate that 816 marriages of deaf-mutes produce 82 deaf children: in other words, every 100 marriages are productive of 10 deaf children. This is a result independent of the cause of deafness,—an average of all cases considered. Eliminating 40 cases where the cause of deafness is not given, I divide the 776 cases into 4 classes:—

TABLE III.

		Number of Families.	Number of Deaf Children.	Percentage. Number of Deaf Children to every 100 Families.
Class 1.	Not born deaf, no deaf relatives ...	363	18	4·7
Class 2.	Not born deaf, deaf relatives ...	53	5	9·4
Class 3.	Born deaf, no deaf relatives ...	130	15	11·5
Class 4.	Born deaf, deaf relatives ...	230	41	17·8

The percentage results are shown by themselves in the following table (Table IV.), in which the figures indicate the number of deaf children produced by every 100 marriages of persons belonging to Classes 1, 2, 3, and 4.

TABLE IV.

PERIOD OF LIFE WHEN DEAFNESS OCCURRED.	CHARACTER OF THE DEAFNESS.	
	Sporadic Deafness.	Family Deafness.
After birth	4·7	9·4
Birth	11·5	17·8

My statistics are confessedly very imperfect, and many persons have hastily concluded that the results are therefore of no value or significance. This, however, is not the case; for the imperfection of the statistics assures us that the figures given are all underestimates, the true number of deaf children in every case being greater than that mentioned. As a matter of fact, all the statistics since collected by others have shown larger percentages.

While it is believed that the true percentages are larger than those given, it is probable that they are proportionately larger; so that we may conclude with probable accuracy that persons belonging to Class 4 are more liable to have deaf children than those belonging to Class 3, those of Class 3 more liable than those belonging to Class 2, and those belonging to Class 1 are the least liable of any, to have deaf offspring. The relative liabilities are probably represented by the percentage figures.

The results are imperfect from another cause. The institution reports from which the statistics were compiled did not give details concerning both the parties to a marriage.

It would be stated that Mr. So-and-so "married a deaf-mute;" but no information would be given as to whether his wife was born deaf or not, or whether she had or had not deaf relatives. I have only been able, therefore, to classify the marriages by one side. For example: the results noted for Class 1 give the summation of all marriages of persons not born deaf who have no deaf relatives, quite regardless of the fact that some of them may have married congenital deaf-mutes, others semi mutes, and still others hearing persons. We may deduce, however, from the figures, that, if the husband belongs to Class 1, his liability to have deaf offspring will be greatest if his wife belong to Class 4, and least if she belongs to Class 1, etc.

Now that Professor Fay has taken up the subject, I hope that we may obtain statistics of greater accuracy and importance than any yet compiled.

When we obtain statistics classified by both parties to the marriage, I think it will be found, that, where persons belonging to Class 1 marry persons also belonging to Class 1, there will be no deaf offspring, or, at least, that the percentage of deaf offspring will be insignificant; for surely accidental deafness is no more liable to be inherited than the accidental loss of an arm in battle, for instance. If, however, a person born without an arm should marry a person also born without an arm, some of the children would probably exhibit the same defect. In a similar manner, persons belonging to

Classes 2, 3, and 4 exhibit a decided tendency to transmit deafness to their offspring.

Now, there is a law of heredity that may afford great comfort to many of the deaf,—the law of reversion. There is a very strong tendency in offspring to revert to the normal type of the race. It requires constant selection from generation to generation on both sides to perpetuate any abnormal peculiarity. There will always, therefore, be a tendency to produce hearing children rather than deaf, excepting in cases where both parties to a marriage come from families belonging to Classes 2, 3, and 4.

Probabilities for Your Guidance.

Whatever may be the character of the deafness in your own case, you will probably diminish your liability to have deaf offspring (1) by marrying a hearing person in whose family there is no deafness; (2) marrying a deaf person (not born deaf) who has no deaf relatives (Class 1), or a hearing brother or sister of such a person.

On the other hand, you will probably increase your liability to have deaf offspring (1) by marrying a deaf person (not born deaf) who has deaf relatives (Class 2), or a hearing brother or sister of such a person; (2) by marrying a deaf person (born deaf) who has no deaf relatives (Class 3), or a hearing brother or sister of such a person; (3) by marrying a deaf person (born deaf) who has deaf relatives (Class 4), or a hearing brother or sister of such a person.

Of course, if you yourself were born deaf, or have deaf relatives, it is perfectly possible that in any event some of your children may be deaf. Still, I am inclined to think, that, if you marry a member of a family in which there is no deafness (or only a single case of non-congenital deafness), you will not only have fewer deaf children than if you married into a family containing a congenital deaf-mute, or a number of deaf persons, but the deafness of your children will not tend so strongly to be handed down to the grandchildren. The tendency to inheritance will be weakened in the one case, and intensified in the other: that is, in the former case your deaf child will have a less tendency to transmit his defect to his children than you yourself possess; in the latter case a greater tendency.

Take the case of a family in which three or four children are born deaf.

Now, suppose that all the members of this family and their deaf descendants are careful to marry only into families which are free from deafness, or which contain only single cases of non-congenital deafness. Then the probabilities are that at each generation the percentage of children born deaf will be less, and the proportion of hearing children greater, until finally the deaf tendency disappears, and all the descendants will hear.

On the other hand, suppose that the members of this family and their deaf descendants marry into families containing a congenital deaf-mute, or containing several deaf persons. Then the probabilities are that at each generation the percentage of children born deaf will increase, and the proportion of hearing children will be less, until finally the tendency to produce hearing offspring disappears, and all the descendants will be deaf. This family would then constitute a deaf variety of the race, in which deaf offspring would be the rule, and hearing offspring the exception.

Now, the point that I would impress upon you all is the significance of family deafness. I would have you remember that all the members of a family in which there are a number of deaf-mutes have a liability to produce deaf offspring, the hearing members of the family as well as the deaf members.

This, I think, is the explanation of the curious fact that the congenitally deaf pupils of the Hartford Institution who married hearing persons had a larger percentage of deaf children than those who married deaf-mutes. It is probable that many of the hearing persons they married had brothers or sisters who were born deaf.

Cases will constantly arise in which a proposed marriage will appear undesirable and desirable both at the same time. For example: a semi-mute having no deaf relatives may form an attachment for a congenitally deaf person in whose family deafness may be hereditary. Of course, I have nothing to say as to what the young people should do: that is a matter for them to decide. I cannot even undertake to advise. The semi-mute will have no tendency to have deaf children if he or she will marry a person of similar kind (Class 1), or marry a hearing person belonging to a family in which there is no deafness: hence this person, by marrying a congenitally deaf person in whose family deafness is hereditary, will create a liability to have deaf offspring which would not otherwise exist. From this point of view, the marriage is undesirable.

On the other hand, from the point of view of the person born deaf, such a marriage is extremely desirable, for it will diminish the hereditary tendency in his family. In such a case, the friends of one party would probably favour the union, and the friends of the other advise against it; and the mutual friends of both could only say, "It is desirable to one, and undesirable to the other: we cannot advise; your own hearts must decide the matter."

Now, I have come before you to-night to show you that there may be something in my researches of benefit to you; I want also to assure you that there is nothing of harm. I want to disabuse your minds entirely of the idea that I intend or desire to interfere with your perfect liberty of choice. I claim the right to advise you as I would advise my own children, or any young people in whom I feel an interest. In this matter my views coincide very closely with those recently expressed by President Gallaudet through the columns of *Science.* You have to live in a world of hearing and speaking people, and every thing that will help you to mingle with hearing and speaking people will promote your welfare and happiness. A hearing partner will wed you to the hearing world, and be of inestimable value to you in all the relations of life. Not only will your own success in life be thereby increased, but the welfare of your children will be materially promoted. It is surely to the interests of children, both deaf and hearing, that at least one of their parents should hear.

I would therefore hold before you as the ideal marriage a marriage with a hearing person. Do not let any one place in your minds the idea that such a marriage cannot be a happy one. Do not let any one make you believe that you cannot find a hearing person who will treat you as an equal. The chances are infinitely more in your favour that out of the millions of hearing persons in this country you may be able to find one with whom you may be happy than that you should find one among the smaller numbers of the deaf.

I think the sentiment is hurtful that makes you believe you can only be happy with a deaf companion. That is a mistake, and, I believe, a grave one. I would have you believe that the welfare of yourself and your children will be greatly promoted by marriage with a hearing partner, if you can find one with whom you can be happy.

And now, my friends, I must thank you very much for the attentive way in which you have listened to me, and I hope you will all dispel from your minds any idea that I intend to interfere with your liberty of marriage. I know that very grave misconceptions of my position and views have been circulated during the past few years among the deaf, and I want you to help me in dispelling these ideas.

These misconceptions have arisen chiefly, I think, from too great reliance upon newspaper stories and second-hand information. The newspapers seem to know a good deal more about my opinions and views than I do myself, and I am constantly seeing items about myself that have utterly no basis in fact. Only a few weeks ago I read in a newspaper a long report of an interview with me that never took place. The substance of that article has since been copied from paper to paper all over the United States. I happened to be suffering from a slight headache when the reporter called at my hotel, and I thought this would afford a good excuse for avoiding an interview. I therefore sent my compliments to the reporter, and begged to be excused. He went away, and I thought that that was the end of the matter. Alas, no! Next morning I found myself in the paper, in large capitals, giving forth opinions relating to the education of the deaf that I had never expressed.

Now, I would impress upon your minds the fact that if you want to do a man justice, you should believe what a man says himself rather than what people say he says. There is no man in America, I think, who has been more interviewed by newspaper reporters than I have, and I can assure you that I have never yet seen a report of an interview with me that was free from error.

But now I begin to be afraid of you; for you are the interviewers in this case, and I wonder how I shall be reported by you in the newspapers of the deaf. I am talking to you by word of mouth, while my friend, Professor Fay, is translating what I say into the sign-language. Then by and by you will translate it all back again into English for the benefit of your deaf friends in distant parts. You are the interviewers this time, and I fear you are just as liable to make errors of statement as the ordinary newspaper reporter. I have therefore brought with me to-night a gentleman who has taken a stenographic account of all that I am saying to you. I will look over his notes and correct them, and then it will afford me pleasure to present every member of the Literary Society with a printed copy of my remarks. Allow me, therefore, to request the correspondents of distant papers kindly to reserve their notes of my remarks until they can get my own words in black and white.

I must thank you very much for the attention with which you have listened to me, and in conclusion I would simply say, that, if any one here desires to ask me questions upon the subject of my address, I shall be happy to do my best to reply.

GENERAL NOTES.

In his presidential address to the Linnean Society of New South Wales, the chairman, Dr. J. C. Cox, made the following reference to the late President of the Society:—"William John Stephens was born on July 16, 1829, at Levens, in Westmoreland, where his father was the vicar. He was educated first at the Haversham Grammar School, an ancient foundation which has turned out many distinguished scholars, and subsequently at Marlborough College, where he was one of the 200 pupils with which that institution opened. In due course he became captain of Marlborough, and gained the Latin Verse and English Verse prizes, the Plater prize, the Drawing prize, and the College exhibition. Before leaving Marlborough he won a Tabardenship at Queen's College, Oxford, and matriculated in that University. He took his B.A. in 1852, with first-class honours in classics, and third-class honours in mathematics and physics. Soon after he was elected fellow and appointed tutor of Queen's. Among his pupils during this period were Dr. Percival, formerly of Clifton, now headmaster of Rugby; and Dr. Thornton, Bishop of Ballarat. While at Oxford he read widely and deeply in the ancient classics, the love of which never afterwards deserted him. Here also he laid the foundation of that varied learning which eminently distinguished him. At Oxford, too, in his early manhood, he first took up the study of geology, and threw himself into that science with great zeal. To geology he soon added botany, in both of which he took keen interest.

"In 1856, at the instigation of Sir Charles Nicholson, he applied for the headmastership of the Sydney Grammar School, which had just been founded; and he was elected to that position on the recommendation of Dr. Jowett. After ten years' work at the Grammar School he resigned his headmastership, and established a school of his own in Darlinghurst-road, which was known as the New School, and afterwards as Eaglesfield. This school he continued to conduct till his appointment, in 1882, to the Professorship of Natural History at the Sydney University—the title of which was afterwards changed, upon a redistribution of work on the foundation of certain additional chairs, to that of Geology and Palæontology.

"His death took place on Saturday, November 22, after short but severe illness, a fatal termination being unexpected until the day before his death. On November 24th his remains were followed to the grave by a large concourse of friends, colleagues, and official representatives of the various institutions and societies with which he had been connected, old pupils, and University students.

"For a period of nearly thirty-five years then Professor Stephens lived in our midst, labouring uninterruptedly in the cause of higher education, yet finding time and inclination to give the colony at large the benefit of his extensive knowledge and experience by his connection with several of our important public institutions such as the Public Library of which he was Chairman of Trustees, and the Australian Museum of which he was a member of the Board. For a time also he was President of the Sydney Branch of the Geographical Society of Australia. In his favourite pursuit of Natural Science he was actively identified firstly with our fore-runner, the Entomological Society of New South Wales, and afterwards with this Society dating from its inception, having been a member of Council during the years 1875 and 1876, President in 1877 and 1878, Vice-President in 1879 and 1880, Co-Honorary Secretary in 1881-84, and again President from 1885 to the close of his life in November 1890."

List of Fishes of N.Z.—Under date, Christchurch, 15th April, 1891, Professor Hutton writes:—"In my List of the Fishes of New Zealand published in the 'Transactions N.Z. Institute,' vol. xxii, p. 275, I have omitted the following species.

"139a. *Labrichthys roseipunctata*, Hutton, 'Trans. N.Z. Inst.' vol. xii, p. 455."

Crustacea raised from dried New Zealand mud.—At the request of Professor G. O Sars, of Christiania, Norway, I sent that gentleman during last summer, some samples of dried mud taken from fresh-water ponds or lagoons. One lot was collected by Mr. Chilton at Eyretown, Canterbury, from a locality which yields abundance of *Boeckia triarticulata*, as well as other forms of minute crustacea. Two other lots were taken from dried-up lagoons in the Taieri Plain. The materials were sent by post in April last, and on receipt were at once placed in suitable aquaria. From letters received since it is interesting to learn that the results of the experiment have proved very satisfactory. In nearly all the aquaria prepared with mud from Eyretown *Daphnia similis*, (mihi), has been successfully hatched, and has increased in a very remarkable manner. Along with this numerous specimens of a *Cypris* appeared. This species Prof. Sars takes to be my *Cypris ciliata*, and he was at first inclined to consider it as *Herpetocypris stanleyana*, (King), which he has raised from dried Australian (Queensland) mud. But another form raised from the Taieri mud agrees much more closely with King's species, as subsequently described by Mr. Brady. The Eyretown mud also yielded specimens of a very distinct and beautiful species of *Diaptomus*, which is probably identical with my *Boeckia triarticulata*. Prof. Sars goes on to say:—"The parcel of mud from the neighbourhood of Dunedin has, besides the above-mentioned *Cypris*, yielded numerous specimens of a *Simocephalus*, which I supose to be your *Daphnia obtusata*, a species of *Ceriodaphnia*, a small *Chydorus* (probably your *C. minutus*), and four additional species of Ostracoda, viz., two species of *Herpetocypris* (one of which has also been raised from Australian mud and described as *H. viridula*, Brady), one species of *Cypridopsis*, and one of *Notodromas* (of which latter I have, however, as yet only found a single specimen). My experiments will be continued next summer, and I do not doubt that some of the species, at least of the Ostracoda, will reappear in the aquaria, after they have been dried up during the winter." These results are very interesting, and it would greatly increase the value of Prof. Sar's researches in this direction, if samples of mud from the North Island were forwarded to him. I shall be glad to receive and forward any which are forthcoming. The specimens obtained by myself were nearly cubical blocks about four inches deep.—Geo. M. Thomson, Dunedin, 25th April, 1891.

Idotea lacustris (G. M. Thomson).—This species was originally described by Mr. Thomson in 1879. It is chiefly remarkable because of its occurrence in fresh water as the genus to which it belongs is distinctly marine, and it is the only fresh water Isopod at present known in New Zealand, with the exception of some subterranean forms. It has been taken at different times in the Tomahawk Lagoon, near Dunedin, but it has been a little uncertain whether it lived there permanently in fresh water or only came up when a very high tide rendered communication with the lagoon possible.* It has never been taken in the sea on the New Zealand coasts, but in the British Museum collections there are specimens from Port Henry, Straits of Magellan (Dr. R. P. Coppinger), which are very nearly if not quite identical with the New Zealand species. The exact locality of the Magellan species does not appear to be known, but probably they were marine in habitat. So much was known about the species when Miers wrote his "Revision of the Idoteidæ," and though I afterwards described the species in greater detail in my "Revision of the N.Z. Idoteidæ" (Trans. N.Z. Inst. XXI., p. 194), I was not then able to give any further information as to its distribution. In January of this year, however, Messrs. Wm. Cron and D. Strachan, two enthusiastic young collectors who have often helped me, brought me some specimens of what appeared to be *Idotea lacustris* from the Mihiwaka Creek, near the mouth of the Deborah Bay Tunnel, above Port Chalmers, a place perhaps about 200 feet above sea level. I have since collected numerous specimens from the creek; they are found on the under surface of stones and boulders in the small mountain stream, and undoubtedly are permanent fresh water inhabitants. On examination these specimens were found to differ constantly from the Tomahawk Lagoon specimens in several small points; thus the eyes are much smaller, the inner antennæ are longer and the outer antennæ more slender, there is a small depression in the front margin of the head which alters the appearance of the margin, the last segment of the abdomen bears only one pair of sutures instead of two, &c. These differences though small in amount are somewhat numerous, and an examination of a considerable number of specimens from both localities proves that they are constant. They are quite as important as differences that are often held to distinguish species, but in this case it will probably be better and less misleading if the two forms are considered as distinct varieties of the same species. It would be

* I have found it lately in all parts of the lagoon, quite away from tidal influence and where the water is always quite fresh.—G. M. T.

interesting to know if *Idotea lacustris* were once widely distributed in New Zealand as a fresh water species or not; at any rate its discovery in a small mountain stream taken in conjunction with the discovery by Mr. Thomson of *Pherusa cærulea* in a small stream at the top of the Old Man Range at 3000 feet elevation (see "N.Z. Journal of Science, II., p. 576), shows that we have still much to learn about the smaller inhabitants of these streams, and that further search in such localities may lead to interesting results.—CHAS. CHILTON.

MEETINGS OF SOCIETIES.

LINNEAN SOCIETY OF NEW SOUTH WALES.

ANNUAL MEETING.

Sydney, 28th January, 1891.—Dr. J. C. Cox, Vice-President, in the chair.

The chairman delivered the annual address, from which we extract the following:—

"Among the events of the year at home there are several worthy of notice on this occasion.

"First, I may mention the publication of the researches of Mr. A. S. Woodward, F.Z.S., F.G.S., of the British Museum, on 'The Fossil Fishes of the Hawkesbury Series at Gosford,'* a contribution to our knowledge of the Hawkesbury formation of the greatest interest and importance. References to the collections will be found in two papers by Professor Stephens in Vols. I (2nd Ser.), p. 1175, and II, p. 156 of our Proceedings. In an introductory note to Mr. Woodward's monograph, Mr. T. W. Edgeworth David, B.A., deals with the stratigraphical position of the Gosford fish-bed, in reference to which he says that it is at present 'doubtful whether the bed belongs to the lower portion of the Hawkesbury Sandstone or to the upper portion of the Narrabeen Shales.' The series of nearly 400 specimens was richer in individuals than in representatives of many species, Mr. Woodward distributing them among the various orders represented as follows:—One Selachian of the family *Cestraciontidæ,* one species of a new genus (*Gosfordia*) of Dipnoi, the remainder being referable to nine genera (two proposed as new) and seventeen species (all but two being new) of Ganoidei. In concluding his paper Mr. Woodward says, 'perhaps the most important fact, however, is the absence in the Hawkesbury beds of fishes with well-developed vertebral centra. . . . So far as can be determined from the fishes, therefore, the Hawkesbury beds may be regarded as homotaxial with the Keuper of Europe, or, at latest, with the Rhaetic.'

"The monograph is well illustrated; and we must congratulate not only Mr. Woodward on the successful issue of this excellent piece of work, but the Department of Mines on its publication of the volume within the colony. . . . Certainly the year 1890 has been prolific of swarms of animal life, not always beneficial, as well as of the

* Issued as "Memoirs of the Geological Survey of N.S.W., Palæontology, No. 4." Sydney, Government Printer, 1890.

attacks of fungoid pests. To some of these your attention has been drawn from time to time at our meetings by the exhibition of specimens, and by the remarks which these provoked. Early in the year many vineyards in certain districts both in this colony and Victoria were infested by myriads of bugs which I am informed by Mr. Skuse, who has submitted specimens to Dr. Bergroth of Finland, are probably an undescribed species of *Nysius* (family *Lygæidæ*), a genus not hitherto recorded from Australia.

"Last summer and again this year pastoralists in the eastern colonies and South Australia have been troubled with plagues of locusts (sometimes referred to as *Pachytylus australis*, Brunn., but reported as *Chortologa australis* by Mr. Koebele, as determined by Saussure), which this year especially have so accumulated in places as to impede railway traffic on some of our country lines by reason of the greasiness imparted to the rails. Mr. Koebele in his report quotes the opinion of a South Australian observer 'that only in such unusually dry seasons as the present (1888) would the locusts migrate, there being no food left for them in the interior of South Australia.' This hypothesis does not seem to be borne out by the experience of last year which was anything but a dry one, As yet we have had only preliminary reports on these matters. There is much room for investigation on the lines laid down in an article in 'Nature' (Feb. 27th, 1890, p. 403) based on a Report by Mr. Cotes of the Indian Museum, Calcutta, from which we learn that India has been somewhat similary plagued with locusts of recent years. Locusts are not altogether a new pest with us, though records of their depredations in the past appear to be scanty, and their visitations not to have been of so desperately destructive a character; nevertheless a few references to their prevalence in this colony in former years will be found in Mr. Russell's 'Climate of New South Wales,' p. 27. It is also possible too that we are now in some measure reaping the results of the reckless and wanton destruction of many of our native birds which has been going on for so long.

"In this connection also phylloxera as well as rabbits might also claim mention, though I need not go into details.

"The past year has also furnished us with instances of migratory flights of butterflies of at least one species *Belenois (Pieris) teutonia*, Don., as reported at our last meeting. The specimens then exhibited were from Inverell, but in the 'Echo' of recent date, swarms, probably of the same species, were reported from Emmaville. In Vol. VII. of our Proceedings will be found a record of similar swarms of the same species observed at Tamworth by one of our members in December, 1882.

"In this, as in other cases of animals which periodically attract notice by their appearance in migratory swarms, our country members will do well to be on the alert in observing and recording, as we have much yet to learn in these matters, and the records of the past are neither so complete nor so systematic as is to be desired.

"Dr. A. Barclay, of the Bengal Medical Service, early in the year contributed an important paper to the Asiatic Society of Bengal, in which he deals with the subject of the prevalence and character of Rust and Mildew on wheat in India. The number of the journal containing this paper has not yet reached us, but the gist of it will be found in another paper by the same author in the 'Journal of Botany,' XXVIII., p. 257 (September, 1890), from which I take the following passage:—'So far as I have been able to gather, the most prevalent form of rust on wheat, barley, and oats in India is *Puccinia rubigo-vera*, D.C., and not *P. graminis*, Pers. And this is true of the outer Himalayan region, where rust is very prevalent, and where three species of barberry are common (*B. lycium*, Royle; *B. aristata*, D.C.; *B. vulgaris*, L.), one of which, *B. lycium*, bears an Æcidium abundantly. At the same time, I have never been able to find an Æcidium on any species of Boragineæ in the Himalayan region, and none is known on the plains. Whilst *P. rubigo-vera* is apparently by far the commonest rust in India, *P. graminis* is not wholly unknown. I have received specimens of *P. graminis* from Jeypore, about 200 miles in a direct line from the nearest known habitat of barberry; but I have never seen a specimen on the crops actually in the neighbourhood of æcidium-bearing barberry. These facts are sufficient to show the mystery in which the subject here is involved, and that it needs much more study before anything useful can be written on it. The fungus on *Linum* ('Ulsee') is apparently extremely common over large areas of the plains. It is often so closely concurrent with rust on wheat and barley, that the uredo stage on *Linum* has often been supposed to be the cause of the rust on wheat. This supposition, however, cannot be entertained, with our present knowledge, by botanists. The fungus on *Linum* is probably a complete autœcious species.'

"I especially draw your attention to this matter because our fellow-member, Dr. Cobb, whose recent accession to our little band of working members we are glad to welcome, and who since his connection with the Department of Agriculture has had under investigation the question of rust on wheat in this colony, at an early stage of his observations also found that in the specimens submitted to him by far the commonest rust was *Puccinia rubigo-vera*, D.C., and not *P. graminis*. This result was some months ago announced in the daily papers, and full particulars are given in the 'Agricultural Gazette,' Vol. I., No. 3, p. 185.

"To the newly established Forest Department our hopes turn not only for a check to the wholesale destruction of timber which has been going on for so long, to the conserving of such areas as are still available, and to the planting and replanting of suitable tracts of country, but for the realisation in this colony of a matter touched upon by Baron von Mueller, in his presidential address at the second meeting of the Australasian Association, namely the setting apart of areas in different and suitable parts of the colony in which the vegetation and its accompanying fauna may be left untouched, and preserved for educational purposes. Surely our utilitarian necessities are not of so pressing a character as to require every square foot of our richest and best timbered areas to be delivered up to the settler's axe and fire-stick. Comparatively few of even our native-born population know by experience, from artistic representations, or even by adequate description, the beauty and luxuriance of our brushes and semi-tropical scrubs, now alas in danger of altogether disappearing. As means of communication improve, as they are steadily doing, such districts as I speak of will be gradually brought within easy reach of the metropolis, and thus become more accessible to the naturalist, the artist, the writer, and the lover of nature, let us hope not when it is altogether too late, and when the characteristic vegetation has entirely disappeared.

"Of the good likely to accrue from the establishment in some of our country towns of branches of the Sydney Technological Museum much may I think be anticipated. The conditions of existence in a young country like this seem naturally to lead to more or less centralisation, in scientific as in so many other matters. Now the dulness attendant upon life in an average country town to the man who is not fortified against it by the pursuit of some rational hobby is a stern reality often leading to misapplied energies and utter waste of time, not to speak of the acquisition of undesirable habits. Yet very often it is in the immediate neighbourhood of just such localities that there are special opportunities of observing particularly interesting species of plants or animals in a state of nature, of working out the stratigraphical or palæontological relations of particular strata, of obtaining important data relating to the scientific aspect of mining, or of collecting relics and traditions of the fast disappearing black-fellow; and too frequently it is exactly in such localities that such opportunities excite little or no interest whatever. Not absolutely always, however, I am glad to be able to state, since we number among our own members a few who under such circumstances have risen to the occasion; but our Societies want more of such men, and the colony at large needs more of them. Country museums in the hands of judicious curators alive to the value of their opportunities may become directly educative, and do much towards supplying the present want of means of fostering a love of nature in the rising generation, as well as offer a counter attraction to those very much less rational and undesirable ways of 'killing' time, which too frequently present themselves. In answer to my enquiries Mr. Maiden has been good enough to furnish me with the following particulars which I am glad to make use of:—

"'Local museums in connection with the Sydney Technological Museum have been established at Goulburn, Bathurst, West Maitland, and Newcastle, and another will shortly be opened at Broken Hill.'

"'The exhibits are housed in substantial buildings—the large halls of the Mechanics' Institutes being rented at Goulburn and Newcastle, while at West Maitland the large hall of the old Masonic buildings is utilised.'

"'At West Maitland the local Science Association has presented its valuable natural history collection to the Museum, and at the other centres scientific societies have been started which will assist in the working-up of the museums, so that most of these museums will contain a natural history side as well.'

"'The local science master, or head of the local Technical School, is the curator, and he corresponds direct with the Curator of the Sydney Technological Museum in matters of museum detail. He is quite at liberty to devote a portion of his time to original research, or to give lectures, &c.'

"'Each museum contains about 2,000 specimens exhibited in suitable show-cases. Endeavours are being made to form in each museum a display of the products of the district in which it is situated, and substantial additions to the collections have been received already. Numerous applications for the formation of museums in different centres of population have been received, but at present it is proposed to confine them to towns in which technical colleges have already been founded.'"

Sydney, February 25th, 1891.—The Hon. James Norton, LL.D., M.L.C., in the chair.

Papers.—(1) "On the Anatomy of some Tasmanian Land Snails," by C. Hedley, F.L.S., Corr. Mem. This paper is a contribution to a knowledge of the soft parts of *Bulimus dufresni*, Leach, *B. tasmanicus*, Pfr., *Anoglypta launcestonensis*, Reeve, *Rhytida lampra*, Pfr., *Helicarion verreauxi*, Pfr., and *Cystopelta petterdi*, Tate.

(2) "Notes on a small Collection of Hymenoptera from Narrabri, N.S.W," by. W. W. Froggatt. The writer gives a list of the species comprised in the collection exhibited by Mr. Musson at the December Meeting. The occurrence of *Thynnus Brenchleyi*, Smith, a species rare in collections, previously only recorded from Champion Bay, W.A., is particularly interesting.

(3) "Description of a new Species of *Tortricidæ*," by J. Hartley Durrant. *(Communicated by A. Sidney Olliff).* A new species of *Palæobia* from Tumut and Mt. Kosciusko is described under the name *P. longestriata*.

(4) "Stray Notes on Lepidoptera," No. 2, by A. Sidney Olliff, F.E.S. A short note descriptive of a new species of *Libythea* from Somerset, N. Australia, proposed to be called *L. nicevillei*, hitherto confounded with *L. myrrha*, Godart, and of a singular variety of *Euschemon Rafflesiæ* from the Richmond River, N.S. Wales. A specimen of the butterfly was exhibited.

(5) "Notes on Australian Aboriginal Stone Weapons and Implements." Nos. x.-xv., by R. Etheridge, jun. A continuation of former Notes read before this Society. The author now describes additional stone knives from Northern Australia, and one made of bottle glass; small and beautifully formed spear-heads from Kimberley; larger lanceolate spear-heads from Nicholson River and Settlement Creek, N.W. Carpentaria; talismanic stones from New England and North Queensland, the latter a very interesting tael formed of two rock crystals joined by a gum-cement mixed with human hair; a gouge from North Queensland; and an awl, or some form of piercing instrument, made of a nail, and portion of a human radius. The author is indebted for an opportunity of describing these interesting specimens to the kindness of Mr. C. W. de Vis, M.A., Curator of the Queensland Museum, and Messrs. W. W. Froggatt and E. C. Blomfield.

Mr. Etheridge showed a fine collection of aboriginal stone knives and implements in illustration of his paper.

Among exhibits, Mr. Hedley showed a colony of the nests of a trap-door spider, together with specimens of the animal, from Rose Bay. These spiders are abundant round Sydney, occurring even in the public parks of the city. A favourite spot for them is a patch of mossy earth in the crevice of a sandstone rock. The species exhibited forms a wafer-like lid, not as in some species a thick door like a gun-wad. The presence of several egg-bags in the larger burrows would indicate that the present month (February), is the breeding season.

Mr. Fletcher exhibited two specimens of a land planarian (*Bipalium kewense*, Moseley,) collected by Mr. J. J. Lister at Upolu, Samoa, under stones in the bush; and a specimen of the same species from Eltham, Victoria, collected by Mr. W. W. Smith; seeing that this planarian has now undoubtedly been introduced into many widely separated localities, and that the species of the genus whose habitats are certainly known belong to the Palæarctic and Oriental regions, there seems little ground for supposing it to be indigenous in Samoa.

Also two instances of floral prolification in the "Flannel-flower" (*Actinotus helianthi*), in which from the ordinary umbels spring, in one case about seven, in the other eleven small secondary umbels each with its involucre of woolly bracts; the specimens were gathered at Oatley a few days ago.

Also living specimens of three species of frogs (*Hyla cœrulea*, *H. peronii*, and *Limnodynastes salminii*, Str.), brought from Gomgra on the Namoi, near Walgett, by Mr. A. Carson; these specimens offer fresh evidence of the very wide distribution of these three species in the interior of the colony; in the specimens of *L. salminii* the dorsal stripes which in spirit specimens are pink or rose-red are of quite a different tint, being a bright ochreous-yellow. Specimens of an interesting frog (*Hyla gracilenta*) from the Richmond River were also exhibited; the species has not previously been recorded from N.S.W.

Sydney, March 25th, 1891.—Professor Haswell, M.A. D.Sc., President, in the chair.

New member.—Mr. Oswald B. Lower, Adelaide.

Papers.—(1) "On the Classification of Eucalypts," by Rev. W. Woolls, Ph.D., F.L.S. After critically reviewing the characters of Eucalypts which have, from time to time, been made use of for classificatory purposes, more particularly those of the anthers and of the bark as set forth in the antherial and cortical systems of Bentham and Mueller, the author suggests the probable value of a classification based on the characters of the fruit—such as shape, position of the capsules, the number of cells, and the appearance of the valves, &c.

(2) "On the Trail of an extinct Bird," by C. W. De Vis, M.A., Corr. Mem. A new genus and species (*Lithophaps ulnaris*) are provisionally proposed for an extinct pigeon whose ulna was found in deposits of the Nototherian period at Warwick, Darling Downs, Queensland.

(3) "Note on an Extinct Eagle," by C. W. De Vis, M.A., Corr. Mem. The generic name *Taphaetus* is now proposed for a bird whose femur came to light in the same deposits as the ulna of *Lithophaps*, and which presents characters irreconcilable with those of any genus known to the writer. To the same genus in all probability must be referred the species previously described as *Uroaetus brachialis* (Proc. Roy. Soc.

Qsld., Vol. VI., p. 161), its correct association with the genus *Uroaetus* being now more than doubtful.

Both papers were illustrated by speciments of the fossil bones referred to.

(4) "The Land Molluscan Fauna of British New Guinea," by C. Hedley, F.L.S., Corr. Mem The species already described are enumerated and discussed, sundry errors in classification and habitat being rectified, and twenty species mostly collected by the author himself during a recent tour in Papua are described as new. Anatomical descriptions of a few species are included.

Mr. Fletcher exhibited for Mr. J. H. Rose two living specimens of an inland species of frog (*Chiroleptes platycephalus*, Gthr.), obtained near Walgett, previously only recorded from Bourke and Dandaloo, N.S.W. It is an expert burrower, Mr. Rose reporting that he has never met with it above ground.

FIELD NATURALISTS' CLUB OF VICTORIA.

Melbourne, 9th March, 1891.—D. Best, Esq., in the chair.

The report of the Club's recent excursion to Heidelberg was read by Mr. F. G. A. Barnard.

Papers.—(1) "Sagacity of Insects," by J. Lidgett.

(2) "On the Australian Bustard," by C. French, F.L.S.

(3) "An Acid Secretion from the Seeds of *Grevillea mimosoides*," by Nicholas Holtz. The secretion which is powerful and acrid enough to produce sores, the scars of which remain for many months after, is thought to be useful in protecting the seeds from the attacks of cockatoos.

A number of natural history notes were communicated as follows:—

(1) "On the occurrence of the Comb-crested Parra in Victoria," by A. J. Campbell.

(2) "How Flies die," by G. H. Hennell.

(3) "On the impaling of Butterflies on Thistles," by G. Lyell, Jun.

(4) "On the Earthworm," and

(5) "A new Potato disease," both by G. Renner.

A large number of articles of interest were exhibited.

ROYAL SOCIETY OF VICTORIA.

Melbourne, 12th March, 1891.—At the annual meeting the following gentlemen were elected office-bearers for the year:—President: Professor W. C. Kernot, M.A., C.E. Vice-Presidents: J. Cosmo Newberry, C.M.G., B.Sc., and E. J. White, F.R.A.S. Hon. Treasurer: C. R. Blackett, F.C.S. Hon. Librarian: J. E. Neild, M.D. Hon. Secretaries: H. K. Rusden, and Professor W. Baldwin Spencer, M.A.

Members of Council: A. W. Howitt, F.G.S., J. Jamieson, M.D., Professor Laurie, M.A., A. H. S. Lucas, M.A., Professor R. T. Lyle, M.A., A. Sutherland, M.A., C. A. Topp, M.A., A. S. Way, M.A. The following Members continuing to hold office from 1890—R. L. J. Ellery, F.R.S., G. S. Griffiths, F.G.S., Professor Orme Masson, M.A., and Mr. H. Moors.

An ordinary meeting was held afterwards.

Papers.—(1) "A new species of *Dictyonerua*," by T. S. Hall, M.A.

(2) "A preliminary account of *Synute pulchella*, a new genus and species of Calcareous Sponge," by Arthur Dendy, D.Sc.

(3) "The Geology of the Southern portion of the Moorabool Valley," by T. S. Hall, M.A., and G. B. Pritchard.

Melbourne, 9th April.—Papers.—(1) "On the Occurrence of the Genus Belonostomus in the Rolling Downs Formation (Cretaceous) of Central Queensland," by R. Etheridge, Jun., F.G.S., Palæontologist to the Geological Survey of New South Wales, and Arthur Smith Woodward, F.Z.S., of the British Museum.

(2) "Note from the Biological Laboratory of the Melbourne University," by Professor W. Baldwin Spencer, M.A.

WELLINGTON PHILOSOPHICAL SOCIETY.*

ANNUAL MEETING.

Wellington, 13th February, 1891.—Chas. Hulke, Esq., President, in the chair.

New Member.—Mr. W. T. Cohen.

The following is an abstract of the annual report:—The Report stated that during the past year six general meetings had been held, which had on the whole been fairly well attended, and some interesting discussions had taken place on the various papers read, as will be seen from the reports of the proceedings published in the usual liberal manner by Messrs. Lyon and Blair in their *Monthly Record and Review*. The titles of the papers, with the names of the authors, were given, making a total of twenty-five. Four new members had been elected during the year, the total number of members now on the books being one hundred and fifty. The receipts during the year amounted to £150 3s. 6d., and the expenditure was £120 4s. 3d., leaving a balance of £29 19s. 3d.; there was also a fixed deposit in the bank of £20, the first payment to the prize fund.

The following office bearers were elected:—President, Mr. E. Tregear; Vice-Presidents, Mr. A. McKay and the Hon. R. Pharazyn; Council, Sir J. Hector, Sir W. Buller, Messrs. W. M. Maskell, A. de B. Brandon, G. V. Hudson, W. T. L. Travers, and C. Hulke; Secretary and Treasurer, R. B. Gore; Auditor, T. King.

* Our report is taken from the *Monthly Record and Review*.

Papers.—(1) "On a Deposit of Diatomaceous Earth at the Bay of Islands," by A. McKay, F.G.S. The author stated that he had had an opportunity of examining a deposit of diatomaceous earth about half a mile to the east of the residence of the Hon. Henry Williams, and that he brought samples from the upper surface, and from about one foot below the surface of the deposit, which were submitted to Mr. Maskell, who found only recent species in the samples from the upper part, and fossil forms only in the samples taken at about a foot from the surface of the deposit. Such being the result of the examinations made by Mr. Maskell, on his describing the conditions under which the deposit had accumulated, by way of explanation of the facts Mr. Maskell suggested that probably an older diatomaceous deposit had been denuded for supply of the lower part of the deposit under description, and in which only fossil forms are found, while the higher and last deposits were manifestly due to diatoms which (of recent forms only) had lived and died within the area wherein their remains had accumulated. But this is not the only explanation that may be advanced, and he (Mr. McKay) deemed it necessary to describe more closely the position of the deposit and the conditions under which it had accumulated. After giving a full account of the locality in question, and the position of the specimens collected, Mr. McKay stated that on the stones and fern fronds which are under water when the basin is full, the green living diatoms are deposited, forming a coating of from $\frac{1}{6}$in. to $\frac{1}{2}$in. thick, according to circumstances. This deposit round the margin of the basin soon bleaches white on the surface. According to Mr. Maskell it is almost wholly composed of living forms of diatomaceæ. Very probably the same samples, Mr. McKay thought, would be found among the grass-roots, and for the first few inches into the deposit filling the basin itself. Unfortunately, Mr. McKay did not bring samples to prove that such is the case; but it is so self-evident that this must be so that no doubts need be ventured on the subject. The deposits in the middle of the basin are 6ft. to 8ft. thick, and were exposed by the cutting-down of a cattle-track crossing the creek at this place. Mr. McKay took a sample from about 1ft. below the surface. Some of this also was examined by Mr. Maskell, whose decision as to the fossil nature of the species forming this part of the deposit has already been stated. Subsequently Mr. Maskell forwarded samples to England, which were examined by one of the chief authorities on diatoms, whose decision was in accordance with the conclusion Mr. Maskell had already arrived at. Such were the facts of the case, and such the conclusions arrived at by competent authorities. And yet he (Mr. McKay) was not satisfied that the true explanation had been hit upon; and here he ventured a theory of explanation to which, though there might be objections grave as applied to Mr. Maskell's explanation, they were yet not the same, and he had therefore written the paper so that the Society might have an opportunity of debating the probabilities of each. Considering the conditions under which the diatomaceous deposits had accumulated, it was reasonable to expect that the recent forms of diatoms would be found in the lowest, as well as the highest, beds of the deposit; and it was certainly surprising that the upper beds, or latest part of the deposit, should be wholly composed of recent species, which were absent from the middle and lower parts. It was quite a possibility that the fossil-species forming the bulk of the deposit had been derived from an older deposit, either forming the bed of the lake or now buried beneath the scoria hills to the east of Paoroa. But it seemed to him that, in order to account for the facts of the case, it must be supposed that at first only fossil-species carried along the underground channels were deposited in the little basins whence the specimens were obtained. And as the deposit was entirely composed of fossil-species to within 1ft. of the present surface, the introduction or appearance of living forms was of very recent date. As, however, the whole deposit was manifestly of quite recent date, and as at first the conditions were as fit for the existence of recent forms of diatoms as they now were, it seemed extraordinary that throughout the deposit there was not a mixture of fossil and living species. Taking these facts into account, he (Mr. McKay) would prefer to account for the difference in the species found in the top and bottom beds of the deposit, by supposing that the species first living in the pond gave place to other forms, either modified descendants of the original species or species introduced from different stocks, and in this way would avoid the necessity of hypothecating an older deposit, the existence of which had not been proved, and, at the same time account for the separateness of the living and extinct forms as they were found in the higher and lower parts of the deposit. He would here add that as the surface-layers were formed wholly of living forms, and all were extinct at about 1ft. 6in. from the surface, it seemed reasonable to suppose that at, say, 6ft. from the surface other and quite distinct species might be found. And as Mr. Williams informed him, he (Mr. Williams) dug into the deposit to a yet greater depth without passing through it. Other and quite distinct species, it was probable, would be found in the first-named and lower parts of the deposits. If samples were taken not more than 6in. apart in the section of the deepest part of the deposit, an examination of these would be likely to set at rest any doubts as to the true origin and mode of accumulation, since it was mainly a derived and secondary deposit; then from about 1ft. from the surface to the greatest depth there should be little variation of the specific forms; while on the other hand, if the species changed more than once, that would go far to prove the correctness of his theory on the subject.

Mr. Maskell said that as he had been referred to in Mr. McKay's paper, it would be necessary for him to ask the writer's leave to add a a short note for the Transactions, explaining his view of this rather puzzling matter. He had no pretensions to a knowledge of geology; but it was possible that a micoscopist's observations might sometimes come in useful as an aid to a geologist, and perhaps this was the case in the present instance. Put very shortly, the point was this: When Mr. McKay handed over to him some specimens of these diatomaceous deposits, he was at once struck with three peculiarities in them. First, the upper deposit evidently owed its greenish tinge to the presence of endochrome in the diatoms, showing therefore that these organisms were not only recent, but alive. Secondly, the lower deposit, on the other hand, was not only pure white, from the absence of any endochrome, but also remarkably and exceptionally clean and clear from sand and dirt, having all the appearance of a perfectly pure fossil diatomaceous mass. Thirdly (and this was the important point), in the upper deposit he found only a quantity of two species of the genera Melosira and Himantidium, with a very few Naviculæ; whilst in the lower deposit, with one species of Melosira, and a few Naviculæ, there were many specimens of a peculiarly-shaped diatom, which, from the distinct cross visible on it, he took for a Stauroneis. Having submitted specimens of this to Dr. de Lautour, of Oamaru, a leading diatomist of the colony, that gentleman considered it as a new species; and he agreed with Mr. Maskell that it was undoubtedly 'fossil.' Specimens of the deposit were also sent to Mr. Grove, one of the first authorities in England on diatoms, and to Mr. Hardman, another very eminent student of the same family at Liverpool; and these gentlemen, whilst ascribing this particular diatom to the genus Achnanthes, also agreed that it was clearly fossil. Now, the result of these investigations showed positively, as he thought, that there is a radical and important difference between the two deposits. The upper one is recent, with living diatoms and no Achnanthes; the lower one is conspicuously full of Achnanthes, quite in a fossil state. If the geological evidence taken by itself, seemed to point to a similarity of conditions and of time in which both deposits were formed, the microscopical observations went to show that there must have been a considerable difference of time, at least. It seemed to him that the two classes of evidence would have to be taken together; or, at least, the indications of the microscope should receive full attention. The case certainly was a peculiar one, as the two deposits were so closely adjoined.

Mr. Hulke supposed that Mr. McKay wished to show that he had evidence of evolution, while Mr. Maskell contended that this had not been proved. Had these deposits been bones, Mr. McKay would not, he presumed, say they were the same had the bones been of distinct forms. It would be interesting to know whether the lower deposits were much abraded.

Mr. McKay briefly replied, and said he felt sure that his statements would be fully borne out by anyone carefully examining the district where these deposits had been found.

(2) "On the Botany of Antipodes Island," by T. Kirk, F.G.S. Antipodes Island is about 460 miles from Port Chalmers in a southerly direction, and is simply the crater of an extinct volcano. An overflow of lava on the eastern side has formed an angle where a landing may be made with some difficulty, but only in the finest weather. In all other places the cliffs are steep, so that the island is practically inaccessible. The albatross and other oceanic birds breed on the island, which, in some places, is dotted over with the nests of the great albatross, constructed of earth, built up into a truncated cone about eighteen inches high, slightly concave on the upper surface, and usually containing one large egg. The highest point on the island, Mount Galloway, a rounded hill, is about 1,320 feet above sea level. There is not a tree on the island; nothing much larger than a gooseberry bush. The chief vegetation consists of masses of coarse sedges and grass. The island is about as desolate a place as can well be imagined. Some bushy scrubs at the base of Mount Galloway were enlivened by the yellow-headed parroquet,

which was rather common although not abundant. About fifty-five species of plants were collected, of which the most striking was named *Pleurophyllum criniferum*, with smooth leaves something like rhubarb leaves, and erect stems five feet high, carrying large disc-like heads of reddish-purple flowers; it is found also on the Auckland and Campbell Islands. Two plants are peculiar to this little island: a pretty Gentian with yellow or red stems and leaves. The yellow-stemmed form has white flowers; that with the red stems, white flowers striped with red, the result in both being that the flowers are inconspicuous; the other plant is a large herbaceous Groundsel, resembling in some respects a species found on the Falkland Islands.

(3) "On the Botany of the Snares," by T. Kirk, F.G.S. The Snares consist of a group of rocky islands, situate near the 48th parallel of south latitude, and about sixty-five miles from the South Cape of Stewart's Island. The principal island is inhabited by thousands of crested penguins, which perch on the trees in rare numbers, forming 'rookeries' during a greater part of the year, but during the breeding-season the trees are forsaken. In many places the ground is honeycombed by petrels, which occur in large numbers. Several land-birds were noticed: a small snipe found also on the Auckland Islands; a small bird only known elsewhere on the Chatham Islands; and the South Island grass-bird; all species with very poor powers of flight. Two fur-seals were also noticed. The island is remarkable for the occurrence of two grand trees, *Senecio Muelleri*, which is probably the largest species of the genus, and one of the grandest, the trunk being sometimes two feet in diameter, and the tree twenty-five feet high. The other is *Olearia Lyalli*, which is nearly thirty feet high, with leaves from four to seven inches in length, white on back surfaces, and producing racemes of large button-like velvety flower-heads on the tips of the branches. Both these trees are amongst the rare plants of the world, the first being confined to the Snares and Herekopere Island, the other to the Snares and the Auckland Islands. The punui is a strong growing herb, which resembles in most particulars the punui of Stewart's Island. The leaves are sometimes two feet across, and are carried on leaf-stalks as thick as a rhubarb-stalk. About twenty-five other kinds were observed, two or three of which had evidently been introduced by sealers.

(4) "On the Wandering Albatross, with an exhibition of specimens and the determination of a new species (*Diomedea regia*)," by Sir Walter Buller, K.C.M.G., F.R.S. The paper reviewed the history of *Diomedea exulans*, and referred to an exhibition of specimens made by the author at a meeting of the Wellington Philosophical Society on February 13th, 1885, when he had expressed his conviction that two distinct species of wandering albatross were being confounded under the above name. He had lately had an opportunity of examining sixteen examples of the supposed new bird (collected at Campbell Island, on the Auckland Islands, and off the New Zealand coast), and he had no hesitation whatever in declaring it to be a distinct species, readily distinguishable from *Diomedea exulans* by its larger size, by its perfectly white head and neck from the nest to maturity, and by its having the bare eyelids jet-black, at all ages,

instead of being greenish-purple as in the other species. This albatross being undoubtedly the noblest of the entire group, he selects for it the distinctive specific name of *Diomedea regia.* Its great breeding-place is Campbell Island, where it nests some five weeks earlier than *Diomedea exulans* does on the Auckland Islands. Captain Fairchild, who has made the breeding habits of the albatross his special study for some years past, was till lately of opinion that this larger species never came farther north to breed; but on the occasion of his recent visit to the Auckland Islands, he found a colony of them breeding there, but in a separate locality and quite distant from *Diomedea exulans.* Here, too, in the Auckland Islands, the two species observed their own breeding times, *Diomedea regia* actually hatching out its young whilst the other species was only preparing to lay. Amongst the hundreds of nests of the latter examined by him only one contained eggs (two instead of one, a very unusual circumstance). The author's collection contains a fine series of skins of both species. *Diomedea regia* has a perfectly white head, neck, and body, with blackish-brown shoulders and wings, even from the nest; one of the exhibits having still remnants of the down adhering to the plumage. Apart from the much larger size of the bill (exceeding eight inches, measured along the column), it is further distinguished from the common species by having a distinct black line along the cutting edge of the upper mandible. *Diomedea exulans,* on the other hand, has a dark-coloured nestling, and the young bird of the first year has a uniform sooty-gray plumage, with a white face. The bird passes through many phases in its progress towards maturity, and no two individuals are exactly alike in the delicate markings of their plumage. In his 'Birds of New Zealand' (vol. ii, pp. 190-192), the author has described no less than ten of these intermediate or transitional states.

The following papers were then taken as read :—

(5) "On the Fossil Flora of New Zealand," by Professor Van Ettinghausen; communicated by Sir James Hector, F.R.S.

(6) "On Pleurophyllum, with description of New Species," by T. Kirk, F.L.S.

(7) "On the New Zealand Species of Centrolepsis," by T. Kirk.

(8) "On the Macrocephalous Olearias," by T. Kirk.

(9) "Notes on certain Carices," by T. Kirk.

(10) "Further Notes on New Zealand Fishes," by Sir James Hector.

(11) "On Patent Fuel," by Sir James Hector.

(12) "On the Discovery of Leiodon Remains in Middle Waipara," by J. McKay, F.G.S.

(13) "On *Belemnites australis* with Dicotyledonous Leaves," by A. McKay.

(14) "On the Alleged Insular Character of Young Secondary and Older Tertiary Formations in New Zealand," by A. McKay.

(15) "On Lithological Characters in Sequence as a Means of Co-relation and as Indicative of Age," by A. McKay.

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THE NEW ZEALAND JOURNAL OF SCIENCE

DEVOTED TO THE FURTHERANCE OF PURE AND APPLIED SCIENCE THROUGHOUT THE COLONY.

Judicio perpende: et si tibi vera videntur
Dede manus: aut si falsum est, adcingere contra.

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THE PARLIAMENT OF NEW ZEALAND IN ITS RELATIONS TO SCIENCE.

The columns of a scientific publication do not constitute a suitable place in which to discuss questions of politics, and it is therefore from no political stand point that we propose to look at the subject of the probable views of the present parliament of New Zealand on matters of scientific interest. Of late years the tendency has been towards a steady retrogression in the educational status of our House of Representatives. The men elected to represent the people at the seat of government may be as able and as earnest as their predecessors ever were, but their educational calibre is decidedly lower than it used to be ten or twenty years ago. In this respect the present House has probably reached a lower depth than any of those which preceded it. The men elected by most of the urban constituencies cannot, and we believe do not lay claim to belong to the best educated portion of the community, and hence the bearing of the present House towards scientific questions will be watched with interest and considerable anxiety. New Zealand has in the past achieved a very high reputation outside of its own narrow borders for the enlightened policy which its successive governments have pursued in matters scientific. Its survey department has always been presided over by men of high standing in their profession, whose efforts to do high-class work have been repeatedly recognized. The geological survey has since its inception been under the distinguished management of Sir James Hector, who, with the aid of able assistants, has year by year added to the knowledge of the geological history of the colony, until it may well be questioned whether any part of the world has been so well worked out within such a short period and with such small means. We may probably rest assured that the present House will not do anything to cripple either of these branches of the service, because the practical value of their work commends itself even to the non-scientific mind. Indeed this is the only aspect in which scientific work is apt to be regarded by the *ὁι polloi*, and it is as the outcome of this utilitarian way of looking at things that we anticipate any trouble or difficulty is likely to occur.

Attention has already been drawn towards such a sweeping reduction in the staff of the Colonial Museum in Wellington that the best thing that could now be done would be to shut it up altogether. For years there has been a growing tendency to starve this institution, and now we believe that there is actually no one left in charge beyond a mere caretaker. Sir James Hector's work covers a large field, Mr. Skey, who has so long acted as Colonial Analyst, always has his hands full of work, and Mr. Gore must have an amount of clerical work to get through which would satisfy even the Minister of Lands. But there is no one left to receive and properly preserve perishable specimens which may be left at the Museum, no taxidermist or articulator to set up the materials already accumulated. For years past an immense amount of material illustrating the natural history of these islands must have come into the hands of the Museum authorities, but without means, no Curator can do anything in the way of preserving and suitably exhibiting such material, and so its educational value is entirely lost. The collections of the geological survey alone are mostly stored in boxes where no one ever sees them.

Another direction in which the action of the present House and Government will be critically surveyed both within and outside the Colony is in its bearing towards the proposed Antarctic Exploration expedition. The important additions to be made to a knowledge of the unknown regions surrounding the South Pole will hardly commend themselves to our present rulers as a *raison d' être* for the proposed expedition. But the possibilities of opening up valuable whale and other fisheries which from their geographical position would probably be largely controlled from New Zealand ports is an argument which may carry considerable weight.

We hear sinister rumours about the intention of certain Hon. members to move in the direction of repealing the New Zealand Institute Act. The total cost to the Colony under this Act is a sum of £500 voted annually for the publication of the volume of its Transactions. We venture to affirm that there are few amounts for which the Colony gets better value, and which bring equal credit on the community. The suppression of the annual vote would be stigmatised and properly so, as the result of ignorance.

There have been already, on the part of the so-called "labour" representatives in the present House, indications that they will give careful consideration to questions of the nature hinted at above. The real danger to enlightened administration does not, however, lie so much with this class as with that very considerable section of "claptrap" politicians, who will do anything to catch a little cheap applause, and who are the most dangerous class when questions of education and science are concerned.

SOURCE OF THE GOLD AT THE THAMES.

BY CAPTAIN F. W. HUTTON, F.G.S.

The geological structure of the Thames district is as follows:—A sedimentary formation composed of dark coloured sandstones and slates, which are not younger than Triassic, is overlain quite unconformably by a younger volcanic formation, in which all the gold mines are situated. So far nearly all New Zealand geologists are in agreement; but opinions differ as to whether any long interval of time separates the volcanic rocks into two distinct series, the older of which is alone auriferous, or whether all should be considered as parts of one series.

The gold appears to have come out of the volcanic rocks and not to have been introduced from below through lodes traversing the old sedimentary rocks. The reasons for this opinion are (1) that after nearly forty years' prospecting auriferous reefs have only been found in the volcanic series or in the slates immediately in contact with them. (2) The gold veins are often small, irregular and branching, sometimes only a quarter-of-an-inch thick, and often die out. They very rarely lead into large reefs, and when they do so, these large reefs are barren. (3) The amount of gold in the veins varies with the state of decomposition of the country rock, the veins in decomposed rock being richer than those in undecomposed rock. This being so it will be interesting to see what process of decomposition has gone on in the rocks, which has resulted in concentrating gold in the veins.

The volcanic rocks themselves were originally lava streams of that variety called andesite. They consisted of a ground-mass, partly glassy and partly stony, containing abundance of fine grains of magnetite and crystals of titaniferous iron-ore. In this ground-mass were larger crystals of lime and soda felspars and of some ferro-magnesian minerals, usually augite alone, but sometimes with hypersthene in addition, and more rarely hornblende. When fresh the rocks are dark grey to black in colour, and a close inspection shows the small white crystals of felspar embedded in the dark ground-mass. Small patches of these undecomposed rocks are still found here and there, but the mass of the rocks are now soft and light coloured, grey or greenish, or occasionally red. The original dark colour of the rocks was due to the iron ores and ferro-magnesian minerals they contained, and the change of colour is due to the decomposition of these minerals. In some places the magnetite has been changed into hematite and the rock has become red, as between the Karaka and Hape creeks, but this change is comparatively rare. In nearly all cases the ferro-magnesian minerals—Augite, Hypersthene, and Hornblende,—have been altered into chlorite, and this newly formed chlorite was also often deposited as infiltrations in the ground-mass, giving the rocks a green colour. In some rocks the decomposition has gone no further, but in others another change took place the felspars being decomposed into quartz, calcite, and kaolin, while the chlorite was gradually dissolved out, leaving the rocks nearly white, but coloured grey by small specks of iron ore. At the same time the titaniferous iron ore was changed into an opaque white mineral called leucoxene, giving the rock a spotted appearance. In some cases a still further change took place, the iron oxides being hydrated and gradually removed, and the calcite leached out, leaving nothing but quartz, kaolin, leucoxene, and pyrites.

The first series of changes took place at depths sufficiently great to be beyond the direct action of surface agents, and was probably produced by the percolation of warm acidulated water. The second set of changes were no doubt due to the direct action of cold carbonated surface water in limited quantity; and the third set of changes to the same agent but in much larger quantity. The second and third set of changes would be gradually brought about by the removal of the overlying rocks by denudation. The first series of changes is probably connected with the volcanic action which caused the eruption of the lava streams.

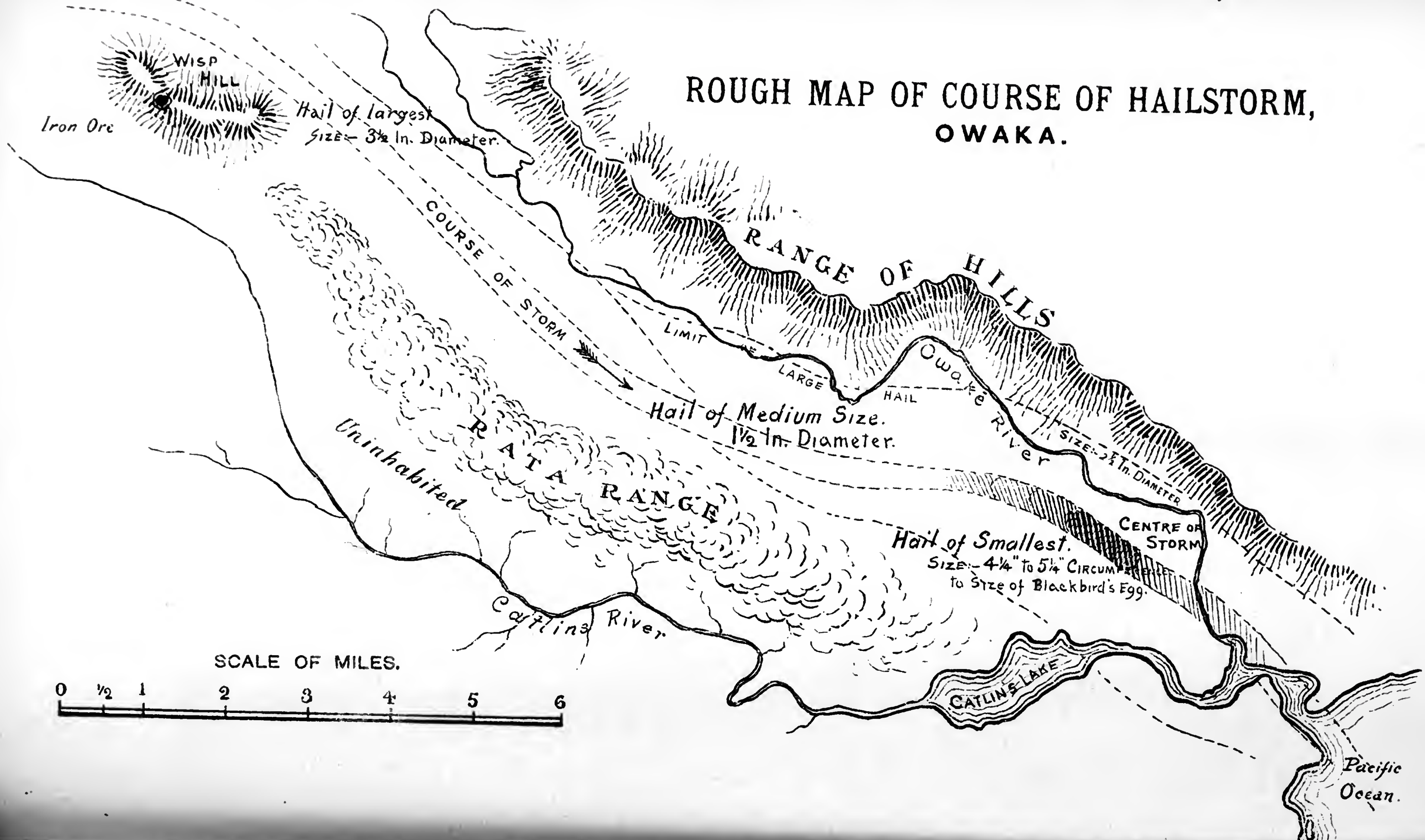
The pyrites found in the rocks was probably formed while the first series of changes was going on, but would be quite independent of them. Pyrites is never found as an original mineral in lava streams, but is always formed subsequently from the magnetite by the passage of sulphuretted hydrogen through the rock.

The gold occurs in the veins in four different ways (1) in auriferous pyrites, (2) scattered in small grains through massive quartz, (3) in threads or scales between the points of quartz crystals in comby veins, the quartz at the base of the crystals being often stained red, and (4) in calcite, but only very rarely. It is never found enclosed in a quartz crystal. The auriferous veins usually contain abundance of pyrites, but other sulphides—stibnite, blende, arsenical-pyrites, and copper-pyrites—are in small quantity only, and these have been introduced subsequently to the gold. The carbonates of lime and iron have also been introduced into the veins after the quartz.

Now how far do these facts of decomposition of the rocks and of precipitation in the veins tally with each other? The first change in the rocks was the conversion of the ferro-magnesian constituents into chlorite. Now these minerals are anhydrous bisilicates of lime, magnesia, and iron, with some alumina; while chlorite is a hydrous magnesian unisilicate with some alumina. Consequently in the process of transforming augite into chlorite; silica, lime, and some iron must have been liberated; and we can easily conceive that the lime, being soluble, was entirely removed, while the silica and the iron might have been deposited in the fissures and the iron converted into pyrites by sulphuretted hydrogen. And if the ferro-magnesian minerals originally contained gold it might have been in part removed and deposited with the pyrites. During the second series of changes, which I have described, no more iron would be removed, but the whole of the chlorite with the remaining gold would be dissolved with the silica of the felspars and auriferous quartz would be deposited in the veins. If the decomposition of the felspars took longer than that of the chlorites, which is very probable, pure crystallised quartz might subsequently be deposited on the auriferous quartz. In the third series of changes the carbonates, which had been formed during the second series of changes, would be dissolved and part may have been deposited occasionally on the quartz.

It will be thus seen that the two sets of facts tally very well, but there is no apparent reason why the sulphides of antimony, zinc, arsenic, and copper, should have been formed subsequently to the pyrites. Absence of gold in the well crystallised quartz shews that silica continued to be removed after all the gold had gone; and we might account for the fine threads and scales of gold between the points of quartz crystals by supposing that during the second or third series of changes, the auriferous pyrites in the veins was, in some places, dissolved and that the gold was redeposited, while the sulphur and most of the iron was removed as sulphate of iron, nothing but red stains being left behind.

ROUGH MAP OF COURSE OF HAILSTORM, OWAKA.



The only assumption that has been made is that the ferro-magnesian minerals originally contained gold, and this assumption is warrantable because, both in Europe and in North America, gold and silver as well as many other metals have actually been found to exist in small quantity in these ferro-magnesian minerals, and Mr. Becker has shewn, almost conclusively, that the gold of the Comstock lode has been derived from them. If this hypothesis is the true one for the Thames, I should expect that, as the whole of the gold in the veins in the hard dark rocks is due to the first set of changes, it would exist chiefly as auriferous pyrites, while in the softer and more decomposed rocks more gold would be added in auriferous quartz without pyrites. This however is based on the supposition that the gold has not travelled far in the fissures, which may be incorrect. Another deduction from the hypothesis is that the pyrites in the rock, away from the veins, is non-auriferous, for it is formed directly from the magnetite, while the auriferous pyrites has been formed from iron originally in the ferro-magnesian minerals, part of which may however have been subsequently deposited as secondary magnetite.

THE REMARKABLE HAILSTORM AT OWAKA, IN JANUARY LAST.

BY J. T. BRYANT.

An extraordinary hailstorm took place on the 23rd January, 1891, at Owaka, Clutha County, Otago, N.Z. The storm covered ground about 16 miles long by from half-a-mile to a mile wide. It commenced at the head of the valley and travelled down to the sea. At the head of the valley the hail began to descend first, and fell in large lumps like potatoes, about 3½ inches long by 2½ inches; as they fell on the soft ground they buried themselves. When they fell on grassy land they rebounded several feet into the air, and when they fell on corrugated iron roofs they broke through or split the iron open. One place was seen where the iron overlapped and the two parts were cracked. As the storm came down the valley, the pieces of ice diminished in size but increased in number and quantity until it reached the lower part, where I observed it. Here, after the storm, I picked up several pieces and found them to be from 4¼ to 5¼ inches in circumference, but the greater number were about the size of a blackbird's egg, and when split open showed a core about the size of a pea, with three and sometimes four distinct coats surrounding it.

At the head of the valley the pieces of ice lay on the ground like potatoes on a newly dug field, and little or no damage was done to the crops there; but where the storm passed over the forest it broke off the small branches of the trees. The greatest damage was done in the lower part of the valley where the standing crops of oats were beaten down and not one stalk left standing. The edge of the storm where it went through a field was quite distinct. In two cases the farmer afterwards reaped the one-half of the field not so severely affected.

For two or three days previously the weather had been very warm. At 3.30 p.m. on the 23rd, black clouds began to gather and thunder to roll, in half-an-hour more the thunder commenced to rattle incessantly and so continued for an hour. I saw no lightning except a brown flash or two, as if a bird had flown swiftly by; but the lightning showed itself in large sheets in the next valley, five miles north, where no hail fell.

The thunder advanced until it was nearly over head, but it seemed a great many miles off. Long banks of clouds came from the east and then ascended straight up. About 5 p.m. I could see the storm coming down the valley. Presently it reached the house. The view of all objects a hundred yards distant was shut out by the downpour of hailstones; they battered the roof as if determined to crush it down; they struck the panes of glass in the windows and hurled the fragments across the room. The noise was terrific. We placed the children in the strongest room in the house, for we momentarily expected the roof to be crushed in. The ground outside was white with hail; streams of water rushed wildly in all directions, for it was the middle of summer and the ice melted as it fell. In about twenty minutes the storm had passed. Heaps of ice lay in various places from 15 to 20 inches deep. The largest pieces of ice appeared to be made up of several smaller ones frozen together for they were of very irregular shape. I send a rough map of the district with the course of the storm outlined, showing the place of greatest density. There was no wind. The largest pieces of ice were not cubical; they were flattish, long, and broad, but not very deep. Some were clear, and others milky-white. There had been a heavy shower of rain early in the morning.

From the evidence, collected from half-a-dozen reliable men and from the position of the broken oat stalks, as well as from my own observation, I feel inclined to the following theory:—

The cloudy envelope over the valley became charged with electricity to an extraordinary degree, until it became an electric storm which began to circle round and to ascend into very high regions, carrying with it masses of vapour. The higher masses of vapour were first converted into ice-drops; these were dashed together and congealed, forming the largest ice pieces. The lower masses of vapour were then changed into hail. The largest pieces being the first formed were the first to fall, increasing their size as they fell through those below. The smaller hail came from the centre of the storm nearest to the earth. The whole must have resembled the figure usually given of a water-spout; but in this case the water was turned into ice-drops.

[Mr. Bryant's interesting account is drawn partly from his own observations, and in part from the evidence of a number of settlers in the Owaka district who were eye-witnesses of, and in some cases, sufferers by the storm, viz.:—Rev. W. G. McLaren, Messrs. Morton (who was at the head of the valley and measured the hailstones just after they fell), McCalman, junr., Clapperton, Todd, Dalton, Young, and others. A correspondent of the *Clutha Leader* says:—"The iron roof of Mr. Brugh's wool-shed was riddled. Mr. Garry had also 21 holes made in his iron roof by the hail." In Mr. Jno. Thomson's house a new iron roof measuring 43 feet by 36 feet had 53 holes knocked through it. Mr. Morton reports having measured a piece of ice which fell that day, and which was 12 inches long by 5 inches broad—thickness not given. He also says—"I measured a number of hailstones which averaged 3½ inches in diameter." Owing to the warning given by the dense gathering of the clouds and the preliminary thunder neither people nor cattle were hurt, as all had time to get under shelter. —EDIT.]

THE GEOGRAPHICAL DISTRIBUTION OF THE FRESH-WATER MUSSELS.

BY DR. H. VON JHERING, OF RIO GRANDE DO SUL.

(From "Das Ausland für Erd-und Völkerkunde," 1890, Stuttgart).

The exchange of mammals between North and South America took place only towards the end of the tertiary period. The Old World with North America seems to be the land where the placental mammals originated; those families which are characteristic of South America, especially the Rodentia, occurred in early tertiary times only in Europe not in North America, and South America, therefore must have obtained its original stock of mammals from the Old World. The subsidence of the old communicating bridge (the Atlantis) and the continuance of the central-American sea up to the end of the tertiary epoch gave, in consequence of the long isolation, the peculiar character to the South American fauna. The littoral marine mollusca will in time help to identify the extension of the still fabulous Atlantis. The number of molluscs already known from South America and the Antilles on one side, from the Mediterranean and West coast of Africa on the other side, is already considerable. Recently some Nudibranchiatæ, hitherto known only from the Mediterranean and the East Atlantic Ocean, have been found: *Doris verrucosa* on the coast of Brazil by myself, and *Tethys leporina* in the Gulf of Mexico by Bergh.

The geographical distribution, together with the geological appearance and distribution of the mammals during the tertiary period gives an excellent opportunity for ascertaining the distribution of land and water during that period. But for the Secondary epoch, when there were hardly any placental mammals, these means are of no avail. Here the fauna of the fresh-water may help us. On studying the fresh-water fishes with regard to their distribution it is surprising to find that they show quite different geographical regions to those of the land-fauna. A map of the different regions of fresh-water fishes has quite another aspect than one on which Wallace's regions of the land-fauna are entered.

This fact has hitherto been much neglected, nor has it been satisfactorily explained. Is it not surprising in the highest degree to see on such a map Chile and Patagonia separated from the remaining part of South America, and united with New Zealand? We shall see that the fresh-water mollusca show a similar appearance. And yet the explanation is not difficult to be given. The study of the fresh-water mollusca shows that the earliest palæontological genera are at the same time cosmopolitan or most widely distributed in all parts of the earth and on many of the larger islands, the genera *Planorbis*, *Physa*, *Limnæa*, and *Ancylus* are found.

All these genera appear already in the Jura, partly even in the the Carboniferous and represent the oldest, palæozic fresh-water fauna. The genus *Unio* shows very much the same distribution, appearing also already in the Jura formation, whilst all the genera of the *Najadæ*, coming into existence much later, have a perfectly different geographical distribution. Especially *Anodonta*, which appears only in the tertiary period, and *Ampullaria* and its nearest allies show a much narrower distribution, they are missing both in Chile and West Peru as well as in New Zealand and Australia. When these genera originated and began to spread, there was evidently no land-communication between the Asiatic continent and its islands, and Australasia. The numerous species of those genera could therefore not reach Australia and New Zealand.

A similar case lies before us in the fresh-water fauna of Chile and Peru, which shows the old fresh-water genera, but not the younger genera *Ampullaria* and *Anodonta*.

Besides some widely distributed genera, the family of the *Najadæ* has a number of smaller genera, some of them inhabiting Africa, but the greater number South America. Of the latter belong to the Anodonta group: *Aplodon*, Spix (*Monocondylæa*), *Mycetopus* and *Columba* (*Leila*); to the Unio group: *Hyria*, *Castalia* and *Castalina*.

All the *Najadæ* of South America just mentioned are nearly related, as shown by the mode of hatching the embryos. The South American embryos are developed in the internal branchiæ, whilst the European *Najadæ* hatch their larvæ in the external branchiæ. Nothing is known of the development of the African *Najadæ*. Perhaps they will show some of the peculiarities of the South American *Najadæ*.

The distribution of the genera of the *Najadæ* over South America is very peculiar. West of the Andes, in Peru and Chile, the genus *Unio* alone is found, which occurs also everywhere in the eastern parts. In the latter parts of South America we find in addition the afore-mentioned genera, peculiar to this country.

Previous to the upheaval of the Andes, in the place of the Chile of to-day, there must have been land in existence richly provided with fresh water; which is proved by the genera of fresh-water animals common to Chile and La Plata. The fauna of the La Plata and Rio Grande do Sul waters is much richer than that of Chile, but the genera of the latter are also found east of the Andes. Amongst the Najadæ is:—

Unio auratus, from Chile, closely allied to *Unio rhuacoicus* of Uruguay
„ *araucanus* „ „ „ „ „ *faba* „
„ *atratus* „ „ „ „ „ *lepidior* „
„ *montanus* „ „ „ „ „ *Beskeanus* of S. Paulo.

They are so nearly allied that the question may be raised whether they belong to one species or not.

Of Crustacea, *Parastacus* and *Æglæa lævis* are common to Chile and Rio Grande do Sul, the latter having in both places the parasite *Temnocephala*. Most important is the relation between the La Plata and Chile fauna. The upheaval of the Andes in the beginning of the tertiary period divided a formerly united territory into two parts, between which no more exchange was possible. The genera and species common to both parts represent the original stock of fresh-water animals, but what is only found in Eastern South America represents the tertiary addition, coming from the East.

All we know about fossil fresh-water mollusca confirms this hypothesis. The only genus of the *Najadæ* reaching far in the Secondary epoch is the genus *Unio*, and this is the most widely distributed, the only one really cosmopolitan. As in Chile, no *Anodonta* have been found in Australia and New Zealand, nor *Ampullaria* either, though this genus is nowhere missing from the Philippine Islands to Brazil. Dr. Günther unites the fresh-water fishes of Chile and New Zealand in one region; the study of the *Najadæ* confirms it. *Unio mutabilis*, Lea, found in New Zealand and Australia, has its nearest ally in *Unio auratus* of Chile.

The absence of alligators and turtles from Western South America can only be explained by their immigration having taken place in tertiary times. As in *Najadæ* there is also a very great difference in the *Chelonia* of North and South America. A fauna common to North and South America does not exist, but on the contrary only the greatest contrasts. This fact can only be understood by admitting a separation up to the end of the tertiary epoch.

The fresh-water fishes of North America are those of the palæarctic region; but the *Characinidæ*, *Chromidæ*, &c., of South America have their representatives in Africa, There must have been land communication between Africa and South America. The African *Testudo sulcata* is also found in Patagonia.

Of the *Pontaderiæ*, common in South America, not only several genera, but also one species, *Eichhornia natans*, occur in tropical Africa, besides *Pistia stratiotes*, *Lemna polyrhiza* and other Brazilian water-plants. The world-wide distribution of many species of water-plants, from East Prussia to Australia, and from South America to East India could not be understood if we did not suppose that they are very old forms, existing already in the Secondary period, and whose distribution occurred at a time when the now separated continents were continuous.

The marine littoral mollusca of East and West America consist, with the exception of one *Siphonaria* and *Cuspidaria patagonica*, of quite different species and partly of different genera.

It seems that during the Secondary period there were four more or less continuous lands; three archi-continents formed, an arctic, an antarctic and a tropic atlantic. The first is identical with Heilprin's holarctic region. The connexion between Europe and North America must have been more extended, whilst there was, up to the tertiary period, no land communication with South America, or at least only formed by a number of islands.

The connexion between South America and Africa seems to be confirmed also by the as yet but little studied *Najadæ*. The African *Iridina* and *Spatha* have their nearest allies in *Mycetopus* and *Anodonta* of South America. *Iridina*, or similar forms, are also found in the eocene fresh-water deposits of Brazil, which very likely are erroneously considered by White as cretaceous. Even in Australia and Asia we find a *Mycetopus* or allied genus. Those fragile, elongated, iridina-like forms are therefore those which appear next to *Unio*. Their scanty distribution in Australia and absence from New Zealand and Chile show that the land-bridge which once existed between Australia and the Indo-Malayan territory disappeared during, or shortly after, the cretaceous epoch, at which time the immigration of *Mycetopus* had taken place. Had it been longer in existence, Australia would also have received a stock of placental mammals! The tertiary genera of the *Najadæ* and the *Ampullariæ* could therefore not reach Australia nor New Zealand.

Many observations on the structure of the umbo seem to prove a near connexion between the African and South American *Unio*, but only the examination of the animals can solve the question.

Additional to the archiboreal and archiatlantic continents there would be the archiaustral continent, reaching from Chile over New Zealand to Australia.

The study of the fresh-water fauna will help us principally or perhaps exclusively to gain a proper knowledge of the geographical distribution of the organisms during the Secondary epoch as well as for the distribution of land and water during that period.

ON THE GREAT OAR-FISH.*

BY H. O. FORBES.

On the morning of the 28th of May I received a note from Mr. Warnes, the fishmonger, requesting me to inspect a curious fish caught in Okain's Bay, Banks Peninsula, on the 26th, and which he was bringing up to town that day. On its arrival in Christchurch in the afternoon I found the fish to be a species of *Regalecus*, or oar-fish of unusually large proportions.

Regalecus is a genus of fishes belonging to the family *Trachypteridæ*, or ribbon-fishes. According to Dr. Günther, of the British

* A paper communicated to the Philosophical Institute of Canterbury.

Museum, they "are true deep sea fishes, met with in all parts of the ocean, generally found when floating dead on the surface or thrown ashore by the waves. Their body is like a band, specimens from 15 to 20 feet long being only from 10 to 12 inches deep, and about an inch or two broad at their thickest part. The eye is large and lateral; the mouth small, armed with very feeble teeth, or altogether wanting them; the head deep and short. A high dorsal fin runs along the whole length of the back, and is supported by extremely numerous and fragile rays; its foremost portion on the head is detached from the rest of the fin, and is composed of very elongate flexible spines." There is no anal fin. The ventral fins are reduced to a single long filament, terminating in an oar-blade-like expansion. The coloration of the body is of a beautiful glistening hue, like frosted silver, admirably set off by the rich rosy red colour of their dorsal and ventral fins. Black spots and irregular streaks, especially in the front part of the body, contribute their share toward the effective adornment of this singular fish. "At what depth Ribbon-fishes live is not known; probably the depths vary for different species, but although none have yet been obtained by means of the deep sea dredge, they must be abundant in all oceans, as dead fishes, or fragments of them, are frequently obtained. There is no doubt that fishes with such delicate appendages as their crest and ventral fins, are bred and live in depths where the water is absolutely quiet, as a sojourn in the disturbed water of the surface would deprive them at once of organs which must be of some utility for their preservation." The Oar-fishes are the largest of the deep-sea fishes known. They derive their name from the singular form of their ventral fins, which reduced to one long slender and fragile filament, terminating in an oar-blade-like expansion which, projecting from its sides for a distance, in our specimen, of nearly 3½ feet, are functionally useless.

The *Regaleci*, or Oared-Ribbon fishes, have been taken in the Mediterranean, in the North and South Atlantic, and in the Indian oceans; in Australian waters, one has been taken off the coast of Victoria, and several on the shores of this colony; but they are very scarce, not more than twenty captures having been recorded from England in the space of a century and a-half, and not more than thirteen from the coasts of Norway. The present specimen is the tenth caught in New Zealand. I take from a paper read before the Otago Institute by Professor Parker, F.R.S., who has compiled a list of these captures up to the date of his communication, describing the eighth species taken on our coast, the following notes:—Of these one was captured at Nelson in 1860, a second at Jackson's Bay in 1874, another (*Regalecus pacificus*, Haast) which is now in the Canterbury Museum, as well as a drawing of it by Dr. Powell, was caught at New Brighton in 1876; a fourth was cast ashore on Little Waimangarao beach, on the West Coast of the South Island; a fifth (*R. banksii*) at Cape Farewell in 1877; the sixth was thrown on the shore near Moeraki about the year 1881, and near the same place the seventh also (*Regalecus argenteus*, Parker) on the 14th June, 1883, whose skeleton is now in the British Museum, South Kensington; the eighth—a specimen of the same species—came ashore in Otago Harbour about ten miles north of Dunedin, on June 3rd, 1887, and is now in the Otago Museum, while the ninth was taken in Nelson Harbour on the 23rd September, 1890. Of the fewer than twenty specimens captured in England, eleven are referable, the same author observes, to a single species (*Regalecus banksii*), while one is assigned to *Regalecus grillii*. The specimen captured in May, 1878, between Victoria and Tasmania has been identified by Sir Fred. McCoy as *Regalecus banksii*. Taking as our guide, however, the key to the species of *Regalecus* given by Professor Parker in vol. xvi. of the "Transactions of the New Zealand Institute," it ought, it would appear, to bear the name of *R. grillii*, on account of the number of its dorsal fin rays. This specimen has been described and figured by Sir Frederick in the fifteenth decade of the Prodromus of the Zoology of Victoria. After a careful comparison of the descriptions and figures of the species of *Regalecus* known to me, I have come to the conclusion that the species that has been exhibited during the past week in Christchurch is identical with that taken off the Australian coast, viz., to the species described by Lindroth, under the name of *Regalecus grillii*. In an addendum to his paper in the twentieth volume of the "Transactions of the New Zealand Institute," Professor Parker, who while writing his excellent monograph on *R. argenteus*, gave the literature of the subject his careful attention, writes:—"Everything seems to lead to the conclusion that most of the supposed species of *Regalecus* are identical, and that the more recent specific names (including *argenteus*) will have to give way, probably in favour of Ascanius's original name *glesne*." The synonomy of the species is rather involved, and the works necessary to its elucidation are not within my attainment here. Professor Parker's opinion, however, is entitled to very great weight, and the observations on the present specimen tend to support it. This new specimen, therefore, ought strictly to be denominated *R. glesne*; but for the present I shall speak of it under the name *R. grillii*, to indicate that in my opinion it belongs to the same species as Lindroth described.

This fish had been exhibited in Lyttelton, I believe, before being brought to Christchurch, and had unfortunately, in its various transports, and perhaps also in its capture—for it was still alive when caught—suffered to some extent. It had lost much of its brilliant colouring, and most of the singular rays of its crest, as well as received damage to the long rays of the ventral fins. With these exceptions, however, the specimen was a particularly fine and complete one. The *Regaleci* being deep sea denizens are generally found to have suffered on approaching the surface, from the expansion of their internal gases, consequent on the diminution of pressure; but the specimen under description showed no signs of any "loosening or tearing of its ligaments and tissues," by its ascent to the surface of the sea.

The name *Regalecus* means *King of the Herrings*, because one of the earliest specimens taken on the British coast was first seen on the "herring ground," and being of a silvery hue, as is also the herring, the fishermen imagined they had discovered a mighty herring.

It has been supposed that the Sea Serpents so often observed, but never caught, may probably be specimens of great oar-fishes swimming near the surface, a supposition I do not myself feel inclined to subscribe to.

The following notes were drawn up under considerable disadvantages, owing to the fish being under exhibition at the time, and that in a very badly-lighted room. I had to write amidst a talkative crowd, while my observations were confined to the one side —naturally the best—exposed to the public. Imperfect as they may be, I lay them before the Institute as a contribution toward our better knowledge—still very imperfect—of this rare genus of fishes.

It is remarkable that all the New Zealand specimens have been found on the South Island; and like all the other specimens, European or New Zealand, (except the Nelson Harbour one, which was a male), whose sex has been determined, the present is a female, and it has occurred on our shores at the same period of the year (the spring and early winter), as they have invariably done.

In order to facilitate comparison with the observations recorded by Prof. Parker in the Transactions of this Institute for 1887, I shall arrange my notes under the same heads and in the order adopted by him.

Size, Proportions and Number of Fin Rays.—It will be seen from the accompanying measurements that the present is the largest specimen of *Regalecus* yet taken on the coast, its length being 18 feet 10 inches, with its protrusile mouth not extended. It is probable, however, that it does not exceed by much the length attained by Prof. Parker's Otago Harbour specimen when complete. This specimen was broken across, and he conjectures that it was most likely about 17 feet in length. Its ribbon-like form is indicated by the proportion of its height to its length, which was $\frac{1}{15}$, the New Brighton specimen was $\frac{1}{11}$, the Moeraki specimen, sent to London, $\frac{1}{10}$, while the Victorian specimen was still more band-like, its height being only $\frac{1}{23}$ of its total length. The Otago harbour specimen is given as $\frac{1}{11}$, but if this were corrected for the length that the fish is conjectured, as stated above, to have reached, the proportion of height to length would closely approximate to that of the Okain's Bay example. In this specimen the neck crest is damaged, and a gap occurs in the dorsal fin, so that it is difficult, with absolute accuracy, to determine the number of fin rays. Taking 14, the number given by Professor Parker in the Otago Harbour specimens, as the probable number here, these were succeeded by 221 rays anterior to the gap, in which 17 were made out,—but there may have been one more,—and succeeded by 170 more to the termination of the tail, giving in all 422, which comes very close to the number recorded by Lindroth in *R. Grillii*, and by Professor McCoy in the Victorian specimen, which is 423.

Tail.—In the present specimen the tail is almost perfect, a mere fraction only being possibly absent. It terminates in a point, and is curved upwards for its terminal few inches. The dorsal fin extended, I am convinced, to, but it did not pass, I am certain, the extreme point. Its fin rays have been broken off for the last few inches, but with a magnifying glass it was possible to detect their broken extremities. There is, therefore, no caudal fin. There is no sign of any old fracture having at any time taken place, as the body graduates gently from head to tail. It would seem, therefore, that the supposition that the end of the tail "has been lost as a useless appendage at a much earlier period of the life of the fish," which has arisen from the circumstances that these fishes are so often found in a truncated condition, is probably groundless, and their mutilation is merely the result of accident. Moreover as the stomach has an extraordinary cæcal prolongation which extends for many feet behind the anus, it is evident that a loss of any considerable length of its tail would probably be fatal to the fish.

Colour and Markings.—In general appearance the fish presented, on its arrival in Christchurch, numerous bright silvery patches, and indications that this colour had covered the whole general surface of the fish. These patches were eventually lost, and the fish assumed a light greyish colour. Its crest, its dorsal, pectoral, and ventral fins had faded to a dark salmon red colour. In some lights it could be detected that dark spots and stripes had been dispersed over the anterior part of the body, but they had almost faded out at the date of examination. As to their number, form, and situation, I can, therefore, speak with no certainty. On the sides of the body there are five (5) well-defined black bars or ridges, running longitudinally. These bands on examination proved to be composed of raised tubercles, and they are distinctly separated by interspaces, which in the fresh fish would be bright silvery stripes, quite free of tubercles, as a sensitive finger passed along them discovers only the very finest skin granulations. Above the uppermost of these bars, and separated by a smooth interspace, a broader tuberculated band extends up to the base of the dorsal fin. The tubercles in this band are not so rough as on the lateral bars. Toward the tail and at a few feet anterior to it these bars become lost, and exchange their dark colour for a silvery white. The second, which is the most prominent of all, runs furthest along the body and is finally lost at two feet from the tail, where the tuberculation entirely ceases and the rest of the body is soft and glistening. The first true bar and the sub-dorsal fin-band pass forward, which is not the case with the others, and terminate the front of the head above the anterior margin of the eye. The lateral line cuts the second, third, and fourth true bar (or ridge) a little posterior to the head margin of the operculum, while the fifth follows the lateral line for a great part of its length. The ventral surface is very roughly tuberculated, rougher than any other part of the body, the tubercles presenting a suspicion of points. Behind the anus the surface is very dark coloured, and was probably black in the living fish.

In its internal anatomy this oar-fish agreed so closely with that already described as to require no further remark here. The liver, however, must arrest the attention of anyone opening the body of *Regalecus* by its pink colour, From this organ, when placed in spirit, escaped a very large quantity of a deep salmon-coloured oil. In the ovaria there were very minute ova, but, as in all the other specimens hitherto examined, they were unimpregnated, as the winter is evidently not their breeding season.

The *Regalecus* has no teeth; and I found in the æsophagus only a gelatinous glairy fluid, mingled with a quantity of very fine grey sand, whfle the food in the stomach consisted of finely-comminuted matter, entirely structureless under the microscope. It is probable, that *Regalecus* finds its food in the minute animal forms, or *debris*, among the fine sand at the bottom of still, deep waters.

As was found in the gigantic skate recently thrown on the Sumner coast, this *Regalecus* was infested to an extraordinary degree with intestinal worms, thousands extruding themselves from the liver as it lay on the table. They were found in the æsophagus also. Perhaps these fishes become infested during the winter season with those parasites, and in their desire to rid themselves, it may be that they seek shallower water and are thus thrown on our coasts, by currents, in a dying state.

I have to record my thanks to Mr. Warnes and the syndicate exhibiting this fish for their extreme courtesy and good nature in allowing myself and my assistant to intrude on their show whenever we desired, in order to make the notes recorded above, and especially for their kindness in permitting us to remove the fish from its stand for the purpose of obtaining a photograph of it.

I am indebted also to Mr. Sparks, the taxidermist of the Museum, for his help and care in taking the measurements.

VEGETATION OF LORD HOWE ISLAND.

BY W. BOTTING HEMSLEY.

(From "Nature," April 16th, 1891).

There is nothing absolutely new to announce concerning the flora of this remote islet but what has been published in the form of Government reports, which have a comparatively restricted circulation, and many persons who would be interested in their contents are unaware of their existence. And even when one knows of the existence of such reports, it is often difficult to procure them. Through the intermediary of Sir Saul Samuel, Agent-General for New South Wales, the library of the Royal Gardens, Kew, has just received a copy of a report on the state and prospects of Lord Howe Island, with a number of photographic illustrations of the scenery and vegetation of the island; and it is on account of these illustrations that I have thought it worth while making known to the readers of *Nature* the existence of such a report, though it was published as long ago as 1882. Unlike the majority of such documents, this report is too meagre: "Thompson's farm" and other matters being mentioned and illustrated in such a manner as to take for granted an amount of previous knowledge that very few readers could possibly have possessed.

Although so remote and so small, Lord Howe island supports an indigenous flora of a highly interesting character, especially interesting because it includes some plants whose nearest allies are natives of New Zealand. The island is about 300 miles from Port Macquarie, the nearest point of the Australian mainland, in 31° 30′ S. latitude. It is seven miles long, with an average breadth of about a mile, and the basalt mountains rise to a height of nearly 3000 feet. The soil is fertile, and is, or rather was, everywhere covered with vegetation. The scenery is beautiful; the climate is described as unsurpassable, and a great future is predicted for the island as a sanatorium, "when the Australian colonies become more densely inhabited." Without waiting for the time when Australia will be crowded with inhabitants, Lord Howe Island might be made a pleasant holiday resort, involving just enough of a sea voyage to be exciting and exhilarating, and not long enough to be monotonous.

The most complete account of the flora yet published is by Mr. Charles Moore, Director of the Botanic Gardens, Sydney, N.S.W., though many of the new plants then—1869—collected by him have since been published in various books and periodicals. The dominating feature in the vegetation is composed of palms, of which there are three or four species peculiar to this island—a condition of things paralleled in remote insular floras only in the Seychelles. Next in interest and prominence are the four or five endemic species of tree ferns, which, however, we are informed, in the illustrated report referred to, by the Hon. J. Bowie Wilson (botany by Mr. J. Duff), are fast disappearing from the lowlands, and will soon be extinct if their removal is not absolutely prohibited. In this connection one is gratified to find both the chief of the Commission of Exploration, and the botanist attached thereto, strongly urging the Government to take active steps to preserve the beautiful vegetation of the island, and especially to make no concessions, nor grant any leases that might entail any further destruction of the woods. Commonest among the other trees are *Hibiscus Patersonii*, *Myoporum acuminatum*, and *Ochrosia elliptica*—all three Australian trees; one or more species of *Ficus*, and one or more endemic species of screw-pine. One of the vegetable wonders of the island is a huge banyan-tree (*Ficus* sp.), said to cover three acres of ground; but no particulars are given of this remarkable tree, beyond a photograph of a portion of it. This is rather disappointing, because of all the famous banyan-trees in India, some of which are encouraged by artificial means in the development of the aërial descending roots, which eventually become auxiliary trunks, few surpass in size this one, on such a speck of an island. The celebrated banyan between Poona and Kolapore, in the Bombay Presidency, is, indeed, the only one, of which I have found a record, that covers a greater area than the Lord Howe Island banyan, and that, according to measurements given of the spread of its branches, must cover between six and seven acres.

In striking contrast to the flora of Australia, the flora of Lord Howe Island, like that of New Zealand, contains exceedingly few species of the large natural order Leguminosæ. Out of five species collected, three are common sea-side plants that often establish themselves on a shore from seeds cast up by the waves. Of the other two, one belongs to the otherwise exclusively New Zealand genus *Carmichaelia*, and the other, *Sophora chrysophylla*, is also a native of the mountains of the Sandwich Islands, and has hitherto been found nowhere between these two distant parts of the immense Pacific Ocean, and nowhere else in the world. From the foregoing notes may be gathered what an interesting flora that of Lord Howe Island is, and it is to be hoped that the recommendations of the Commissioners for its preservation have been carried out by the Government of New South Wales.

THE BOTANY OF THE SNARES.*

BY T. KIRK, F.L.S.

The Snares comprise several rocky islands situate on the 48th parallel of south latitude and about 65 miles in a south-westerly direction from the extreme southern point of Stewart Island. Owing to their being outside the direct track of vessels they are but rarely visited, so that hitherto nothing has been known of their fauna or flora. My visit was restricted to a few hours in January, 1890, when I was able to land on the largest island, which is of irregular outline and about a mile and a half in its greatest diameter. The cliffs are steep and lofty, but a good boat harbour exists on the north-east side. The rocks are granitic, and the greatest altitude does not exceed 480 feet. The rocks are everywhere covered with a deep layer of peat.

There is but little fresh water on the island; two small rills issuing from swampy ground unite before reaching the cliffs, but the water is undrinkable, being polluted by the penguins; and the few swamp-plants that occur exist under difficulties, being continually flattened under the broad feet of these birds, which abound everywhere, their numbers being but little reduced by the predaceous sea-hawks, which swoop down upon unguarded eggs or young birds, and are almost ready to attack man himself.

The crested penguins (*Eudyptes pachyrhynchus*) exercise an injurious effect upon large portions of the woody vegetation; they select sheltered places with an open aspect, where they perch upon the trees in vast numbers, forming large "rookeries"; the trees thus honoured by their presence are soon killed by their pungent ordure. Various petrels—the "mutton-birds" of the Maoris—form their burrows amongst the roots of the trees, and may be heard mewing and puling in all directions. Several interesting land birds inhabit the island, the more noticeable being the Auckland Island Snipe (*Gallinago Aucklandica*); the grass bird (*Sphæneacus fulvus*), although now rare on the mainland, was frequent on this little island, and associated with a small robin (*Miro Traversii*) only known elsewhere on the Chatham Islands. The occurrence of birds with such weak power of flight on these lonely islands is very suggestive.

The true fur-seal was formerly plentiful on the Snares, but has almost become extirpated through the continuous visits of sealers, who have unintentionally introduced a few plants from the mainland.

* From "The Journal of Botany."

The greater portion of the island is covered with light and occasionally open bush, which never exceeds thirty feet in height. In a few places a dense scrubby growth of *Veronica elliptica*, five to eight feet high, requires some exertion to force one's way through, the difficulty being aggravated by the penguins, which make vicious snaps at the legs, while the explorer is held fast by entangled branches above. Usually a belt of open land covered with tussock occurs between the bush and the margin of the cliff, and a few small open patches occur also in the central parts of the island. In places where patches of bush have been felled by sealers the ground is covered with a dense growth of *Veronica elliptica* intermixed with tussock.

Approaching the island on a fine morning in January, the attention is at once arrested by the peculiar grey or whitish hue of the foliage, flecked here and there with green on the lower margin of the bush. On landing this is found to arise from the abundance of *Olearia Lyallii*, which is the principal tree on the island, and forms the greater portion of the arboreal vegetation. When growing in level situations of an open character it is a noble erect tree, with rather open spreading branches; but when growing on sloping hillsides exposed to the wind it is often inclined, or with a prostrate trunk, the roots, partly from the burrowing of the petrels, being torn out; on the soil the branches rooting at their tips give rise to new trunks, which in their turn are brought to the ground and repeat the process. The short trunks are sometimes three feet in diameter, but the majority were from one to two feet, the extreme height of the tree rarely exceeding twenty-eight feet.

The mature leaves of this fine tree are excessively rigid and coriaceous, with a very short, almost sheathing petiole, orbicular-ovate or broadly ovate, and abruptly acuminate, from three to seven inches in length, white, with appressed tomentum on *both* surfaces, although that on the upper surface usually disappears during the first winter. The flower-heads are produced in terminal racemes from three to eight inches in length, and are rayless; the rachis, peduncles, bracts, and outer involucral leaves are clothed with close snow-white tomentum, which forms a striking contrast with the almost black discoid heads, mostly composed of perfect florets. The involucral leaves are arranged in from five to eight series.

Although this fine plant differs widely in its general appearance from *O. colensoi*, it is difficult to point out good distinctive characters. It diverges chiefly in the more open habit, stouter branches, broader leaves with the pubescence partially persistent above, and especially in the involucral leaves being arranged in from five to eight series; the last character alone being of any importance. The cultivator, however, will always consider it distinct. It is restricted to the Snares and to the Auckland Islands.

The patches of green amongst the white masses of the *Olearia* were caused by another grand plant, *Senecio Muelleri* T. Kirk,* a noble species originally described from specimens collected on Herekopere Island, but the specimens in the original habitat are not nearly so large as those on the Snares, where it attains the extreme height of

* "Transactions of New Zealand Institute," vol. xv., p. 359.

twenty-six feet, with a short trunk two feet in diameter. The branches are somewhat naked, so that the tree presents a straggling appearance, but the handsome foliage and large terminal panicles of yellow flowers, place it amongst the finest members of a large genus abounding in grand species.

Veronica elliptica, which has been already mentioned, completes the short list of ligneous plants; it is, however, of a more robust form than the plant found on Stewart Island and at the Bluff, the flowers being larger, with pure white corollas, which are never pencilled or streaked.

The open land is covered with tussocks of the fine grass *Poa foliosa* Hook. f., *a.*, freely interspersed with masses of *Carex trifida*, the largest of the New Zealand species; a few small plants of no great importance are hidden away in the hollows between them.

One of the most interesting plants in the island is *Colobanthus muscoides* Hook. f., which hitherto has been considered endemic on the Auckland, Campbell, and Macquarrie Islands, where it is plentiful. It is rare and local on the Snares, and appears to be confined to a small swamp in the centre of the island, but its discovery extends its northern range fully 150 miles; subsequently I observed it on Antipodes Island, which shows a still wider extension of its range in an easterly direction. It forms rather large dense masses, the inner portion consisting of the partially decomposed stems and leaves of old plants and the roots of young plants. The seeds often germinate in the capsule, and it was no uncommon thing to find capsules still attached to the stem, and with apparently perfect seeds embedded some three or four inches below the surface of the mass, the old surface having become covered with a growth of young plants too quickly to allow of the germination of the buried seeds.

Another interesting plant was a new *Ligusticum*, which I have named *L. acutifolium*; it was only observed in one place, at an altitude of about 350 feet above sea level; its stems below the leaves were nearly as thick as a man's wrist, the entire plant being four feet high: a description is appended.

The most striking herbaceous plant is undoubtedly the punui, *Aralia Lyallii* T. Kirk, var. *robusta*, the large orbicular leaves of which are sometimes two feet in diameter. It differs from the typical form in the absence of the remarkable stolons of that plant; in the petioles being very stout, flat on the upper surface and convex beneath, giving a plano-convex section; and in being solid, or nearly so, instead of terete, thin-walled, and fistulose. The flowers also, although forming equally large masses with the type, are individually smaller, and invariably of a pale dull yellow hue, never lurid; but there is no structural difference, although it must be admitted that at first sight the plant appears to differ widely from the type.

Lepidium oleraceum Forst. ("Cook's scurvy-grass") was found in one or two places on the cliffs, associated with *Myosotis capitata* var. *albida*, a form not infrequent on the cliffs of Stewart Island.

The only ferns collected were *Lomaria dura* Moore, *Asplenium obtusatum* Forster, and *Aspidium aculeatum* Swartz, var. *vestitum*. It had long been thought possible that tree-ferns might extend to the Snares, but none were observed. The extreme southern limit of tree-ferns therefore is the South Cape of Stewart Island, in S. latitude 47° 20', instead of 45° 50', as usually stated in our text-books.

A few naturalised plants have been introduced by the sealers, and four or five indigenous species from the mainland have become established in the Snares by the same agency.

The total number of Phanerogams and Ferns observed in the island was under thirty, but my visit was too brief to allow of an exhaustive examination being made; it is not probable that any large number of species will be added.

Mosses are exceptionally rare; a few Lichens were observed, but no Fungi or Hepaticæ. No opportunity of collecting Marine Algæ was afforded.

I append a description of the more remarkable species:—

Ligusticum acutifolium, sp. n. A stout herb 3–5 ft. high, root-stock as thick as a man's wrist. Leaves 2 ft. long or more, 6″–9″ broad, oblong, or ovate-oblong, tripinnate; segments large, acute; petiole with the upper part of the sheath free, forming a ligule. Stem stout, much branched; flowers not seen. Fruiting umbels 2″–2½″ diameter, compound, dense; carpels $\frac{3}{16}$″ long, exceeding the pedicels, 3–5 ribbed.

Hab. The Snares.

A handsome species, allied to *L. intermedium* Hook, f. and *L. Lyallii* Hook. f., but distinguished from the former by the ligulate petiole, acute segments, smaller umbels, and shorter fruits; from the latter by the broad segments of the leaves and broad ligulate petiolate sheath; and from both alike by the absence of viscid, milky juice. The sheathing bracts are leafy at the tips and unusually large, sometimes exceeding the flowering branches.

Aralia Lyallii T. Kirk, var. *robusta.*—More robust and less hispid than the type. Stolons absent. Petioles flat above, convex below, solid or nearly so; teeth more strongly mucronate. Flowers smaller, petals shorter, dull yellow.

Hab. The Snares.

The typical plant, which is found on Stewart Island and islands in Foveaux Strait, has softer and more hairy foliage; terete, thin-walled, fistulose petioles; lurid, purple flowers; stout stolons as thick as a man's finger, and which are at first erect. No difference is presented in the form of the leaves, the curious tubular ligule at the base of the petiole, nor in the structure of the fruit.

Deschampsia gracillima, sp. n.—An erect, tufted, glabrous species. Culm very slender, 2″–5″ high; leaves involute, narrow, almost filiform, sheaths slightly inflated; ligule entire or lacerate. Panicle ¾″–2″ long, open; branches few, capillary; spikelets few, 2-flowered; outer glumes unequal, 5-nerved; flowering glumes with a pencil of hairs at the base, ovate, truncate, minutely 3–5-toothed, or else with a short dorsal awn inserted just below the apex; paler, minutely ciliated; rachilla silky; lodicules 3; grain free.

Hab. Carnley Harbour, Auckland Islands, 1,000 ft., *T. Kirk.*

The flowering glumes in some instances are deeply and evenly toothed, in others the teeth are shallow, or the margin is merely erose. The lower flower is sessile within the outer glumes; the upper is carried on a short stipe, which is invariably silky. The grain is very large for the size of the flower.

Deschampsia Hookeri mihi.—*Catabrosa antarctica* Hook. f. Fl. Antarc. i. 102, t. 56; Fl. N. Z. i. 308; Handbook N. Z. Fl. 330; J. Buchanan, Indig. Grasses of N. Z., t. 41. *Triodia*, Benth. and Hook. f. Gen. Pl. iii. 1176.

Mr. N. E. Brown having referred this plant to *Deschampsia*, Pal., in the Kew Herbarium, a new specific name is rendered necessary, the one which it bears as a *Catabrosa* having been appropriated to a Chilian species, *Aira antarctica* Hook. f., which has been removed to *Deschampsia* by M. Desvaux. No name can be more appropriate than that of its original discoverer.

Culms very slender, erect or decumbent, 3″–18″ high. Leaves involute, narrow or almost filiform, longer or shorter than the culms; sheaths slightly inflated, grooved; ligule very long and narrow. Panicle very slender 2″-8″ long, contracted or effuse; branches capillary, often trichotomous; spikelets few, pedicillate, glistening, 2-flowered; outer gls. unequal, obscurely 3-nerved; flowering gl. ovate, truncate, minutely toothed or erose, obscurely 5-nerved, with a short awn inserted immediately beneath the apex or 0, or with the median nerve excurrent; palea equalling the flowering gl.; rachilla glabrous or silky, often reduced to a mere point. Lodicules 3. Anthers very short and broad. Grain free.

a. The larger outer glume equalling the lowest flower; pedicel of upper fl. glabrous or with a few short hairs; awn present or 0; rachilla glabrous when present.

b. The larger outer glume half the length of the lowest flower, pedicel of upper flower silky, awn usually present, rachilla silky.

Hab. Central mountain range of the north and south islands. Antipodes island. Auckland Islands. Campbell Island. Sea level to 5,000 ft. Also in Chili.

This plant affords an instance of the difficulty attending the limitation of the genera of Grasses, on account of the distinctive characters being chiefly drawn from organs usually considered to be of but secondary importance. In some states all the spikelets are perfectly awnless; in others the awn is represented by the short, excurrent, median nerve of the flowering glume alone, and when present is never inserted below the middle of the glume; all characters in which it diverges from the typical form of *Deschampsia*. In some instances the truncate flowering glume is minutely but distinctly 3-toothed, as in *Triodia* Br., to which it is referred by the learned authors of the *Genera Plantarum*; in others it is rather waved at the margin than erose, with or without a minute projection of the median nerve, and in this state may well be referred to *Catabrosa* Beauv., in which it was originally placed by its discoverer, who evidently observed the close general resemblance of the flowers to those of *Deschampsia*.

It varies considerably in habit and stature, but in the fruiting state the leaves are shorter than the culms, the panicle is usually effuse, and the capillary branches rigid. Two forms are easily distinguished by the relative lengths of the lowest flower and the largest outer glume, as stated above; the awn is usually situate just below the apex of the flowering glume, and sometimes does not project beyond it, or but very slightly, when it is liable to be mistaken for a prolongation of the median nerve; in most cases, however, it is well developed and unmistakable, but it is rarely situate below the upper third of the glume and never below the middle. In some panicles the upper flower is invariably awned and the lower awnless; but the panicles from the same plants vary greatly in this respect. Another variable character is found in the rachilla, which, in the form with small outer glume, is always present and very silky, but is often wanting in the form with a large outer glume, and when present is usually glabrous. A similar variation is seen in the pedicel of the upper flower, and in the presence or absence of a small panicle of silky hairs at the base of either flower. The grain is very large for the size of the flower.

I have for some years past distributed specimens of an elegant form of this plant, with an elongated panicle and glumes of a faint purplish hue, under the name of *Triodia antarctica* Benth. and Hook. f., var. *purpurea*; and Mr. Petrie informs me that he has described a similar plant, under the name of *Deschampsia Chapmanii*, but I have not seen his description.

RECENT ADDITIONS TO THE FERN FLORA OF NEW ZEALAND.

Nearly every volume of the Transactions of the New Zealand Institute for the past ten or fifteen years has contained descriptions of new species of plants, and among these new ferns have been frequently included. When the present writer brought out his "Ferns and Fern Allies of New Zealand" in 1882, he felt compelled to reduce many of these new species to the rank of mere varieties of already known forms, a course which subjected him in certain quarters to considerable obloquy. The latest number of the "Annals of Botany" contains the first part of a paper* by Mr. J. G. Baker in which all new ferns which have been discovered or described since 1874 are summarised. The following notes are extracted from this paper and will enable collectors of New Zealand ferns to reduce some of their aberrant forms to their correct species.—G. M. T.

* "A summary of the new Ferns which have been discovered or described since 1874," by J. G. Baker, F.R.S., Keeper of the Herbarium, Royal Gardens, Kew, "Annals of Botany," April, 1891, p. 181.

GLEICHENIA, Sm.

G. circinata, Sw. I cannot specifically separate *G. patens*, Colenso, in Trans. N.Z. Inst., 1888, p. 212.

G. rupestris, R. Br., must evidently be placed as a mere variety of *G. circinata*. (See also "Ferns and Fern Allies of N.Z." p. 25).

G. littoralis, Colenso, in Trans. N.Z. Inst., 1883, p. 334, I cannot separate from *G. flabellata*.

CYATHEA, Sm.

C. medullaris, Sw. I cannot separate *C. polyneuron*, Colenso, in Trans. N.Z. Inst., 1878, p, 429.

C. dealbata, Sw. I cannot separate *C. tricolor*, Colenso, in Trans. N.Z. Inst. xv., p. 304.

HEMITELIA, R. Br.

H. Smithii, Hook. I cannot separate *H. stellulata*, Colenso, in Trans. N.Z. Inst. 1885, p. 222.

HYMENOPHYLLUM, Smith.

H. Armstrongii, Kirk; Baker, in Hook, Ic., tab. 1614 = *H. melanocheilos*, Colenso, in Trans. N.Z. Inst. xvii., p. 255, is the same as *Trichomanes Armstrongii*, Baker, Syn. Fil. edit. 2, p. 465.

H. polyanthos, Sw. I cannot separate *H. lophocarpum*, Colenso, in Trans. N.Z. Inst., 1884, p. 255.

H. villosum, Colenso; Kirk, in Trans. N.Z. Inst. x., p. 395. Midway between *polyanthos* and *demissum*, more deltoid in outline than the former, with narrower segments and smaller sori.

H. montanum, Kirk, in Trans. N.Z. Inst. x., p. 394, tab. 21, fig. B,.........Like dwarf *australe*, with very jagged indusia.

H. demissum, Sw. I cannot separate *H. megalocarpum*, Colenso, in Trans. N.Z. Inst. xv., p. 308.

H. erecto-alatum, Colenso, in Tran. N.Z. Inst., 1878, p. 431.—Not seen. Said to come in between *dilatatum* and *pulcherrimum*.

H. rufescens, Kirk, in Trans. N.Z. Inst., 1878, p. 457, tab. 19, fig. A,.........I am not sure that this is specifically distinct from *H. subtilissimum*, Kunze.

H. tunbridgense, Sm. I cannot clearly separate *H. pusillum*, *revolutum* or *pygmæum*, Colenso, New Zealand ferns described in the Transactions of the N.Z. Inst. for 1879–1880.

TRICHOMANES, Linn.

T. venosum, R. Br. I cannot separate *T. venustulum*, Colenso, in Trans. N.Z. Inst. xii., p. 366.

DICKSONIA, L'Herit.

D. fibrosa, Colenso. I cannot separate specifically *D. sparmanniana* Colenso, in Trans. N.Z. Inst., 1879, p. 363, nor *D. microcarpa*, Colenso, in Trans. N.Z. Inst., 1888, p. 214. The Chatham Island *Dicksonia* is said to be intermediate between the Australian *antarctica* and the New Zealand *fibrosa.*

D. squarrosa, Sw. I cannot separate specifically *D. gracilis,* Colenso, in Trans. N.Z. Inst., 1882, p. 306.

DAVALLIA.

D. Tasmani, Cheeseman; Field, Ferns of New Zealand, p. 75, tab. 24, fig. 5. Kermadec Islands, Cheeseman. Near *pyxidata* and *canariensis.* One of the very few endemic plants of this small group of islands.

CYSTOPTERIS, Bernh.

C. fragilis, Berh. I can only separate as geographical varieties *C. novae-zealandiæ,* Armstrong, in Trans. N.Z. Inst., 1880, p. 360, and the Australian *Woodsia lactivirens,* Prentice.

LINDSAYA, Dryand.

L. linearis, Sw. I can only separate as a slight variety *L. trilobata,* Colenso, in Trans. N.Z. Inst., 1883, p. 345.

L. viridis, Colenso, Fil. Nov. Zeal. 14. Allied to *L. microphylla,* Sw., from which it differs by much closer regularly cuneate final segments, and sub-davallioid sori.

ADIANTUM, Linn.

A. diaphanum, Blume—*A. heteromorphum,* Colenso, Field, Ferns N.Z., p. 80, is a variety, and I cannot separate specifically *A. polymorphum* and *A. tuberosum,* Colenso, in Trans. N.Z. Inst., 1888, p. 215–217.

A. affine, Willd., var. *intermedium,* Benth., Fl. Austral. vii., p. 725, Queensland and New South Wales, differs from the N.Z. type by its transversely oblong sori; var. *chathamicum,* Field, Ferns N.Z., p. 81, Chatham Island, is less compound than the type, with longer final segments. See also var. *heterophyllum,* Colenso, in Trans. N.Z. Inst., 1888, p. 218.

CHEILANTHES, Sw.

C. tenuifolia, Sw. It seems impossible to draw any definite line of demarcation between *tenuifolia* and *Sieberi.* I cannot separate specifically *C. Kirkii,* Armst., in Trans. N.Z. Inst., 1880, p. 36, non Hook., ... (and) *Pteris alpina,* Field, Ferns of N.Z. p. 97, tab. 98, fig. 3.

PTERIS, Linn.

P. cretica, L......I cannot specifically separate the N.Z. *P. lomarioides,* Colenso, in Trans. N.Z. Inst., 1880. p. 380; Field, Ferns of N.Z, p. 91, tab 25, fig. 4.

P. macilenta, A. Cunn. I cannot separate specifically *P. pendula,* Colenso, in Trans. N.Z. Inst., 1888, p. 218.

Lomaria, Willd.

L. vulcanica, Blume. I cannot separate specifically *L. paucijuga*, Colenso, in Trans. N.Z. Inst., 1888, p. 222.

L. lanceolata, Spreng. I cannot separate specifically *L. aggregata*, Colenso, in Trans. N.Z. Inst., 1888, p. 223; Field, Ferns N.Z., p. 103, tab. 29, fig. 7.

L. parvifolia, Colenso, in Trans. N.Z. Inst. 1888, p. 224. Exactly matches our type specimen of *L. pumila*, Raoul, which can scarcely be regarded as more than a variety of *L. alpina*. See Field, Ferns N.Z., p. 106.

L. membranacea, Colenso. I cannot separate specifically *L. oligoneuron*, Colenso, in Trans. N.Z. Inst., 1883, p. 346.

Doodia, R. Br.

D. caudata, R. Br. I cannot separate specifically *D. squarrosa*, Colenso, in Trans. N.Z. Inst., 1880, p. 332.

(To be continued.)

GENERAL NOTES.

Removing Tassels from Corn.—Experiments with strawberries made at the Ohio Experiment Station indicate that pollen-bearing is an exhaustive process, and that larger yields of fruit, as a rule, may be expected from those varieties which produce pollen so sparingly that a small proportion of other varieties producing pollen abundantly must be planted with them in order to insure a full crop, than from those which produce sufficient pollen for self-fertilization.

The following very interesting and valuable experiment on corn, made by the experiment station of Cornell University, at Ithaca, N.Y., gives strong support to this theory.

It has been claimed that if the tassels were removed from corn before they have produced pollen, the strength thus saved to the plant would be turned to the ovaries, and a larger amount of grain be produced. To test the effect of this theory, the following trial was made during the past season.

In the general cornfield a plot of forty-eight rows, with forty-two hills in each row, was selected for the experiment. From each alternate row the tassels were removed as soon as they appeared, and before any pollen had fallen. The remaining rows were left undisturbed. The corn was Sibley's Pride of the North, planted the last week in May in hills three feet six inches by three feet eight inches, on dry, gravelly, moderately fertile soil.

On July 21 the earliest tassels began to make their appearance in the folds of the upper leaves, and were removed as soon as they could be seen, and before they were fully developed. A slight pull was sufficient to break the stalk just below the tassel, and the removal was easy and rapid.

On July 25 the plot was gone over again for the removal of such tassels as had appeared since the previous work, and at this time by far the greatest number of the tassels were removed.

On July 28, when the plot was gone over for the third time, the effects of the tasselling became apparent in the increased number of silks that were visible on the rows from which the tassels had been removed.

On the 1,008 tasselled hills there were visible 591 silks; on the 1,008 untasselled, 393 silks.

On Aug. 4 the plot was gone over for the last time, but only a few tassels were found on the very latest stalks. The preponderance of visible silk on the tasselled rows was still manifest, there being at this time 3,542 silks visible on the tasselled rows, and but 2,044 on the untasselled rows. The corn was allowed to stand without cutting until ripe.

Sept. 29 to Oct. 1 the rows were cut and husked, and the stalks and ears weighed and counted, with the following results:—

	Aggregate Yield.		Comparative Yield.	
	Tassels left on.	Tassels removed.	Tassels left on.	Tassels removed.
Number of good ears	1551	2338	100	151
Number of poor ears	628	885	100	141
Number of abortive ears	2566	951	100	37
Total number of ears	4745	4174	100	88
Weight of merchantable corn (pounds) ...	710	1078	100	152
Weight of poor corn (pounds	130	187	100	144
Number of stalks	4186	4228	100	101
100 stalks weighed (pounds)	82	79	100	96

It will thus be seen that the number of good ears and the weight of merchantable corn were both a little more than fifty per cent. greater on the rows from which the tassels were removed than upon those upon which the tassels were left. This is not only true of the two sets of rows as a whole, but with the individual rows as well. In no case did a row upon which the tassels were left produce anywhere near as much as the tasselled rows on either side of it. In fact, the results given above are really the aggregate results of twenty-four distinct duplicate experiments, each of which alone showed the same thing as the aggregate of all.

By abortive ears is meant those sets that made only a bunch of husks, and sometimes a small cob, but no grain. It will be noticed that the total of the good, poor, and abortive ears is about fourteen per cent. greater on the rows on which the tassels were left, while the weight of merchantable corn is more than fifty per cent. greater on those rows from which the tassels were removed.—*Science*, March 27th, 1891, p. 171.

The Souring of Milk during Thunder-storms.*—In *Science* of Sept. 19, 1890, appeared a short note on some work recently done in Italy by Professor Tolomei on the souring of milk during thunder-storms. Professor Tolomei concludes that there is a sufficient amount of ozone generated at such times to coagulate milk by a process of direct oxidation, and a consequent production of lactic acid.†

Similar results have been obtained by other experimenters, and some have even gone so far as to say that free oxygen, when in contact with milk, will generate enough lactic acid to coagulate its caseine.

These results are very different from some obtained in this laboratory. While working on the bacteria in milk the idea occurred to us to find out, if possible, the truth of the somewhat widely accepted theory that milk will sour with extreme rapidity during thunder-storms. Although the statement that this is an oxidising action had been frequently made, a Mr. Iles of Baltimore was the first, so far as I know, to perform any experiments in this direction.‡ His method was to subject milk to the action of ozone, generated by an electric spark passed through oxygen, above the milk. He found a rapid coagulation produced, which he attributed to the direct oxidising action of the ozone.

Our method was similar to that of Mr. Iles's. A Wolff bottle was filled about one-third full of milk, and the air in the bottle displaced by pure oxygen. Through the opposite necks wires leading from a Holtz induction machine were passed into the interior, and the necks plugged tightly with cotton to prevent any escape of oxygen; ozone was then generated by passing a spark across through the oxygen from one pole to the other. In some cases, instead of the spark, a "silent discharge" of electricity from the two poles was used to generate ozone.

In all cases a second bottle was partially filled with milk, and kept as a "control;" *i.e.*, one in which the milk is left in its normal condition.

For some of our experiments three bottles were used,—one left as a control; a second filled with milk and oxygen; while a third was filled, like the second, with milk and oxygen, and then treated with the electricity. We thus had milk under three conditions: 1. In its normal state; 2. Under the influence of free oxygen; 3. Under the influence of free oxygen plus a certain amount of ozone. The electricity, in all cases, was passed through the oxygen for at least half an hour. That a considerable quantity of ozone was generated, was shown by its odor, and strong action on starch-iodine paper. Our results were very different from those given by Iles and Tolomei. The milk treated with ozone, or simply pure oxygen, soured a little, but only a little, faster than normal milk. If the milk in the control coagulated in thirty-six hours, the milk experimented on coagulated only an hour or two earlier.

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* *Science*, March, 27th, 1891, p. 178.

† A more extended account of Professor Tolomei's experiments is given in *Biedermann's Central-Blatt für Agriculturchemie*, 1890, p. 538.

‡ *Chemical News*, vol. xxxvi. p. 237.

This result was very constant. In a considerable number of experiments, using milk of all degrees of sweetness, from that just from the cow to that a day or more old, the same result followed,—a slight hastening of the time of coagulation in milk treated with ozone or oxygen. Between the time of coagulation of milk treated simply with oxygen, and that treated with oxygen plus ozone, no perceptible difference could be noticed.

We had, then, in our experiments, produced a slight hastening of the time of coagulation. Was this a direct oxidation? From the fact that it required over a day to act, it seemed likely that it could not be. If, however, it were an oxidation, it ought to act as well on sterilized milk—*i.e*, milk in which all bacteria have been killed by heat—as on ordinary milk. We therefore, before introducing the oxygen, sterilized the milk. In this case no coagulation occurred. Milk that had been treated at two separate times, a week apart, with oxygen and ozone, was kept for over two months without the appearance of the least sign of coagulation.

Briefly summed up, then, our results were as follows:—

1. Milk, under the influence of oxygen, or oxygen and ozone, coagulates somewhat earlier than when left in its normal condition.

2. This action does not take place if the milk has been sterilized, and is kept from contact with unfiltered air.

3. It is probably, therefore, not an oxidation. The conclusion drawn from this is that the souring was simply produced by an unusually rapid growth of bacteria. The bacteria of milk are mostly aerobic, and would undoubtedly be stimulated to rapid growth by free oxygen or ozone.

If in a thunderstorm ozone is set free, as some observers claim, its action on bacteria would perhaps explain the effects produced at such times. I am inclined to think, however, that a more probable reason is to be found in the general conditions of the atmosphere preceding and during the storm. It has been found in our laboratory that bacteria growing on gelatine will multiply with unusual rapidity during warm, sultry weather. Now, these are the atmospheric conditions that usually precede and accompany thunder-storms. It seems to me most likely, therefore, that whatever rapid souring occurs is due to an unusually rapid growth of bacteria, caused by especially favourable conditions of the atmosphere.

The experience of the proprietor of a neighbouring creamery confirms to a certain extent these conclusions. He finds, that, if milk is kept at a uniformly low temperature during the thunder-storm season, no trouble results from rapid souring, indicating that this souring, when it occurs, is due more to a high temperature and sultry atmosphere than to the ozone in the air. If this were a process of direct oxidation, it should take place, partially at least, at the lower temperature.

Professor Tolomei finds, also, that a slight electric current, if less than three ampères, will have a preservative effect on milk, the current being passed directly through the liquid. A current greater than three ampères will decompose the milk.

In our experiments, a current of less than one-fortieth of an ampère was sufficient to produce decomposition, with a certain amount of coagulation at each electrode. A stronger current would produce complete coagulation, with the somewhat curious result that the coagulum was strongly acid at the positive pole, and more feebly alkaline at the negative pole.

Aaron L. Treadwell.

Wesleyan University,
Middletown, Conn., March 20.

In a paper "On some aspects of Acclimatisation in New Zealand," read before the Australasian Association at its Christchurch meeting by Mr. G. M. Thomson, the following remarkable case of hereditary transmission of an apparently defective characteristic was described as follows:—"In the district of Strath Taieri, in Otago, some years ago, certain sheep on one of the runs—probably the progeny of a single ram, were found to be evidently short-winded. Apparently the action of the heart was defective, for when these sheep were driven, they would run with the rest of the flock for a short distance and then lie down panting. The result of this peculiar affection was that at nearly every mustering these short-winded sheep used to be left behind, being unable to be driven with the rest. Sometimes they were brought on more slowly afterwards, but if it happened to be shearing time they were simply caught and shorn where they lay. As a result of this peculiar condition a form of artificial selection was set up, the vigorous sheep being constantly drafted away for sale, &c., while this defective strain increased with great rapidity throughout the district, for whenever the mobs were mustered for the market, shearing, or drafting, these 'cranky' sheep (as they came to be called) were left behind. This defective character appeared in every succeeding generation, and seemed to increase in force, reminding one of the Ancon sheep referred to by Darwin. At first, of course, the character was not recognised as 'hereditary,' but as the members of this cranky breed increased to a very serious extent and spread over the district, it came at last to be recognised as a local variety. When the runs, on which these sheep were abundant, were cut up and sold or re-leased in smaller areas a few years ago, the purchasers found it necessary for the protection of their own interests to exterminate the variety, of which hundreds were found straggling over the country. This was easily and effectually done in the following manner:—As soon as a sheep was observed it was pursued, but after running for a couple of hundred yards at a great rate of speed, it would drop down panting behind a big stone or other shelter, and seemed incapable for a time of rising and renewing its flight. It was immediately destroyed, and in this manner a useless—but to the naturalist a very interesting variety, was eliminated."

Auckland Institute.—From the annual report of this Society, adopted on 16th February, we learn that the following gentlemen have been elected officers for the present season:—President: Prof. F. D. Brown, F.C.S.; Vice-Presidents: Messrs. J. Stewart, C.E., and

J. Martin, F.R.G.S.; Council: Revs. J. Bates and J. Campbell, Prof. A. P. Thomas, F.L.S., Messrs. W. Berry, C. Cooper, T. Humphries, E. A. Mackechnie, T. Peacock, J. A. Pond, F.C.S., A. G. Purchas, M.R.C.S., and E. Withy; Secretary and Treasurer: T. F. Cheeseman, Esq., F.L.S., F.Z.S. The membership of the Institute shows a slight decrease, 205 names being on the roll. The income of the Society for the past year, exclusive of a balance in hand at the commencement of the year of £204 14s. 6d., was £861 14s. 3d., and the expenditure amounted to £987 8s. 9d. This excess of expenditure reduced the balance in the Bank of New Zealand to £79. The Museum has received several important additions during the year, including a collection of animals from Borneo and a number of Maori ethnological specimens. Captain Gilbert Mair has also deposited in the Museum his Maori collection, which is one of the most complete in the colony. The attendance of the public on each Sunday has averaged 173, on week days it is estimated at about 70. Of the 22 papers read before the Institute during last Session, a number contain valuable additions to the scientific knowledge of the colony.

Theory of the Structure of the Placenta.—In the "Anatomischer Anzeiger" of 11th March, Prof. Minot of Harvard Medical School has an article under the above heading, in which he summarises the results of his own researches and those of others as follows (p. 130):—According to the views explained in the preceding pages, I hold the placenta to be an organ of the chorion; that primitively the chorion had its own circulation, and formed the discoidal placenta by developing villi which grew down into the degenerating uterine mucosa; by the degeneration of the maternal tissues the maternal blood is brought closer to the villi, and the degeneration may go so far that all the tissue of the uterus between the villi disappears; a layer of the mucosa is preserved between the ends of the villi and the muscularis uteri to form the so called decidua; the placenta receives its foetal blood by the means of large vessels running in the mesoderm of the allantois. From this discoidal chorionic placenta the zonary placenta of carnivora, the diffuse placenta of the lower primates, and the metadiscoidal placenta of man have been evolved.

"A second type of placenta, perhaps evolved from the first is found in ungulates, and is characterised by a vascular allantoic vesicle uniting with a non vascular chorion to form the foetal placenta, and by the absence of degeneration in the maternal tissue. This type is the allantoic placenta, which offers many interesting modifications."

Humble-bees in the North Island.—In his letter of May 25th, the Waikato correspondent of the Auckland *Star* says: "The humble-bees that I send you down were caught on Richmond Downs estate, at Walton, Thames Valley. I could have caught a good many more, but thought it best to send three only, as I am not sure that they will stand the journey well, I having no proper boxes to put them in. Judging by the numbers I have seen lately, I am convinced that they are now thoroughly established, and that this district could supply others which require them in any number. It was at Richmond that I heard of them first having been seen two years ago, and at that time it was very much doubted if it was a fact, but it is now a certainty. They are to be seen now on flowers, and in numbers on the Scotch thistle heads, which are yet fresh, and also on the hakea hedges, which flower at this season of the year. If the introduction of this bee means, as they say it does, the inoculation of the clover seeds, they are indeed valuable. What an immense saving it would be could we grow our own clovers. I should say, roughly speaking, that not less than £6,000 to £8,000 has been spent in this Thames Valley alone on clover seeds during the past season or two. And clover grows so well here, too, that large yields might be looked for."

T. W. Kirk, F.L.S—We regret very much to hear that in their zeal for retrenching the Civil Service, Ministers have cut down the staff of the Colonial Museum, dispensing with Mr. Kirk's services. The circumstances connected with his retirement almost justify the use of the term "brutal," which is used by one correspondent in reference to this retrenchment. Mr. Kirk has been for many years connected with the Colonial Museum, has taken an active part in the establishment and carrying on of the Wellington Field Naturalists' Club, and has from time to time published papers on various biological subjects. We shall be glad to hear that he has been able to obtain occupation whereby his scientific acquirements will not be lost to this colony.

MEETINGS OF SOCIETIES.

OTAGO INSTITUTE.

Dunedin, June 9th, 1891.—Professor F. B. de M. Gibbons, M.A., President, in the chair.

New Members.—Messrs. T. G. Brickell and D. Wilkinson.

Papers.—(1) "On a disease which has attacked the American Brook Trout (*Salmo fontinalis*) in the Acclimatisation Society's ponds," by Professor J. H. Scott, M.D. Dr. Scott stated that he found a structure which corresponded closely with what in mammals was called cancer. It was a fatal and malignant spreading tumour in the throat of the fish, and it seemed to be confined to the American brook trout, though Mr. Deans, the Acclimatisation Society's curator, informed him that a similar disease had attacked the Rhine trout in the ponds at Masterton, Wairarapa. Dr. Hocken inquired whether Dr. Scott considered the disease was the same as affected the trout in Lake Wakatipu some years ago—a disease which compelled the trout to come to the surface of the water and which was not confined to a spot under the lower jaw but extended forward and enveloped both jaws in a large mass. Professor Parker said that if he was not mistaken, the disease in the case mentioned by Dr. Hocken was caused by fungus and was similar to the sand disease, which was well known in Europe, and Mr. F. R. Chapman remarked that about two years ago the native fish, the *inanga*, in Lake Wakatipu, were found in the condition referred to by Dr. Hocken, presenting a fluffy, feathery appearance on the under side. Mr. A. Hamilton desired to know if the disease in the American brook trout was likely to be induced or accelerated by the artificial food supplied to the fish, and also whether it was likely to detrimentally affect the eating properties of the fish. In reply to this Dr. Scott said that the causation of cancer was a thing about which there was still a great deal to be learned, and while he thought there was no doubt that the fish were injured from an eating point of view, he did not consider there was the least danger of cancer being obtained from them, because he did not think cancer was inoculable at all.

(2) "Note on the Structure of the Mammalian ovum," by Professor Parker, F.R.S. "Sections of the ovary of a kitten recently prepared for my practical class exhibited the unusual character of a number (6 or 8) of nuclear bodies in the vitellus. Each is globular, about $\frac{1}{100}$ mm. in diameter, and consists of a cortical and a medullary substance taking on slightly different tints with borax-carmine. They are apparently germinal spots which have passed from the germinal vesicle into the vitellus, a phenomenon which seems to have been described by His in fishes, and by Baltiani, Fol, Roule and Sabatier in Myriapods and Ascidians, but as far as I have been able to ascertain has not previously been observed in Mammals. (See Leydig, Zool. Anzeiger, vol. x, 1887, p. 626). The germinal vesicle contains, as usual, a single germinal spot."

(3) "On Volcanic appearances in Dowling Street, Dunedin," by L. O. Beal.

(4) "On *Dactylanthus taylori*," by A. Hamilton. "In the first volume of this Magazine I recorded the finding of a plant of Dactylanthus at Tarawera, about halfway between Napier and Lake Taupo, on the Great North Road. Since then I have found more or less perfect specimens in that immediate neighbourhood, and sent good examples of male and female flowers to Kew, preserved in spirits, for a more detailed examination than was possible in the original pressed type specimens forwarded so long ago by the Rev. Richard Taylor. Through the kindness of a friend of mine, Mr. K. Newton, of Napier, I am enabled to add another locality for this interesting root parasite. During a survey of the country at the back of Nuhaka, a native settlement, between Wairoa and the Napier Peninsula, Hawkes Bay, Mr. Newton collected two female flowering bracts and brought them to Napier. He has since forwarded to me the large tuberous portion of the plant, but I regret that in the packing or during the journey all the shoots have been rubbed or broken off. The inconspicuous character of the plant, its apparent scarceness, and its probable extinction in the near future, must be my excuse for sending you this note."

Mr. Hamilton added—"On this block of country, which has only just been surveyed, there is a warm mineral spring, and the water from it has been analysed at the Colonial Laboratory, as follows:—

"*a.* This is a clear, colourless, and highly saline water containing 1723 grains of fixed salt per gallon, only 22 grains of which is silica. The remaining portion is principally composed of alkaline chlorides, with a fair proportion of alkaline carbonates. It is rich in iodine.

"*b.* This water contains 216 grains of fixed salts per gallon, and these are almost entirely composed of alkaline chlorides. It is feebly alkaline and contains distinct traces of iodine.

"From these results it appears that both samples belong to the group known as the 'alkaline chlorinated' waters. The sample *a* should, when tried, prove to be a valuable mineral water, and resembles that of Wiesbaden, also that of Harrogate and Cheltenham, but is much more highly charged with salts than they are, the specific gravity being that of genuine sea water.

"These springs may be of public use and interest in the future. The Government reserved an area of 1,200 acres around them as a hot spring area. The springs flow into the Nuhaka river about 10 miles from the mouth."

Professor Parker exhibited a series of specimens of *Ileodictyon cibarium*—a fungus found in the bush near Dunedin—mounted in alcohol for demonstration purposes, viz. :—

1. The entire immature fungus.
2. The same in section, showing the thick brownish wall or *peridium*, the white net-like *receptaculum*, and the blackish *gleba* or spore-forming tissue.
3. A similar preparation with the gleba removed to show the receptaculum.
4. The fungus at the period of dehiscence showing the receptaculum escaping from the ruptured peridium.
5. The liberated and fully expanded receptaculum.

Professor Parker also drew attention to some Tasmanian Sponges presented to the Museum.

Mr. F. R. Chapman exhibited two cards of Maori bone implements, comprising fish-hooks, shawl-pins, neck ornaments, and ear pendants.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

Christchurch, 4th June, 1891.—

Papers.—(1) "On the Foliated rocks of Otago," by Professor F. W. Hutton, F.G.S. The foliated rocks of Otago are found in two districts separated from each other by a band of sandstones and slates, about eight miles broad at its narrowest, which belong to the Maitai or Carboniferous System.

(1) Northern Otago.

The rocks of central and north-eastern Otago are mica-schists and phyllites, which have been thought to be the altered equivalents of the fossiliferous Silurian and Ordovician rocks of north-western Nelson.

The reason for this opinion was, that it was supposed that the two sets of rocks, in the north and in the south, could be traced continuously, and that one could be proved to pass into the other. But in 1887 the author found that the two tracts were not continuous, but were separated along the line of the Buller River by a band of Maitai slates and granite,* thus destroying the only evidence for their correlation. In the present paper the author shows that the schists of Northern Otago are metamorphic rock, but that the metamorphism has been caused neither by crushing nor by contact with masses of igneous rocks, but is due to their having been deposited in the Archæan Era, when the earth was much hotter than now. They are therefore older than the Silurians and Ordovicians of Nelson.

(2) Western Otago.

The foliated rocks of the West Coast Sounds, from Milford to Dusky, have been generally regarded as consisting principally of typical gneisses of Archæan age, and as passing below the mica-schists of Northern Otago. The author however finds, from an examination of rocks collected during the excursion of the Australasian Association to the Sounds, that these rocks are all Schistose Diorites of eruptive origin associated with other Diorites and Gabbros. In the paper the rocks are considered as Hornblende Diorites, but it is probable that they were originally Augite Diorites. The following rocks are described:—Mica Diorite, Hornblende Diorite, Enstatite Diorite, and Enstatite Gabbro.

The absence of contortion and the almost universal westerly dip of the foliation planes are strong evidence that these rocks are not Archæan. On their flanks there is found in places a series of sedimentary rocks altered by contact, which Sir James Hector considers to be probably Devonian. If this be so the eruptive Diorites must be younger than Devonian and may be connected with the Greenstone-tuffs of the Route Burn and Greenstone River west of Lake Wakatipu.

(2) "On a Specimen of *Regalecus* from O'Kain's Bay," by H. O. Forbes, A.L.S., F.G.S., &c., (see p. 154.)

AUCKLAND INSTITUTE.

Auckland, June 8th, 1891.—Professor F. D. Brown, President, in the chair.

New Members.—Messrs. T. Allen, Auckland; E. S. Brookes, jun., Wharehine; Rev. H. S. Davies, Lake Takapuna; W. G. Rathbone, Auckland; and Dr. T. O. Williams, Thames.

The Secretary announced an extensive list of donations to the Museum and Library.

The President delivered the annual address.

After dealing with the subject of reading of scientific papers at their meetings, which he considered to be a survival from those times when literary work was chiefly conveyed orally, he then dealt with the great value of the Museum to the city, laying particular stress on the importance of extending the popular branch of the collections, and of

* "On the Geology of the Country about Lyttelton."—Trans. N.Z. Inst., vol. 22, p. 387

arranging and displaying them in the most interesting, instructive, and attractive manner possible. All this required space, and space could only be obtained by subdividing the collections and placing a large portion of them in another building. What was, in his opinion, absolutely necessary if they were to make any further advance, was the erection of an additional hall in which they could place their ethnological collections and, especially, their specimens of Maori workmanship. While speaking of those Maori collections, he parenthetically mentioned the magnificent collection deposited by Captain Gilbert Mair, and took the opportunity of tendering to that gentleman the thanks of the Institute and of the community. The Professor then went on to argue that no grand, ornamental, permanent edifice was required, but one in which attention was paid to the necessity for elasticity in the accommodation, for facility of modification, so that additions and re-arrangements could be effected without restriction. His experience with the University College had impressed him with the superiority of temporary buildings for young and growing institutions, because the expenditure of small sums from time to time had resulted in the gradual adaptation of means to ends. Of course, it was absolutely necessary that their collections should be preserved, that the structure should be strong and fireproof. He found, on the authority of his friend Mr. Bartley, that a building 103 feet long and 50 feet wide could be erected on that particular site for £610. The cost of fitting it up would be about £400, and the re-arrangement of the exhibits now in the Museum would take about £200 more. This would be £1200 in all, a sum well within their means. They had recently received by the sale of a block of land on the Coromandel peninsula a sum of £1000, with an agreement to pay two other thousands at intervals of a year. This sum they did not actually need for the maintenance of the Museum, as last year they had not only paid all ordinary fixed expenses, but had spent £50 in providing cases and otherwise improving the interior of the building. Thus they were well able to afford the cost of a modest but substantial building, and he trusted that ere long they would be able to place before the public such a well-ordered and complete collection of Maori workmanship as befitted Auckland, as befitted a city the history of which was so intermingled with that of the natives.

LINNEAN SOCIETY OF NEW SOUTH WALES.

Sydney, April 29th, 1891.—Professor Haswell, M.A., D.Sc., President, in the chair.

New Member.—Mr. C. Hedley, F.L.S.

Papers.—(1) "On the Occurrence of Barite (Barytes) in the Hawkesbury Sandstone near Sydney," by H. G. Smith, Laboratory Assistant, Technological Museum, Sydney. *(Communicated by J. H. Maiden).* Few localities are recorded in which this mineral occurs in sandstone; and no mention of its having been previously recognised in the Hawkesbury sandstones has been met with. It is usually found associated with metallic ores, but is not so in this instance. The purity, transparency, and brilliancy of the smaller crystals, together with their location, gives special interest to the occurrence of the specimens herein noted.

(2) "On the Occurrence of a Gum in *Echinocarpus (Sloanea) australis*, Benth," by J. H. Maiden, F.L.S., F.C.S. The characters and composition of a gum which has not been previously recorded from this species, are described.

(3) "Notes on Australian Economic Botany. No. ii," by J. H. Maiden, F.L.S., F.C.S. In this paper brief descriptions are given of some indigenous foods and food-adjuncts, stock-poisons, essential oils and timbers, either imperfectly known or not previously described.

(4) "In Confirmation of the genus *Owenia*, so-called," by C. W. De Vis, M.A. The recent acquisition of the greater part of a fairly sound mandible enables the author both to characterise a second species of the genus for which the name *Owenia* was originally proposed as a slight but appropriate tribute of appreciation of the labours of the illustrious exponent of our extinct marsupials—though the author himself at the time was aware of its preoccupancy among the invertebrates,—and to maintain the validity of the genus, a matter which has been called in question. Accordingly to prevent further complications the name *Owenia* is withdrawn in favour of *Euowenia*. The paper concludes with a synopsis of the genera of the *Nototheriidae*, in the sense in which the author would prefer to use that term (to include *Nototherium, Diprotodon, Euowenia, Zygomaturus,* and probably *Sthenomerus*) in place of Mr. Lydekker's two families *Nototheriidae* and *Diprotontidæ.*

(5) "*Onyx* and *Dipeltis*: new Nematode genera; with a Note on *Dorylaimus*," by N. A. Cobb.

NOTES AND EXHIBITS.

Mr. Maiden exhibited a number of vegetable products—fruits, seeds, gums, essential oils, and timbers—in illustration of his papers. Also specimens of a number of interesting indigenous (N.S.W.) plants including *Palmeria scandens*, F. v.M., from Bulli; *Callicarpa pedunculata*, R.Br., and *Alchornea ilicifolia*, F.v.M., from the Richmond River; *Telopea oreades*, F.v.M., and *Persoonia chamæpeuce*, Lh., from the southern portion of the colony.

Mr. T. W. Edgeworth David exhibited, on behalf of Mr. J. E. Carne, F.G.S., Mineralogist to the Department of Mines, Sydney, a specimen of precious opal from the White Cliffs about fifty miles northerly from Wilcannia. Precious opal and common opal have lately been discovered in this locality in a formation corresponding to the Desert Sandstone of Queensland. The opal occurs disseminated as an infiltrated cement throughout the mass of the sandstone in places, and also replacing the calcareous material of fossils. It also occurs in cracks in the sandstone and in fossil wood, which is somewhat plentifully distributed throughout the sandstone, and occasionally replaces part of the original woody tissues of the silicified trees.

Mr. A. Sidney Oliff stated that he had recently had an opportunity of examining a collection of *Coccinellidæ* gathered by Mr. A. M. Lea, among which he had found specimens of the lady-bird, *Vedalia cardinalis*, obtained at Mossman's Bay, near Sydney. This capture is interesting from the fact that the species has not previously been observed by our local collectors. Mr. Olliff also showed, under the microscope, specimens of the larvæ and females of *Phylloxera vastatrix*, the vine pest; and he remarked that, so far, he had not yet been able to find either specimens of the leaf-form of the pest, or reliable records of its having been observed in New South Wales.

Mr. Whitelegge exhibited a set of herbarium specimens of British species of the genus *Equisetum*. Also, under the microscope, specimens of the *Peridinium*, to the presence of which the recent discolouration of the waters of the harbour has been due; also specimens of several other species of allied organisms, including a second species of *Peridinium*, *Prorocentrum micans*, Ehr., *Gymnodinium spirale*, Bergh, and *Glenodinium* sp.

Dr. Cobb exhibited an inexpensive dissecting microscope of simple construction, made by one of the clerks in the Agricultural Department, Sydney. Also, under the microscope, examples of the Nematodes described in his paper. Also, two examples of fungi, one a species of *Phallus* from the adjoining garden, the other the bird's-nest fungus, *Cyathus*, from soil near a pumpkin vine; and coloured drawings of a number of other Australian fungi which he had recently met with.

Mr. Fletcher exhibited three specimens of terrestrial Nemertines (*Geonemertes* sp.)—one from the Richmond River, N.S.W. (collected by Mr. R. Helms), the other from Tasmania (collected by Mr. C. Hedley). The Tasmanian form seems to differ in colour and pattern from the Victorian specimens recorded by Dr. Dendy and Professor Spencer, Mr. Hedley describing them while alive as "black at the oral extremity for about a quarter of an inch, the rest of the body dull white." The New South Wales specimen may, perhaps, belong to the same species as those noted by Dendy, the colour being brownish-orange, except for a lateral band on each side. If *G. chalicophora*, Graff, like *G. palaensis*, Semper, has six eyespots, in two groups of three each, then the specimens exhibited to-night, in which more than six eyespots are present, are not to be identified with the former, which is supposed to have been brought with palms from Australia to the palmhouse at Frankfurt Zoological Gardens.

Also, a male specimen of *Peripatus leuckarti*, Sang., (the only male out of a total of five specimens obtained on the Blue Mountains), which presents the exceptionally remarkable character of possessing a pair of papillæ—the only pair present.—on the ventral surface of the *first* pair of legs.

Also, fruits of *Sechium edule*, Swartz, a West Indian member of the natural order *Cucurbitaceæ*, which has been successfully acclimatised in Queensland for some years past. From a specimen forwarded from Queensland to Sir William Macleay a flourishing plant has been raised, which is now bearing freely in Sir William's garden, the specimen exhibited being from the plant in question.

Also, a living specimen of *Chiroleptes australis*, Gray, forwarded from Herberton, Queensland, by Mr. F. Christian. This species of frog inhabits the northern half of the continent, and has not been recorded on the east coast from further south than the Clarence River.

Sydney, May 27th, 1891.—Professor Haswell, M.A., D.Sc., President, in the chair.

Mr. A. Meston of Queensland was introduced as a visitor.

New members.—Mr. Fred Turner, F.R.H.S., Department of Agriculture, Sydney, The Right Rev. Dr. Camidge, Bishop of Bathurst, N.S.W., The Rev. J. G. Buggy, Kempsey, N.S.W., and Mr. C. A. Chesney, C.E., Randwick.

The Chairman called the attention of the meeting to a circular, copies of which were laid on the table, recently received from the Department of Agriculture of N.S.W., offering national prizes among other things for the best Australian Pathological, Entomological, and Botanical collections submitted to the Department.

Papers.—(1) "A Contribution to the Geology and Petrography of Bathurst, N.S.W.," by Rev. J. Milne Curran, F.G.S. This paper deals with the geology and lithology of the country immediately around Bathurst. The formations described are silurian, pliocene, and recent. The igneous rocks represented are granites and tertiary basalts. No vestige of the old floor on which the silurian sediments were laid down remains. A microscopic examination of the granites and basalts reveals some interesting structures. The granite is a hornblende granite, with orthoclase and triclinic felspars. The basalt is seen, under the microscope, to be an olivine basalt, with a microporphyritic granular structure. The basalts show a streaming of the felspars round the porphyritic augites and olivines. The following were amongst the conclusions arrived at: That the granites of Bathurst are surrounded by an aureole of metamorphic rocks. There is no gradation from a clastic to a holo-crystalline rock. The granite is intrusive as regards the surrounding slates. The slates are the oldest rock in the district, granites coming next in order of time. The conclusion that the granites were intrusive was not necessarily opposed to the view that the granites may have been formed, as a whole, by a partial fusion of pre-existing sediments.

(2) "Remarks on Post-tertiary *Phascolomyidæ*," by C. W. De Vis, M.A., Corr. Mem. In this paper the author adduces weighty evidence, based on the phascolomine peculiarities of their respective contents, in favour of the conclusion that the ossiferous deposits of the Darling Downs and of the Wellington Caves are not upon the same palæontological horizon, the cave wombats, *Phascolomys latifrons*, *P. krefftii*, and *P. curvirostris*, not having come into existence when the Queensland breccias and Tertiaries—characterised by the presence of *P. parvus* and *P. angustidens*, n. sp. (herein described),—were laid down; and secondly that no living species of wombat has come down to us from the Age of the Condamine beds.

(3) "Description of a new Marine Shell," by C. Hedley, F.L.S., and C. T. Musson, F.L.S. The new species, described as *Eulimella moniliforme*, flourishes in the brackish water of the lagoon at Manly, near Sydney.

NOTES AND EXHIBITS.

Mr. Hedley read a short note descriptive of the ova of a common Sydney land mollusc, *Helicarion robustus*, Gould, which are somewhat different from those of other pulmonate molluscs occurring in the neighbourhood, being spirally ribbed.

Mr. A. Sidney Olliff exhibited (1) two species of a small fly *(Diplosis spp.)*, recently bred at the Department of Agriculture by Dr. Cobb and himself from larvæ found feeding on rust *(Puccinia)* on peaches and sunflowers; (2) a drawing of a larva of one of these flies, illustrating the anatomy of the animal, and exhibiting the embryo and larva of an internal parasite, apparently belonging to the Hymenoptera; and (3) specimens of a dipteron *(Tachina sp.)*, a parasite of the plague locust, *Pachytylus australis*, Br., which is allied to the recently-discovered *Musicera pachytyli*, Sk.

Mr. Maiden exhibited ripe fruits of *Monstera deliciosa* grown at North Sydney by Mr. J. Malbon Thompson, who believes that this is the first time that these fruits have fully ripened in Sydney. They were fifteen months in ripening after the fruit had set.

Also, specimens of the "vegetable sponge," *Luffa aegyptiaca*, grown by Mr. James Hurst at Summer Hill; and an abnormal growth of maize cobs, from Bathurst.

Mr. P. N. Trebeck showed some insects collected at North Sydney.

Mr. Henry Deane exhibited a fine specimen of *Ophideres salminia*, Cr., from Casino, a moth which enlarges, by means of its auger-like proboscis, the holes made by fruit-flies, &c., in the rind of oranges and bananas.

Mr. Deane also stated that last month, while travelling by night through the Big Scrub in the Richmond River District, his interest was aroused by the remarkable effect produced by luminous insects which abounded by the roadside. Specimens were secured and sent off in the hope that they would arrive in time to be exhibited at last month's meeting, but they came a day too late, and in the meanwhile have died. From their general resemblance to the larvæ of *Ceroplatus mastersi*, Sk., which are also phosphorescent, Mr. Fletcher, who had seen the specimens forwarded, was of the cpinion that these were very probably also dipterous larvæ.

Mr. David made some remarks on certain luminous organisms which he had observed in old coal mine workings in Illawarra, the identification of which it was hoped would not long be postponed.

ROYAL SOCIETY OF NEW SOUTH WALES.

ANNUAL MEETING.

Sydney, 6th May, 1891.—Dr. Leibius, President, in the chair.

Treasurer's Statement.—The financial statement for the year ending March 31, 1891, was submitted and adopted. The total receipts were put down at £1265 11s. 7d., and the total disbursements at £1268 11s., the balance in hand on March 31 being £41 12s. The building and investment fund shewed a fixed deposit in the Union Bank of £566 17s. 1d., and the Clarke memorial fund a similar deposit of £300 1s. 8d. The total income for the year showed an increase of £45 on that of the previous 12 months, and the expenditure an increase of £88.

New Members—Dr. W. H. Coutie, Petersham; Dr. A. Jarvie Hood, Sydney; Rev. W. Jordan, Cooma; Mr. D. C. Selman, Sydney; and Mr. J. M. Smail, Sydney.

The New Council.—The following members were elected to fill positions on the new council:—President: Mr. H. C. Russell, B.A., C.M.G., F.R.S. Vice-Presidents: Professor Liversidge, M.A., F.R.S., Mr. W. A. Dixon, F.C.S., F.I.C., Dr. A. Leibius, Ph. D., M.A., F.C.S., and Mr. H. G. A. Wright, M.R.C.S.E. Hon. Treasurer: Mr. R. Hunt, C.M.G., F.G.S. Hon. Secretaries: Messrs. F. B. Kyngdon, and Prof. Warren, M. Inst. C.E. Members of Council: Messrs. Robt. Etheridge, junr., C. Moore, F.L.S., F.Z.S., Professor Anderson Stuart, M.D., C. S. Wilkinson, F.G.S., F.L.S., W. M. Hamlet, F.C.S., F.I.C., T. W. Edgeworth David, B.A., F.G.S., J. A. McDonald, M. Inst. C.E., &c., J. H. Maiden, F.L.S., F.C.S., Alexander McCormick, M.D., and C. W. Darley, M. Inst. C.E.

Sectional Committees.—The President announced the election of the sectional committees for the session 1891. They were appointed for the three following sections: Microscopical, Medical, and Civil Engineering.

Correspondence.—A letter was received from Professor F. W. Hutton, F.G.S., of Canterbury College, Christchurch, New Zealand, acknowledging the award of the Clarke Memorial.

Anniversary Address.—The President, Dr. Leibius, then delivered the annual address, from which we make the following extracts:—

"*Antarctic Exploration*—As you are aware Professor Liversidge referred somewhat largely to this subject in his Presidential Address last year, from which it appears that a Committee of the British Association was formed in 1885, which presented three reports, while Baron von Müller of Melbourne, as early as 1886 strongly advocated an Antarctic Expedition. Nothing however, came of it; the request of the Agent General of Victoria made in 1887 to the Imperial Government for a subsidy of £5,000 towards the cost of such an Antarctic Expedition under the condition of Victoria giving a similar sum having been declined on two grounds, viz., that as regards the two objects then put forward in support of such an expedition, *i.e.*, promotion of trade and scientific enquiry, the first did not justify imperial contribution, and as to the second, that the proposed outlay of £10,000 on such an expedition could do but very little in the way of scientific investigation. At a meeting of the Australian Antarctic Exploration Committee held at Melbourne on the 4th of March, 1890, the munificent offer of Baron Oscar Dickson of Gothenburg, Sweden, to fit out and start a Swedish-Australian Expedition under the leadership of the celebrated Baron Nordenskjöld, to explore the Antarctic regions, provided Australia contributed half the estimated cost, viz., £5,000, while Baron Dickson offered to pay the other half, was brought before the members by the Consul for Sweden at Melbourne, Mr. Gundersen. This offer was enthusiastically received by the meeting, and the Victorian Branch of the Royal Geographical Society of Australasia in conjunction with the Royal Society of Victoria, at once set to work to enlist the hearty co-operation of the different branches of the Royal

Geographical Society of Australasia and other scientific societies in the Australian Colonies, with a view of getting the stipulated £5,000.

"Notwithstanding however, that considerable efforts have been made to secure this comparatively small sum, the amount subscribed up to date is less than £1,000, and it is more than probable that the Swedish-Australian Antarctic Expedition, which it was proposed to depart from Europe in a steamer specially fitted up for such purpose in July next, so as to start from Melbourne in the following September, and from Macquarie Island, the nearest depôt to polar land, in October —will for this season at least have to be given up, since only the four months of an Antarctic summer, viz., October–February, could be made use of for Antarctic Exploration.

"The subject of Antarctic Exploration was also discussed by the Geographical Section at the Christchurch meeting of the Association for the Advancement of Science in January last, when a paper by Mr. G. S. Griffiths, F.R.G.S., President of the Section, on Australian and Antarctic Exploration was read and discussed. Baron Ferd. von Müller, as President of the Antarctic Exploration Committee of Victoria pointed out the impossibility of obtaining at the present time any large grant from either the Imperial or Colonial Governments and therefore advocated an expedition on lines of less magnitude and extending in the first place to only three or four months.

" Admiral Ommanney in a letter to the *Times* strongly deprecates any idea of landing a party to pass the winter in the Antarctic regions. The exploration of these regions is acknowledged to be of the highest scientific interest and of considerable commercial value, especially to Australasia. The principal objects of such an expedition would be :— 1. Further extension of geological knowledge in South-polar regions. 2. Scientific research including enquiry into the problems of physical geography, natural history, and meteorology. 3. Investigation of the fishery industry—chiefly whale and seal.

" With regard to Baron Dickson's offer I append here an extract reprinted from an article in the London *Times* of February 13th last:— 'Baron Oscar Dickson, of Gothenburg, Sweden, who is in London at present, naturally expresses some surprise at the conduct of the Australasian Geographical Society, which originally approached him with reference to the undertaking. The only condition which he required was that Australia should contribute £5,000, and he would do all else that was necessary. He estimates that for a suitable expedition, even on a comparatively small scale, something like £15,000 would be wanted. Two of the powerful Norwegian sealing vessels, specially constructed for ice navigation could be purchased for £7,000. A complete equipment of scientific instruments would probably cost £1,000; but Baron Dickson believes that such an equipment would be willingly supplied by the Swedish Government. At least one of the ships would have to be furnished with provisions and other supplies for two years, in case of accident: while the equipment of the second ship, the payment of crews, and other expenses would not leave a large balance out of the remaining £8,000. Baron Dickson would contribute £5,000, and would take upon himself the responsibility of obtaining the remainder. The bulk of it, he believes, he could obtain in Sweden and

Norway, though he might give the Royal Geographical Society an opportunity of contributing, if it cared to do so. At all events if the Australians will find the moderate sum of £5,000, Baron Dickson is willing to be responsible for the balance. Although Baron Nordenskjöld had made up his mind to go on no more adventurous expeditions, yet his objections have been overcome, and he is willing to undertake the leadership of this expedition and take with him his son, who has proved himself of the right metal in a recent journey to Spitzbergen. With Baron Nordenskjöld as leader, success might almost be said to be secured. The plan was to send one ship as far south as possible, say to the neighbourhood of Mount Erebus. There the expedition would spend a whole year making regular observations, and carrying out explorations as far as practicable. The second ship would take up its station at the island of South Georgia, there to be ready for any emergency. Baron Dickson has thus made every arrangement possible, so far as he is concerned, but there is no sign of the promised £5,000 from Australia.'

"I sincerely hope that the Governments of the different Colonies as well as private citizens may see fit to liberally contribute towards the cost of such a desirable undertaking as an Antarctic Exploration. . .

. . . .

"*Biological Station.*—Ten years ago the late Professor Smith in his Presidential Address to this Society, made an energetic appeal for contributions towards the cost of establishing a Biological Laboratory at Watson's Bay, where the Government had given an eligible site, and also had promised to double the private subscriptions up to £300. The well known Russian naturalist, the late Baron Maclay, had for two or three years previously been endeavouring to establish a Zoological Station, and in a paper read by him before the Linnean Society of N.S.W. in 1878, he warmly advocated such a step.

"The practical interest of the Royal Societies of Victoria and New South Wales, together with several other Scientific societies and private individuals, having been secured, a neat cottage was erected and fitted up for the purpose required. The contribution from this Society entitled us to nominate a worker, who would be received into the Laboratory with the right to use all its appliances free of charge, but no one applied for this privilege, and Baron Maclay remained its only occupant. In 1886 the Government resumed the site on which the station was erected for military purposes, giving £500 as compensation.

"Professor Liversidge, who is a warm supporter of a Biological Station near Sydney and had been largely instrumental in procuring the late modest building in Watson's Bay, referred to this matter in his Presidential Addresses delivered to this Society in 1886 and last year. Since then the Government have granted the use of an excellent and convenient site at little Sirius Point, near Mossman's Bay, and it is proposed to erect a suitable building thereon as soon as sufficient funds are in hand. At present about £600 are available, but much more is required. Professor Haswell, Sc.D., issued in December last a circular letter, appealing for support and contributions. As this letter and some of the replies received by him fully explain the work in view, and also show the great interest taken therein by some of the most eminent naturalists of Europe, I republish the same here, with an earnest appeal to the members of this Society and all interested in the progress of scientific research in the department of Natural History, for which this Colony and Sydney especially, offers such a rich harvest. I may add that the Royal Society of London has lately granted £50 towards this object:—

"Biology Department, University of Sydney,
"12th December, 1890.

"Dear Sir,—It is intended to re-establish the Sydney Biological Station on new lines and in a more convenient position. The site of the former Station at Watson's Bay was resumed for military purposes in 1886—the Government giving the sum of £500 as compensation for the loss of the building. This sum, with interest that has accrued, is all that the Trustees have at present at their disposal; and, in order to establish and equip the Station in a suitable manner, five or six times this amount will be required. The Government have intimated their willingness to assist by granting the use of a site suitable for the purpose. It is intended to construct one large Laboratory, with Aquaria and other necessary appliances, two or three smaller Laboratories, store-room and workshop, accommodation for a fisherman to act as boatman and caretaker, and, if possible, accommodation for a naturalist. With regard to this last, it is thought eminently desirable for the success of the undertaking that there should be attached to the Institution a resident naturalist continually engaged in researches on the fauna of the coast. The rest of the work done at the station would be carried out at their own expense by biologists from this or the other colonies, or visiting us from Europe. The results would be for the most part published in the local scientific societies' publications. The following gentlemen, the Trustees appointed by the Government, will be glad to receive contributions towards this national undertaking:—Hon. E. S. Combes, Dr. J. C. Cox, Prof. W. A. Haswell, Prof. Arch. Liversidge, Hon. Jas. Norton, Dr. E. P. Ramsay. . . . .

Trusting to have your support and co-operation in this important undertaking, I am yours very truly,

"WILLIAM A. HASWELL,
"Professor of Biology, University of Sydney,
"Hon Secretary and Treasurer.

. . . .

"*The Forest Department of N.S.W.*—The Department of Forests which formerly was a branch of the Mining Department, has during last year been re-formed as a separate Department under the Colonial Secretary, the services of Mr. J. Ednie Brown, F.L.S., as Director-General of Forests, (who successfully filled a similar position in South Australia) having been secured. The importance to the colony of a well managed Forest Department will at once be apparent by the following few facts, with which I have been kindly supplied, and which, I am sure, will be highly satisfactory reading to every well-wisher of this colony:—The number of Forest Reserves is 944, and the area of reserves already proclaimed amounts to 5,579,000 acres, of which there are about four million acres covered with more or less good timber trees. Some 23,000 red cedar trees have already been planted. Great efforts are being made to encourage the natural regeneration of the red cedar forests, and already good results have been attained in this direction. Over 10,000 natural grown red cedar plants of various ages and sizes have been properly cleared round and otherwise attended to.

"The red cedar forests are situated principally on the northern rivers, such as the Clarence, Richmond, Tweed, Bellenger and Maclay. At the Gosford Nursery there is a stock this year of over 700,000 young plants, of which the principal are red cedars, *Pinus insignis*, *Pinus halepensis*, English oaks, poplars, olives, the most important of the Eucalypts of all the colonies, and the American Catalpa.

"Some fifty men are now employed by the Department in thinning the natural red gum forests upon the Murray Flats. It is intended to plant experimental plantations this winter at Broken Hill and Wilcannia with the tree known as the Sugar Gum *(Eucalyptus corynocalyx)*. The growing of timber for the mines is a matter of great importance. The sugar gum has been successfully established in several parts of South Australia in similar soil and situations to those mentioned. Strong efforts are being made to induce not only our cabinet makers, but those in Europe as well, to try our scrub timbers for the making of furniture. Amongst the timbers recommended are the following: red cedar, tulip-wood, rose-wood, bean, onion-wood, beech, ash, she-oak, black-wood, marble-wood, satin-wood, cork-wood, nut tree, rough fig, myall, beef-wood, myrtle, and yellow-wood.

"For buildings and general construction work the following indigenous timbers are also being brought before the market:—iron-bark, mountain ash, red gum, blood-wood, stringy-bark, black-butt, tallow-wood, spotted gum, box of various kinds, and mahogany.

"A Forest Bill is now in course of being drafted, under which the necessary powers will be given to the Department, whereby increased and more satisfactory results will accrue. The Department is now bringing out an illustrated book upon 'The Forest Flora of New South Wales.' The work of lithographing the plates is being done by the Government Printer, and it is expected that the first part will be published about the end of June next. . . . . . .

"*Mining and Metallurgy.*—Shortly we shall be in possession of the annual report of the Department of Mines for 1890 which will, like its predecessors, treat exhaustively of the progress and production of our mining industry. By the courtesy of the Honourable the Secretary for Mines and Agriculture I am enabled to give the following comparative statement of the chief mineral productions of this colony in 1889 and 1890. They are as under:—

Description of Mineral.	Quantity produced in 1889.	Quantity produced in 1890.	Estimated Value in 1889.	Estimated Value in 1890.
	Ozs.	Ozs.	£	£
Gold	119,759	127,760	434,070	460,284
Silver Bullion	416,895	496,552	72,001	95,410
	Tons.	Tons.		
Silver Lead and Silver Lead Ore ...	81,545	131,038	1,899,197	2,667,144
Antimony and Antimony Ore ...	221	1,026	3,344	20,240
Copper and Copper Regulus ...	4,182	3,745	206,641	173,311
Tin and Tin Ore	4,650	3,668	415,171	329,841
Coal	3,655,632	3,060,876	1,632,848	1,279,088
Coke	...	31,097	...	41,147
Shale	40,561	56,010	77,666	104,103
Limestone Flux	...	41,436	...	41,989
Alum	...	220	...	3,000
Manganese	...	100	...	325
		lbs.		
Opals	...	195	...	15,600

"The value of the above enumerated metals and minerals, produced in New South Wales in 1890, amounts to no less than £5,231,482, an increase of nearly half a million sterling over 1889. A comparison of the returns for 1890 with the previous year, shows an increase of 8,000 ounces in Gold; while the produce of Silver Bullion, Silver Lead Bullion and Silver Lead Ore amounted together to no less than £2,762,554, being nearly £800,000 more than the output of 1889, and nearly 2½ times as much as that of 1888. The increase has been most remarkable, and shows the wonderful development of this industry during the last few years, fully confirming the anticipation of Mr. C. S. Wilkinson, Government Geolologist, as foreshadowed in his report to the Minister for Mines in 1884. As is well known, the Broken Hill Proprietary Company is the chief producer. From May, 1886, to 30th November, 1890, this Company has produced out of 483,078 tons of ore treated, 84,127 tons of Silver Lead Bullion, containing 20,594,272 ounces of fine Silver and 83,413 tons of Lead. The production of Antimony and Antimony Ore has also increased during last year by about £17,000 in value.

"A special feature in last year's production is to be noticed in the last item of the above list, viz.—195lbs. Opals, valued at £15,600; they are found at Whitecliffs, Momba Station, about 57 miles from Wilcannia. The principal reductions in last year's output are 1,000 tons less of Tin and Tin Ore to the value of about £85,000, and of Coal a diminished production of no less than about 600,000 tons of a value of £353,000. Deducting therefrom £41,147 as the value of Coke produced in 1890, we have a nett deficiency in the value of Coal produced in 1890, as compared with 1889, of about £312,000—the direct result of last year's lamentable strike.

"The amount of New South Wales Gold received at the Mint in 1890 was 119,564 ounces, against an average of 110,650 ounces during the previous ten years. The Gold from this colony, however, is only 14·86 per cent. of the total amount received by the Mint in 1890 (804,123 ounces), while Queensland contributed 619,367 ounces, or, a little over 77 per cent., of which Mount Morgan furnished 227,053 ounces, Charters Towers and other Queensland Goldfields 392,314 ounces.

"No Iron was produced during last year from Colonial Ores. A great impetus to the Colonial Iron Industry will, no doubt, be given by the fact that the Government have invited tenders (to be received up to 24th June next) for the supply of 175,000 tons of steel rails, to be entirely manufactured in this colony out of colonial ores; fluxes, fuel and other materials required for their production to be also raised in this colony. From a report of Mr. C. S. Wilkinson, F.G.S., the Government Geologist, to the Minister of Mines, dated 30th January last, it would appear that the quantity of Iron Ore available in this colony, so far as can at present be ascertained, amounts to 12,944,000 tons, estimated to contain 5,853,180 tons of metallic Iron. This quantity, calculated upon the present imports of Iron and Iron manufactures, would be sufficient to supply the demands of this colony for a period of 35 years."

Sydney, 3rd June, 1891.—Professor W. A. Dixon, F.C.S., Vice-President, in the chair.

New members.—Messrs. E. A. Amphlett, E. M. De Burgh, R. D. Fitzgerald, T. Haughton, R. E. Jones, and T. Poole.

Paper (1) "Notes on the large Death-rate among Australian Sheep in Counties infected with Cumberland Disease," by Mons. A. Loir. The author said that the death-rate in New South Wales through Cumberland disease had been placed at 200,000 sheep a year, but this number was very much under the reality. The death-rate in infected animals ranged from 25 to 40 per cent. In France the death-rate through the same disease was, prior to the introduction of the anthrax vaccination, only 10 or 12 per cent., and now it was considerably less. This difference could be accounted for as follows:—By comparative experiments it was easy to prove that the microbe had the same virulence in Australia as in Europe. It was, therefore, necessary to look for some other cause for the higher percentage in Australia. Not only was the dangerous season much longer here than in Europe, but the conditions under which sheep were kept in Australia were very favourable to exhaustion, and it was known by experiments recently made in Paris, as well as in Australia, that exhaustion favoured the development of the infection by anthrax as it did for many other diseases. A third cause which could easily be avoided by pastoralists, if the importance of it were well understood, was the following:—In Australia, when an animal died, its carcase remained on the same spot, and was torn to pieces by birds of prey, which spread the disease. This gross carelessness had been continued for many years past, so that the soil was literally saturated with microbes of infection. If stockowners properly understood how dangerous it was to leave undestroyed the bodies of the dead animals, they would, doubtless, devise some simple expedient for burning the remains without incurring the risk of bush fires. It was regarded as certain that as soon as vaccination became generally adopted the number of cases of "Cumberland disease" would diminish year by year, as was the case in those countries in which this valuable means of prevention was the custom. If the process of burning the bodies were adopted, the actual causes of contagion for men and animals would be diminished, and this remark applied not only to "Cumberland disease," but generally to all contagious diseases of stock. In view of the great impetus recently given to the meat export trade, it was most desirable that every possible precaution should be adopted in order to prevent European bacteriologists from finding in meat imported from Australia microbes or remains of microbes in large quantities. Stockowners would do well to bear in mind the fact that the import of hogflesh from America had been interdicted by many countries in Europe for several years past.

Mr. Charles Moore expressed his sense of the value of the paper. He was quite sure that Mons. Loir was right in his conclusions. It was no use burying the dead animals; they must be burned to prevent infection.

Professor Anderson Stuart considered that the thanks of the pastoralists were due to the author of the paper, and thought that the suggestion of Mons. Loir, that the pastoralists should take precautions to prevent the export of any infected carcases, was an excellent one. If any of the microbes were found in Europe in meat received from Australia the fact would be sure to be made the most of by interested parties, and it would prove to be the death-knell to the trade.

Dr. MacLaurin pointed out that the law already provided for the dealing with persons who sold diseased meat. He fancied that exporters would see that it would be not only wicked but foolish to send such meat to market. If they exported it they did so in contravention of the law.

2. Professor Anderson Stuart exhibited an apparatus for the demonstration of sound waves or waves of condensation and reflection. The instrument, to which he had not yet given a name, showed the movements of pellets of ivory, which represented particles of air as they oscillated to and fro. The first idea which led him to construct the apparatus was obtained from the oscillation of the legs of the centipede, which moved in a double wave—as seen from above, in waves of condensation and rarefaction; as seen from the side, in vertical waves. The instrument was described as accurately representing the to-and-fro movement of the particles of air. The sound wave, as it were, could therefore be seen progressing from one end of the instrument to the other.

3. Professor Dixon demonstrated to members the working of Lovebond's tintometer, which is specially useful in examining malt, flour, sugar, beers, and wines. Its purpose is to "dissect" the colours of the objects examined, and to determine what their value is.

ROYAL SOCIETY OF VICTORIA.

Melbourne, June 11th, 1891.—E. J. White, Esq , in the chair.

Mr. E. F. J. Love read the report of the Gravity Survey Committee appointed in November last. The committee had, in accordance with instructions, carefully considered the proposal to carry out a gravity survey of Australasia by means of pendulum observations, and had decided to recommend that the Society should proceed with the observations. The Committee had ascertained that the Royal Society of London would lend for the purposes of the Society the pendulum apparatus employed for a similar purpose at the great trigonometrical survey of India, provided that the Royal Society of Victoria undertook to defray the expenses connected with the packing and despatch of the apparatus. The Committee looked upon the generous offer of the Royal Society of London as a matter of extreme importance, as its acceptance would not only render the construction of fresh apparatus unnecessary, but would make the observations taken in Australasia directly comparable with those made by the Indian survey, also at Greenwich and Kew, bases of the various European gravity surveys. The Committee had further ascertained that Mr. H. W. Russell, Government astronomer for New South Wales, Mr. C. Todd, Government astronomer for South Australia, and Mr. W. H. Bragg, Professor of Physics at the Adelaide University, would be willing to co-operate in the work and serve on the committee appointed to carry it out, and the Committee was of opinion that the assistance rendered by these gentlemen would be of great value. Material assistance had also been promised by Sir John Forrest, Premier of Western Australia. The Committee therefore respectfully asked for re-appointment, with the addition of Messrs. Russell and Todd, and Professor Bragg, with power to arrange for the carrying out of the survey at as many stations as might be found practicable, and further, that a grant of £25 be placed at the disposal of the Committee for the defrayal of current expenses, including the cost of the package and transport of the pendulum apparatus.

On the motion of Professor Baldwin Spencer the report wes adopted.

Papers.—(1) "On the anatomy of *Ceratella fusca*, Gray," by Professor Baldwin Spencer.

(2) "Additional observations on the Victorian Land-Planarians," by Dr. Arthur Dendy.

(3) "On a new species of fresh-water fish, from Lake Mgothoruk, Mount Wellington, Victoria," by A. H. S. Lucas.

(4) "On Land-Planarians from Lord Howe Island, Part I., Description of New Species," by Professor Baldwin Spencer.

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THE NEW ZEALAND JOURNAL OF SCIENCE

DEVOTED TO THE FURTHERANCE OF PURE AND APPLIED SCIENCE THROUGHOUT THE COLONY.

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Dede manus: aut si falsum est, adcingere contra.

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ON THE OCCURRENCE OF MOA AND OTHER REMAINS AT ALBURY.

In Vol. II., page 293 of this Journal, I recorded the finding of numerous Moa and other remains in the caves and swallow-holes of the limestone rocks at Albury. Since I left the district in 1883 considerable changes have been wrought, changes which, from a naturalist's point of view, are not always welcome. The extensive swamps have been drained, the magnificent limestone range has been ploughed, and during the progress of the work many facts which may serve to enlighten us a little on the theories of the ancient or modern extinction of the Moas have come to light. As the opinions of scientists are still about equally divided on this question, the following observations made while digging up and collecting the bones of Moas and other extinct birds in the district, will, I think, show the great antiquity of the birds, as well as tend to prove that they existed there even in comparatively recent times.

By direction of Sir Walter Buller, F.R.S., I lately proceeded to Albury to explore the caves and swallow-holes in the locality, and to collect all bones, &c., as above-mentioned. After engaging a man to assist in the work, we began on a swallow-hole that I had not previously examined. The "holes" I may observe are deep circular pits varying in size from a few feet to eighty or ninety feet in diameter at the top, and about the same in depth; most of them have steep, sloping sides narrowing down to the bottom. In wet weather the rain falling on their sides, and the small streams entering them from the higher points of the range, enter subterranean channels having their outlet in the low gullies, or on the edges of the swamps at the base of the lower downs. The occurrence of great quantities of mixed bones in the bottoms of the swallow-holes, and in the channels or fissures leading from them, suggests that the birds probably fell into them accidentally, and being unable to extricate themselves died in the holes. The bones, owing to the subsequent accumulation of broken rock and clay on the bottoms, are embedded at various depths, while others were carried by the water down the underground channels beyond recovery. The first hole we examined had a perpendicular opening of seven feet, and led into a horizontal cave thirty yards long. In the centre of it, and extending its whole length is a broad fissure of great depth, with jagged almost perpendicular walls. After tying knots on the rope about four feet apart and fixing it to a crowbar driven into the ground on the top of the hole, we put down the tools and lowered ourselves. Having dug through about eighteen inches of earthy clay containing pigs' bones we had to dig three feet deeper before finding any bones of the moa. In order to avoid injuring them with the tools we carefully probed the clay with a fine iron rod to ascertain where they lay. By this means we were able to proceed more expeditiously and with safety. The colour of the clay is yellow and intensely adhesive, it is somewhat difficult to work tools in it, and and although the work is not all rose pink and lavender, the hope of good reward in the form of bones keeps the spirits buoyant. In working down the fissures they become narrower, and frequently the larger bones are found tightly jammed into their narrow bottoms. In all the fissures we worked we found a water channel formed along the bottom through which a considerable stream of water must occasionally flow, and owing to the long continuance of dry weather very little water was in any of the channels. One remarkable feature about them is the occurrence in parts of their bottoms of thousands of small bones mixed together in wet mud and sand (partially dissolved limestone). In some places we found them from six inches to a foot deep, and they appear to me to be composed chiefly of the bones of chicks of several species of Moa and Aptornis. Amongst them we found two skulls of *Stringops habroptilus* (Owl Parrot). Along with these are some that will in all probability prove to belong to the ancient dog, the companion of the moa hunters. We also found chips of moa egg shells, gizzard-stones, and portions of moa skin, with remains of other species of birds still living in some localities, but extinct in the Albury district. For obvious reasons, I must, however, avoid dealing with their specific characters. The first fissure unfortunately becoming too narrow to admit of working it thoroughly, we had reluctantly to leave it, although we were fully aware that numerous valuable bones lay buried for ever beneath our feet.

Our next essay was in the deep hole mentioned in my paper in Vol. II., page 293, and from which came the *Aptornis* skull described by Sir Richard Owen, and supposed by the accomplished naturalist to belong to a new species.* From the same hole were taken along with the *Aptornis* skull some of the largest and best preserved bones of *Dirnornis elephantopus* and *crassus* yet obtained. The bones buried in the damp fissures are cleaner and whiter than bones dug out of swamps, the latter being generally charged with the black or other colouring matter of the clay or mud in which they occur. In entering the hole I observed that slight changes had occurred since I last examined it seven years ago. On each side a broad fissure filled with clay and broken limestone exists. In these fissures the bones are embedded at various depths in intensely tenacious clay. Since I last visited it a considerable quantity of the clay had fallen out of the fissures on to the bottom and left several bones projecting out of the almost upright section of clay and small stones. After turning over and collecting all bones contained in the fallen debris, we built as much of it as possible into one corner, and then dug down close to the wall of rock in line with the fissure until we reached the water channel on its bottom. But the extremely narrow space in which we were placed made it impossible for us to examine the full depth of clay in the hole; it could only be done perfectly by constructing a staging across the top of it, and using a windlass to draw the whole of the clay to the surface. On reaching the water channel we again met with a vast number of small, mixed bones lying in the wet, sandy mud. We followed the channel away from the hole for several yards and obtained some excellent bones, but were stopped in our progress by the fissure again becoming too narrow to work in. We threw back the clay into the closed fissures and tried

* Introduction to Sir Walter Buller's "History of the Birds of New Zealand," p. xxiii.

in the opposite direction. But we were soon compelled to abandon the work in this hole owing to the impossibility of disposing of the removed clay. Having several times previously dug out many valuable bones from this hole, I am the more convinced that a great wealth of osseous relics lies buried at various depths in the accumulated mass of clay and stones partly filling it,—a veritable charnel-house of moa and other remains, awaiting the enterprise of some future explorer.

While removing our tools to another swallow-hole heavy rain commenced to fall and continued for two days, which prevented us in the meantime continuing the work. We however resorted to the dry caves and painted rock shelters to examine their floors and sketch the numerous grotesque figures adorning the walls. On the Brothers Range between the Tengawai and Opihi rivers and in the valley of the Opihi there are a number of painted rocks and caves which have not been examined or recorded. As soon as I can spare the time I intend to visit the district to examine and report on them, which I hope to be be able to figure and describe in a paper to be read before the New Zealand Institute. Archæologically they are of great interest and value, and everywhere that they exist they are rapidly disappearing. The careful digging of all the floors yielded very poor results, for excepting numerous fragments of burned egg-shells and charred pieces of moa bones, we obtained nothing of value. A number of Pipi (*Mesodesma Novæ-Zealandiæ*) and Pawa shells (*Haliotis iris*) were dug out of the layer of ashes that partly covered the floors. Parts of the rock shelters have a smoked and blackened appearance with a thick layer of ashes lying immediately beneath, thus showing that fires were kindled under the rocks and in the caves, probably on frosty nights or during wet weather. When the rain ceased we examined a number of old Maori ovens and the ash heaps around them that had been newly exposed only a few days before by the first ploughing of the land. They are situated on the low flat near the gorge of the Tengawai river, and near the painted rocks. A thorough examination of the ovens and ash heaps yielded even less than the floors of the caves or rock shelters. But there were evidences of the ash heaps having been formed at intervals of several years; at least we judged so by examining them in section. The greatest depth of the ash (which is composed chiefly of comminuted bone,) was fourteen inches. The section in one instance showed two layers of fine earth $2\frac{1}{2}$ inches in thickness interlayered with black ash 3 or $3\frac{1}{2}$ inches respectively, due, of course, to the action of earthworms. We expected to be rewarded for the day's work by finding some rude or polished stone implements, but none were obtained. The weather continuing fine we devoted a day to traversing the whole of the newly ploughed downs and collecting the upturned bones lying in the furrows; wherever we found them we dug the ground carefully around for several yards and obtained some good bones and in one instance some gizzard-stones. But at no time did we obtain a perfect skeleton. Next morning we searched the bed and banks of the creek draining the eastern side of the limestone range,—where in former years I occasionally obtained good bones after floods. In passing along we discovered a native oven brimful of mussels. The plough had lately skinned off the five inches of soil covering the oven and left the shells exposed. After being placed in the oven they were apparently never cooked, as each valve was closed and the shells full of extremely fine earth. Before mid-day we resumed work at the swallow-holes and continued at them for several days with varying success. But I need not recount our work for the time, as the account given of the first two holes we worked will suffice to give a good idea of the others we examined.

The two main theories propounded to account for the extinction of the *Dinornithidæ*, the one holding forth that the moas were exterminated by an autocthonic race anterior to the advent of the Maori, the other that their extermination was solely the work of the latter race, may be briefly discussed here. The evidence given while exploring the swallow-holes, caves, and Maori ovens in the Albury district, seems to me to be more consistent with the views of scientists who hold that their extermination was accomplished, or at least accelerated by the hand of man, within the last three or four generations, certainly in late years. Several minor and extremely ingenious theories have been offered to explain the annihilation of the moas; some are purely fanciful, others appear to me to be nearer to the truth, yet wide of the true cause. Of course I admit that the examination of a certain district may favour one theory and in another it may oppose it, yet the facts I am able to adduce will go to show that the moas—although they were birds of great antiquity, lived in the Albury district within very recent times. It is generally maintained that the larger and more clumsy species of the race were the first to succumb, and in many districts such probably was the case. At Albury, however, the larger bones are as commonly ploughed up on the downs, as those belonging to smaller or intermediate-sized birds. They are buried no deeper, as the ploughs are set to turn over only a certain depth of furrows. I have seen other great bones of *D. elephantopus* that were ploughed up on the tops of the limestone Downs near the cave village in a perfect state of preservation. The greater size and maturity of the bones would preserve them from decaying in the soil for a longer period than the bones of young or immature birds. When digging up the bones in the newly-ploughed furrows we observed that in every instance we only obtained parts of the skeleton; this would appear to indicate that the birds were slain where they lay, and that parts of the carcase had been removed. If the birds had died a natural death where their remains were found, some allowance may be made for hawks, seagulls, and wekas attacking the flesh, and scattering the finer bones. But I know of no carnivorous bird or animal (excepting perhaps the *Harpagornis*) having strength to remove the heavy femurs or tarsi of a large bird. Supposing the extinct eagle to be endowed with the power, I think it is probable that owing to the great numbers of living prey it would not be a carrion feeder. But the fact of portions only of the skeletons being found in the open country, not only at Albury but elsewhere, seems to favour the idea that they were slain on the spot and cut up, and parts of them removed by their destroyers. The day we searched the newly-ploughed land, one of the ploughmen informed me that a few weeks before, while ploughing a small gully, the plough had suddenly turned over a "heap of different kinds of bones," and that he had collected them in a sack, and carried them into the homestead. Before leaving the district I had the pleasure of examining them and found they were composed of leg bones only, including several toe bones and claws, belonging to birds of various sizes. Possibly a thorough search of the spot where they lay would have resulted in finding all the bones belonging to each leg. The case, however, seems to afford support to the theory that when the birds were slain parts of them only were occasionally removed. It certainly is difficult to conceive how the leg bones of several-sized birds could be placed there by other than human agency. The great accumulation of burnt eggshells found in the kitchen middens of the moa hunters points to another potent cause, in fact, the chief one, operating steadily and annually as the destroyer of the moas. The fiercest and swiftest species could be exterminated in a few years by annually robbing their nests, and certainly the cunning of the Maori would be equal to the occasion in all cases. The fragments of eggshells we found in the ash heaps varied considerably in thickness, and in the granular markings on their surface, and the freshest chips occurred in the top layer of ashes.

Now, in drawing conclusions from the evidence afforded by examining the ash mounds, their layered condition suggests that towards the close of the moa age, the tribes by whom they were formed were nomadic in habits, and wandered from the district for periods of several years; other evidence which seems to me to support these remarks is the fact of many of the rocks having been painted over and over again, while the fresher figures are truer and were given a higher finish. This may be considered to have no bearing on the question, yet I think that the nomadic tribes who were probably compelled to live and subsist on the sea coast during part of the year would acquire a taste for sketching them on the rocks when they returned to gather the eggs or hunt the moas; certainly the best executed figures on the rocks at Albury are those representing several species of fish. The occurrence also of marine shells in the floors of the rock-shelters and ash heaps near the old ovens, offers further proof of the moa hunters having occasionally visited, or lived temporarily, on the seashore.

The great age of the bones occurring in the deep, damp fissures at Albury, furnishes an important proof of the remote antiquity of the moas. The peculiar conditions under which they are found have been exceptionally favourable to their long and perfect preservation, while the occurrence of their remains in the tertiary and more recent deposits, and in the surface mould on the downs, illustrates the gradual extinction of the birds for many ages from some not very clearly known cause. The extremely hard and solid structure of the matured bones would naturally resist the solvents of the soil for a longer period than the bones of other animals, but it is difficult to reconcile the fact of the more delicate bones being fonnd sound and perfect in superficial mould with the theory that the birds had perished where they lay four thousand years ago. The subject, however, has been so exhaustively dealt with by Sir Walter Buller, and the whole of the evidence and views of both sides compiled and brought down to date in perfect order, (*loc. cit.* page xviii.), that I refrain from discussing it here. When I have examined the caves, rock shelters, etc., in the Opihi cave districts, I will be able to deal with the subject more fully and to give details of the work.

So far I have not touched on the origin of the bones in the deep fissures, nor am I aware that the subject has hitherto been dealt with, yet it is worthy of a passing notice. The fissures or earthquake rents in the limestone were formed at some remote period when numerous species of moas flourished in the district. Many of the fissures in which the bones are found are several yards broad at their tops, and are now filled up and are not distinguishable except in such parts where they can be seen in section. For ages after their formation, the stupid, clumsy birds, browsing or wandering near them, appear to have accidentally fallen in and perished. This mode of destruction lasted for a considerable time, or at least until the fissures filled up sufficiently to enable the birds falling to walk along the bottom and escape at some sloping outlet. These remarks are based on observations made in the fissures ten years ago, and in others lately, as the invariable result on both occasions, was the finding of the bones, etc., in the lowest ten feet of the clay filling the fissures. The latter extend in all directions on the range, and doubtless may continue to increase slowly in depth, caused by the water channels flowing along their bottoms and the rain water dissolving the rock.

When the future historian of the moa age in New Zealand is dealing with the oldest preserved relics, or the remains of that giant race of birds, he may safely commence his work on the latter with the remnants found in these ancient fissures. When all other districts have been carefully explored we may then be able to discover some cause to account for the extermination of the moas. Until such work is accomplished we must remain content with data we possess. Certainly no zoological subject can surpass in interest the history of these marvellous ornithic relics of bygone ages.

W. W. Smith.

NOTES ON THE KEA OR MOUNTAIN PARROT *(NESTOR NOTABILIS).*

These few notes on the habits and peculiarities of the Kea are made up from information which I have gathered during a period of twenty years spent in localities where the birds were in great numbers —chiefly at the head of Lake Wanaka, at Lake Wakatipu, and at Mount Cook. I have shot and trapped thousands of them, watched them by day and night, and taken advantage of every opportunity of learning anything new pertaining to them. My chief object in writing these notes is to refute what I consider to be a totally erroneous idea which seems to have gained credence, and which, for brevity's sake, I will call the "kidney theory." Further than this, a few facts have come under my observation, which I have never seen mentioned as relating to these birds.

The theory above mentioned was started by Mr. Henry Campbell of Lake Wanaka station. Not having the leisure to go fully into this matter, I will refer my readers to what Mr. Potts has written on the subject (Buller's History of New Zealand Birds, page 54, first edition, and also included in the second edition). I will confine myself simply to correcting and straightening up false impressions that have got abroad, notably one in a book which is now lying before me called "Darwinism," by Alfred Russel Wallace, and which has constantly been referred to in papers here and abroad.

I first went to the Makarora Valley, at the head of Lake Wanaka, in December, 1869, and there met Mr. Henry Campbell, who had a station adjoining ours. I was very anxious to get a Kea, as it was then a new bird to me, and I had never, up to that time, either seen or heard one. I learnt from an old Maori the art of calling and trapping them, and to Mr. Campbell I am indebted for a great deal of information concerning their habits. On visiting Lake Wanaka a year later, this gentleman informed me that these birds had taken to killing and eating his sheep, their plan of operation consisting of picking a hole in the sheep's back *over* the kidneys. Acting on this information, I decided to spend all the time I could spare in endeavouring to find out the reason of their taking up these carnivorous habits.

The following statement by Wallace is generally believed to be a correct description of the bird, viz.:—"It belongs to the family of "brush-tongued parrots, and *naturally* feeds on *the honey of flowers and "the insects which frequent them*, together with such fruits or berries "as are found in the region. *Till quite recently this composed its whole "diet*, but since the country it inhabits has been occupied by Euro-"peans, it has developed a taste for a carnivorous diet with alarming "results. It began by picking the sheepskins hung out to dry, or "the meat in the process of *being cured*. About 1868 (? 1870) it was "first observed to attack living sheep, which had frequently been "found with raw and bleeding wounds on their backs. Since then it "is stated that the bird actually burrows into the living sheep, eating "its way down to the kidneys, *which form* its special delicacy."

A correct description of the Kea will be found in "New Zealand Birds." The young bird, the first year, is very yellow at the base of the mandibles. The beak of the Kea is longer and not so curved as that of the Kaka (*Nestor meridionalis*). The Kaka feeds chiefly on the honey of flowers, and, in winter-time, on the grubs in rotten wood; I have never seen the Kea take to either of these diets. Its beak is more suitable for grubbing after the larvæ of the different insects that are found in the ground,—such as the grub of the Weta of the Natives (*Deinacrida*) and of the *Cicada*, of which there are large numbers in the high country of Canterbury and Otago, although they disappear as the country is burnt by the runholder, who not only kills the insects by so doing, but also destroys all the berry-bearing scrub. This process of course improves greatly the sheep-carrying capacity of the soil, but, at the same time, it deprives the Kea of all its natural food, thereby causing the bird to take to a carnivorous diet. They do no harm to the sheep running in the vicinity of Mount Cook, but further down, where the country is denuded of its scrub, they have proved very destructive. They seem to learn the pernicious habit from their neighbours, as I noticed at the Wanaka that, for a time, they left one run strictly alone, while on the adjoining run in six months they killed 100 hoggets out of 1,500.

I have watched the bird at work. To get at the grubs, it will cock its head on one side, look hard at the ground, and then make a dab at it, bringing bits of earth away each time with the hook of its beak, until it gets a short way in. It does not keep its head under ground for any length of time, although it will make a burrow eight or nine inches deep; but, all the time it is at work, it keeps bringing its heed out sharply to take a look around.

Besides grubs, they feed on the berries of various alpine shrubs and trees, such as the snow berry (*Gaultheria*), *Coprosma, Panax,* the little black seed in a white skin of the *Phyllocladus alpinus,* the *Pittosporum* with its hard seed in a glutinous mass like bird-lime, and the red berry of the *Podocarpus*; also, in winter, on roots of the various herbaceous alpine plants—*Aciphylla squarrosa* and *colensoi, Ranunculus lyallii, Celmisias,* etc.

The Kea has the power of moving its upper mandible to a greater extent than I have noticed in any other of the *Nestor* family.

The reason, I believe, that the bird has been charged with eating the kidney of the sheep it attacks, is that the loin or rump of the sheep is the broadest part whereon it can get an easy grip. As soon as the sheep feels its assailant, it runs away with the bird holding on and naturally having its beak just over the kidneys where it immediately sets to work. It will eat any part of the sheep when the animal is either dead or alive, but it prefers the pulp which it strips from the sinews, in the same way that the kakapo strips the pulp from grass. I have found large numbers of sheep with only a very small hole on the back, about the size of a crown, which on being examined, showed a cavity beneath as large as a man's hand, in which the backbone and ribs were perfectly bare. Others I have found with holes in the side through which the intestines had been drawn, the sheep being still alive; and, in some instances, the wound had healed and apparently formed a false anus.

They become very tame if not disturbed, and their antics are very amusing to watch. At Mount Cook my old collie dog was frequently the victim of their pleasantries. In the evening—their usual time to congregate—they would find the dog lying in front of the house; they would then walk around him, first one would go up and pull his tail and run away, another would follow suit, and so on until the victim would get up growling and retire into the verandah.

They would then form a circle, and one would step into the centre and make a variety of sounds as if he were addressing the others, who would keep perfectly still until he finished up with a cry like "bow-wow," when they would all hop round him. They seem to be a very unselfish lot of fellows, as they will keep this performance up for a considerable time, allowing each member to address the assembly.

They are very playful and inquisitive, and will wrestle and roll one another about like kittens. In fact they carry their playfulness to such an extreme as to become a nuisance to surveyors, whose flags they pull down as soon as the surveyors put them up. Another instance of their playfulness came under my notice, during the last season, at the hut erected by the Government on the Ball Glacier. The birds would perch on the top of the roof, and, two or three at a time, would slide on their tails down the corrugated iron until they reached the lower edge, when they would fly off and continue the game for an hour or more.

I am unable to give a correct estimate of the number killed in the Mount Cook—Lake Wakatipu districts. The slaughter of them at times has been very great; at Lake Wanaka, in four years, I myself killed over three thousand; and I know of several up-country stations where 100 to 200 were killed yearly. To reduce their numbers, the County Councils used to give from one to two shillings per beak, and the Government then gave the Councils a subsidy of £ for £. This has now been discontinued, which has resulted in the birds not being as much sought after, and so given a chance of increase—a chance of which they will not be loth to take advantage. About Mount Cook they breed very early in the year, as I have found their nests in August, when snow was on the ground.

The first time that I saw the nests at that time of the year was when I was shooting, at an altitude of 3,000 feet. I shot a bird that was sitting on a rock; after it fell, another appeared on the rock, and from the same place I shot twenty-two. I went to pick up the dead birds, and I then found that they had, in the first place, all come out of a hole under the rock. On looking into the hole I saw something moving, which eventually turned out to be young birds.

They were out of reach, but after some trouble I managed to noose one, and I found that it was in its nesting plumage of slate-coloured down, with very yellow beak and legs. There were others in different stages of growth, also eggs. I have since found other nests, and have noticed that, after a time, the old birds leave the half-grown ones to hatch out the late eggs, all the community doing their share of feeding the young. The same habit I have noticed in the case of the native parroquet. The Kea's egg is white and about the size of a pigeon's, but rounder and with a rough shell. The young do not come out of the nest until fully fledged and able to fly. The old birds are very courageous, and in defence of their young I have seen the parent birds tackle a hawk, and nearly pluck him before he could get away. The young birds are so tame that if a person comes across a flock of them and keeps perfectly still, they will walk up to him and pull at his clothes. They will learn to talk but are rather noisy.

It is very pleasing to watch these birds as they congregate after the sun sets, and if a person can "call" them they will answer with their usual response of "Ke-ā! Ke-ā! Bow-wow! Bow-wow!"

Like many of our native birds, the Kea will gradually retreat before the march of civilisation, and they will live only in such works as Buller's "History of New Zealand Birds," and others of the same nature.

F. F. C. Huddleston.

AN EXCURSION TO THE TRELISSIC BASIN.

While the wholesome taste for mountain touring which has arisen in the colony in the last few years impels our town folk to visit Mount Cook, Lake Wakatipu, and other centres, our travelling public has not yet learned to value the bye paths which add so much interest to such travelling. Some time before the Hermitage was built I camped with a party including Mr. Huddlestone at the foot of a spur in the Ben Ohou range where now Glentanner station stands. Having a spare day I ascended to the summit of the mountain at the back of the station, and probably got better results than could be obtained nearer Mount Cook at the altitude which I reached, viz., 8,600 feet. I cannot too strongly recommend this comparatively easy day's work—10 hours suffice—to anyone who wishes to study the whole system of Mount Cook and the peaks to right and left and the three great glaciers. Yet this mountain is entirely neglected. I have never yet managed to induce anybody to go and visit a view equal to that from the Görner Grat. Experimenting in a similar way I found another lying much nearer to hand though perhaps not equal to that. In January last after the visit of the Australasian Association was over, I accepted the hospitality of Mr. J. D. Enys, of Castle Hill, for a few days. My wife accompanied me, and we found there Mr. Kirk on a botanising excursion. Castle hill is on the West Coast road, 20 miles from Springfield. It is not on the line of the Midland Railway, but it is the best piece of land in the valley of the Upper Waimakariri. Mr. Enys' house, now owned by Mr. Stronach, is 2,500 feet above the sea, and is beautifully situated in a clump of Mountain Beech (*Fagus cliffortioides*) which extends over some thousands of acres along the face of the range. It commands a full view of Mount Torlesse, a famous collecting ground for botanists. The district is an enclosed basin with no outlet under 3,000 feet in height, save the gorge of the Wamakariri. The floor of the basin is composed of limestone. I am not geologist enough to tell its history, but it looks as if it had been a kind of land-locked bay, with a narrow entrance from an ancient coast sea. Marvellous collections of fossil teeth have been made there, and Mr. Enys showed me a remarkable little bone which we were convinced was the top of a bird's bone,—this, too, out of the limestone. Our first excursion was through the beautiful beech forest in which we noted from time to time the gorgeous crimson mistletoe, and up the stony creek bed to a height of 4,100 feet to the first of the Edelweiss. This for a lady is a good climb. Next day I went with Mr. Rogers, a nephew of my host, to the height of 6,900 feet. The way up this height is simple; it is to follow the spur opposite the door of the Castle Hill Hotel until the summit is reached. It was a broiling day and I shall not easily forget our struggles over the broken slates to reach a small patch of snow near the top. But the view from the top is really magnificent. Mount Cook, about 90 miles off, stood out splendidly with its chief neighbours in bold relief. This is one of the points from which it is seldom seen and it gives a new view of the extension northward of the range. Two bold mountains much nearer flanked the view; I suppose Mount Arrowsmith and

Mount Sinclair. The whole line of the great backbone of New Zealand for 150 miles was visible at once, while by merely turning round one could see the coast from Cheviot to Timaru say 120 miles in a sweep. The summit of Torlesse made a patch over Christchurch, but Sumner was plainly visible. Lake Coleridge lay like an emerald below us and two or three small lakes were visible. On the distant Canterbury plains, farms, roads and plantations could be distinguished. Returning, we descended over the vast slides of shingle by planting one foot in it and taking giant strides covering 2,000 feet in a few minutes. Attempting to quench an intolerable thirst we found nearly all the streams so bitter with alum as to be nauseous. We found a large number of interesting plants. On the vast stretches of shingle we noticed the singular genera which seem to enjoy life in that inhospitable region, while on the lower slopes an immense profusion of Celmisias and other alpine composites prevailed. *Celmisia viscosa* predominated, while *C. sinclairii*, *C. haastii*, *C. laricifolia*, *C. bellidioides*, *C. lyallii*, and a small form of the species or variety now called *C. jervoisii* were identified. At 4,500 feet *C. bellidioides* is a singularly beautiful plant when in flower, but it degenerates at lower levels. *Senecio lyallii*, usually yellow as a buttercup, was found to be cream-coloured above a certain height. Ascending a stream in a rocky bed I presently found it white,—a few yards higher I found a very similar plant with pure white flowers but with rough hairy instead of glabrous leaves. This was the variety or species called *Senecio scorzonerioides*.

A very interesting *Raoulia* or vegetable sheep was very plentiful on steep rocky places, but I believe a finer species is found on Mount Torlesse. I am growing one of these in a pot where it seems to do well. Several which I planted on a rockery have been torn to pieces for insects. It is said that the Keas tear them up with their powerful beaks and that these birds learnt to eat mutton through mistaking dead sheep for masses of *Raoulia*.

F. R. CHAPMAN.

THE GEYSERS ACTION OF ROTORUA.

BY CAMILLE MALFROY, C.E., J.P., CHEVALIER DE LA LEGION D'HONNEUR.

(Paper read before the Auckland Institute, 22nd June, 1891.)

Being appointed engineer in charge of the Government Thermal Spring District at Rotorua, immediately after the eruption of Tarawera in 1886, it became part of my duty to observe and report on any changes which might take place in the hot springs, geysers, &c. The eruption seemed to have had great influence over them. Many which had been quiescent and some which had been considered as dead (having in the course of time become filled with rubbish and overgrown with weeds and brushwood) suddenly burst into renewed activity, and almost daily during the first six weeks after the eruption I could observe some changes in thermal action—something new here and there.

The geysers immediately attracted my attention. Waikite geyser, at Whakarewarewa, which had been quiescent for about ten years, again burst into full activity, with eruptions about every quarter of an hour. Pohutu, Wairoa, and the other geysers were also playing occasionally, but were very irregular in their action. Sometimes weeks would elapse without one or the other of them showing any signs of activity, whilst at other times they would be active for several days in succession.

Not having had a long acquaintance with the district, I made inquiries of old residents (European and Maori) for any theory to account for the inequality in the thermal action of these springs and geysers. The generally received opinion was that these geysers were influenced by the wind—with southerly winds they were quiescent, and with northerly they were active. As I could not well understand how the wind could affect geysers or springs situated in sheltered positions, I began a system of personal observation, and soon found that southerly wind meant high barometer and northerly a low one; and if I could not understand the wind theory, I could understand the hydrostatic effect and the influence of atmospheric pressure, which was simply equivalent to a reduction in the column of water. Every spring and geyser being naturally hydrostatically balanced, the reduction by any means of the weight of the column of water should bring a corresponding increase in the activity of the spring. Acting upon this theory, I determined to experiment privately upon Te Puia, a thermal spring in a secluded spot near an old pa, on the right hand side, and well down in the bed of the Puarenga River, therefore less influenced by winds. It was at that time boiling, but not very actively. By means of a drain which I cut in the sand formation by the level of the river, I removed about two feet of the water of the pool which formed around the spring. This removal of two feet of dead water had an immediate effect on the spring; it began to boil furiously, and a few minutes afterwards burst into a geyser, throwing water from 30 to 40 feet high, discharging at the same time the whole of the dead water of the pool. I watched this eruption of what I thought a new geyser, for there was vegetable growth of several years' standing around it, with wonder and with a certain amount of anxiety, as I began to fear that I had started something which I could not control. However, after a few minutes, taking advantage of a decrease in the eruptive force, I ran to the drain I had made, and refilled it as quickly as possible, causing part of the water thrown up by the geyser to be again caught in the pool or basin. It soon accumulated, and after a while the geyser action ceased, and the water of the pool ran down the geyser's tube, together with a considerable quantity of water from the river, which had flowed back through the partially closed drain. In about ten minutes the tube was filled with cold water to the surface.

I watched it for a while, and saw the water getting hotter and hotter. Eventually it began to boil, but without any geyser action. After a time I again opened the drain, and almost immediately there was another splendid eruption similar to the former. I determined to to allow this to play and see what it would do, as I began to have some confidence in my ability to control it by the same process as before, if it was found necessary. It played for about twenty minutes, the geyser action getting weaker and weaker, and the cooled water in the pool getting stronger all the time. The water eventually got the best of it, and flowed down the geyser tube to repeat the same action as before. Having made the geyser play and cease playing several times, I re-closed the drain thoroughly and went away. I did not see it play again that day, and the following day about noon, when I went near, I found by the marks I had left that it had not been in eruption since I left it the night before. The water of the pool would boil up violently at times, but there was no eruption. I then again tried what the opening of the drain would do. The result was the same as on the previous day—a splendid eruption of the geyser. I again watched the action for three successive times, and eventually went away leaving the drain open, and from the volume of steam which went up periodically from that spot I could see that intermittent geyser action was taking place.

I repeated and watched these experiments on many occasions during the months of August and September, 1886. Once, the river being rather high, I turned the cold water from it on the geyser when in full eruption. This almost instantly stopped its action, but at the same time it caused a great noise, probably owing to the sudden condensation of steam within the geyser tube. After a while, however, the noise ceased, the pool filled up, and all was quiet; and as long as I allowed the cold water to flow across over the mouth of the geyser tube there was no eruption or even any perceptible action of the springs.

Having thus acquired some little practical knowledge of the working of this particular geyser, I began to compare it with that of others to see if any of them could be made to play at will. I then watched and studied the action of Pohutu, which is situated on the principal geyser fissure of Whakarewarewa. This fissure supplies no less than seven active geysers and blowholes, besides quite a number of old geyser tubes, which have been inactive for many years, though they still emit steam and make a rumbling noise, as of boiling water some considerable depth below the surface. They do not seem to affect or to be affected by the working or non-working of the active geysers.

Having noticed the great irregularity of action of the different geysers, I thought that it must to a great extent be attributed to outside or surface influence. I noticed that when Pohutu was in eruption Waikoroihi would stop, and *vice versa*. This showed that they were hydrostatically connected, and as long as Waikoroihi played, the water ejected, finding its way into the blue pool of Pohutu at a considerably reduced temperature (about 160° Fahr.), would so affect the cool water in the blue pool that it would not boil up whilst this lasted. As it did not cause the water to rise in that pool, I concluded that it might find its way back into Waikoroihi, and thus be thrown up again and again. I tested this by discolouring the water in the blue pool with loam, and found that, though the discolouration disappeared, the small bits of grass, moss, etc., were re-ejected by Waikoroihi.

Taking the opportunity of a visit of the Hon. Mr. Mitchelson, the late Minister of Public Works, to our district, I explained my views on these matters to him, with an imaginary sketch of the geyser tubes; Mr. Mitchelson took considerable interest in it, and allowed me to expend a few pounds experimenting thereupon. At the beginning of

September, 1888, I built a temporary wall directing the Waikoroihi water away from the "blue pool." This soon had the effect of raising the temperature of the blue pool from 200° to 210° Fahr. The water rose a few feet and began to boil furiously, then the pipe, which I call the "Indicator," became active, and as soon as this took place the water in the "blue pool" would cease boiling and go down again to the low water-line. I watched this same action for several hours, but unless the water of the blue pool rose to the level of the overflow drain there was no eruption of Pohutu. Seeing that this small indicator tube acted as a kind of safety valve I tried to close it up with bags, stones, etc., but failed, the steam and water finding its way through small fissures in the rocks. It then occurred to me to build a kind of dam around the "indicator" so as to collect the water ejected by it, and also lead some of the water from Waikoroihi into this dam, thus causing this cooled water to flow back down the indicator tube. This had the desired effect. The indicator stopped playing altogether as long as I could keep a small stream of cooled water running down it.

On the following day Waikoroihi stopped playing. The water of the blue pool rose to the level of the overflow drain, became more and more active, and on the 9th of September, two days after the works were finished, Pohutu gave a grand eruption, lasting nearly two hours, throwing large volumes of water from 60 to 80 feet high. This eruption was repeated in the evening, and from that date till December, 1889, it played regularly about twice in 24 hours. During this time, while I was acting as commissioner at the Paris Exhibition, there was no one on the spot to look after these special works. The consequence was that Pohutu again stopped playing regularly. On my return, in February, 1890, I was informed that Pohutu had not played or been in active eruption for the last nine weeks. I at once went over to see it, and finding that the works I had made had been tampered with, I had them put into temporary repair, with the result that Pohutu played up again a few hours after the work was finished, and its action has continued ever since, though not so regularly as before, but this is no doubt only due to the defective repairs of former walls, etc.

As a further illustration of what may be done in regulating the action of geysers, or even in creating or starting new ones, I may state that in the sanatorium grounds there are two hot springs with concrete basins around them, which were never known to have geyser action, though the formation of the surrounding rocks shows that they had been geysers at some remote period. These springs supply the hot swimming bath, but during the year 1889, they had gone so low, and were so much influenced by the atmospheric pressure, that sometimes they would remain for several days two or three inches below the level of the outflow pipe, thus discharging no water. This became a matter of great importance, as the bath which cost £1,000 threatened to become useless, owing to not being able to keep it at a proper and regular temperature.

It occurred to me that by contracting the springs proper into pipes, it would prevent the hot water from becoming cold, by admixture with the water in the basin, for I had noticed that when the springs were active, the temperature of the water in the basins would rise from

140deg. minimum to 180deg. maximum. I thought that this increased activity of the springs, when the water was hot, was owing to the difference in the specific gravity between hot and cold water which the spring tube or fissure might contain in its column, and that this difference might be sufficient to cause the water to rise a foot or two above present level according to the depth at which this influence (in the temperature of the water) would take place. I had some temporary works carried out to prove the correctness of this theory, and to my delight found that it was quite true, and that instead of a small rise of two feet, which would have been quite sufficient for our purpose, there was force enough in the springs under these altered circumstances to form geysers. Having further acquired the knowledge that the whole of the springs in the Oruawhata and Chameleon basins were hydrostatically connected, I arranged a system of pipes over the three principal springs, connecting each of them by secondary pipes to three valves by means of which either of the springs can be made to play as a geyser at will. To keep the springs quiet, low, and cool during the time the works were being carried out, cold water from the town main was injected into one of the three spring tubes, pumping it with an ejector out of another, whilst the work of cementing the geyser tube was going on in the third; and by shifting the injector and ejector pipe from one spring tube to the other I had the three geyser tubes firmly secured. These works were finished early in May, 1890; and the springs were thus kept quiescent for three weeks to allow the concrete to set properly, and eventually four days longer, so as to start them into action for the first time on the Queen's Birthday, at two p.m. A considerable number of people gathered to see this novel experiment. The new fountains were christened the "Malfroy's Group of Geysers," their distinctive names being the "Victoria," the "Nelly," and the "May." [The geyser action in different springs was then described, and it was shown how it could be induced.] From the experience thus gained I support the theory that the geyser tubes are connected with subterranean caverns or chambers, and that heat or superheated steam penetrating through fissures supplies the natural or motive force, and I conclude that the difference between the specific gravity of hot and cold water within the geyser tube will thus produce every phenomenon of geyser action to be observed at Rotorua, and I am led to believe that, by studying the action of geysers and springs in this district, they could in most cases and to a certain extent be regulated and controlled.

Geyser action may be briefly explained according to the foregoing. Supposing that an even-sized tube full of water become so hot that steam generated at the bottom, under heavy pressure, rises through it without being condensed, there comes a time when several globules of this steam will be in the tube at the same time, and as they rise to the surface they will expand in proportion to the release of pressure exerted upon them, and when coming near the surface they, as it were, explode, throwing the small quantity of water contained in the tube above them into the air, forming irregular intermittent explosions. Eruptions of longer duration can be explained thus: The actual weight of water in the geyser tube, acting as valve on the force, may by means of these globule explosions, find itself suddenly released by, say, half the pressure of the column of water. The equilibrium being thus destroyed, the pent-up steam rushes up the (geyser) tube with a force proportionate to the depths at which the reservoir containing this force may be situated, and acting on the principle of a Giffard ejector, the pent-up steam rushes up the tube, taking up with it a certain quantity of the water which may find its way into the tube, and ejecting it into the air in the form of high, low, or intermittent geysers, in proportion to the different size, position, force and volume of the spring, and other circumstances of the case.

I have also observed that the chemical composition of the water is sensibly altered by the different actions of the geysers. Thus, if the geyser is made to play very actively the water becomes softer to the touch, it being more silicious and oily than when the geyser action is subdued and allowed to boil up quietly.

This will account for the comparative rapidity observed in the formation of terraces and mounds around the most active geysers, and the very small amount of silica deposited by springs of less pressure and activity.

THE PROSPECTS OF FINDING WORKABLE COAL ON THE BANKS OF THE WAITEMATA.

BY JAMES PARK, F.G.S.

(Read at the Meeting of the Auckland Institute on 22nd June, 1891.)

The recently reported discovery of a thin, irregular seam of coal in the cliffs near Northcote has again directed attention to the probable existence of workable coal in the vicinity of the city of Auckland. The great economic importance of this question has long engaged the attention of the Director of the New Zealand Geological Surveys, and during the past ten years a number of surveys have been undertaken by the officers of his department with the view of collecting sufficient data to definitely determine the relation existing between the Waitemata beds and the New Zealand coal-bearing series.

In the years 1879, 1880, and 1881 Mr. Cox, late New Zealand Assistant Geologist, examined the country extending northwards from the Auckland isthmus to Whangarei on the east coast and the Upper Kaipara on the west. He arrived at the conclusion that the Waitematas, as typically developed at Orakei Bay and Fort Britomart, were unconformable to and had no connection with the brown coal measures of Drury and the Lower Waikato Basin. In 1885 and 1886 I re-examined the same country, and also made a close and detailed survey of the shores of the Hauraki Gulf from Auckland to the Maraetai Range. The result of my observations tended to show that no uncorformity existed from the top of the Waitematas to the base of the Papakura series; and subsequent surveys by Mr. McKay, F.G.S., the present assistant geologist, have shown that the Papakura beds rest quite conformably on the brown coal measures of the Waikato and

Drury areas. The fact has, therefore, been established by actual survey and observation that the Waitemata beds are conformable and belong to the New Zealand coal series—an opinion which has always been maintained by Sir James Hector.

It may be as well before pursuing this subject further to shortly inquire into the physical conditions considered necessary for the formation of coal. By the geologists of the early part of this century it was believed that workable true coal could only be found among a certain class of shales and sandstones of the palæozoic or primary period, to which the age and name of carboniferous had been affixed; and it may be as well to note here that this conclusion was fully sustained by their experience of the coal measures of Great Britain, Continental Europe, and North America, all of which were found to belong to this period. But the many brilliant discoveries of the past forty years have led to a remarkable evolution of thought and theory in every branch of knowledge, and in none is this seen more conspicuously than in the science of geology. True coals of superior quality have been found in the jurassic and triassic rocks of India and New South Wales, and in New Zealand in rocks that belong to the base of the tertiary period, but which possess in some places a secondary *facies*, and hence have been called cretaceo-tertiary in age.

Thus it is seen that there is interposed between the carboniferous coals of Britain and the cretaceo-tertiary coals of New Zealand the whole of the secondary and a part of the primary periods, representing an immensity of time of such infinite duration as to defy the comprehension of our finite minds. This wide lapse of time renders it easy to explain the great geological differences which exist between our own and the Old World coals. Perhaps the most marked distinction lies in the character of the vegetation of which each is composed; for, while the European coals are mainly composed of the remains of a flora belonging to the cryptogamic kingdom, truly characteristic of the palæozoic period, the New Zealand coals are composed of the remains of a varied forest vegetation which everywhere marks the advent of the tertiary period and the luxuriant flora of the present time. In the forests of our coal period there flourished two species of the kauri, which at that time grew all over New Zealand; three species of the beech, so commonly and erroneously known throughout the colony by the settler's name of birch; also the oak, laurel, myrtle, heaths, palms, ferns, grasses, etc.

It is now recognised by geologists that coal could form at any period of the earth's history if the necessary conditions existed, and it is probable that these conditions have continued the same through all geological time. They were: (1) a humid, temperate climate, favouring the growth of a dense vegetation; (2) flat or gently sloping, low-lying areas, favourable for the accumulation of thick deposits of vegetable humus and peaty matter; and (3) a stationary, or nearly stationary state of the land to permit a long-continued and uninterrupted growth of vegetation.

In New Zealand our coal areas are mostly littoral, of small extent, and patchy, characteristics resulting principally from the insular and mountainous nature of the country in older tertiary times. Where the sides of the valleys were steep and the hills met the sea, it was impossible for the remains of vegetation to accumulate to any extent, and this explains the somewhat anomalous fact that the coal measures do not always contain coal. The steepness of the land during the coal period is also accountable for the noticeable fact that our coals often thin out towards the dip, and, where lying near the old rocky floor, are usually found to conform with the contours of its surface.

But whether the forests which formed the coal grew on soils lying directly on the old basement rock, as we find is the case with those of the Auckland provincial district, or on the upper surface of the areas reclaimed from the sea, as is the case of the forests which formed the Shag Point and West Coast coals of the Middle Island, it happened that after a long period of rest, permitting the accumulation of thick deposits of vegetation, the land began to sink slowly, aud in course of time the vegetation became covered by fluviatile clays and sands, generally containing fragments of leaves and other plant remains derived from the vegetation which continued to flourish on the higher portions of the dry lands which had not become submerged.

As the land continued to sink, the fluviatile or estuarine beds became covered by blue clays and greenish-coloured sands containing the embedded remains of the numerous mollusca, crustaceans, corals, whales, sharks, and other life which teemed in the seas of those times. In a few instances in the north of Auckland coalfields, true marine beds containing a varied molluscous life appear close to the roof or upper surface of the coal. It is difficult to look back into these old eocene times, and judge the conditions which prevailed in every isolated nook during the formation of the coal; but examining the geological records (the fossil life preserved in the rocks) we arrive at the conclusion that, in these exceptional cases, the matter which afterwards formed the coal accumulated in narrow, sheltered valleys adjacent to the sea, in places where, after its gradual submersion, it was not subject to the action of streams or rivers laden with sand or mud or other detritus.

Again pursuing the order of events which followed the deposition of the coal, we find that the blue clays and green sands were followed by shelly and coralline sands, which now form the well-known Whangarei, Waipa, Raglan, Mokau, and Oamaru limestones. These are simply local names for the same limestone, which is, perhaps, one of the most marked, constant, and characteristic geological horizons in New Zealand, and seems to form the natural close of the coal formation. Now, this limestone is followed throughout New Zealand quite conformably by a great series or succession of sands and clays, which in the classification of the New Zealand Geological Survey possesses the generic name "grey marls," or "Waitemata Series." These sands and clays are typically developed on the shores of the Waitemata, which has given its name to the rocks of this period throughout New Zealand. The Waitematas, as seen at Fort Britomart or the Calliope Dock, consist of rapidly alternating layers of clays and soft sandstones. The presence in these of numerous broken plant remains, and sometimes thin, irregular streaks of coaly matter, together with the almost entire absence of true marine beds, clearly points to the prevalence of fluviatile conditions during their deposition.

The sequence of events which we have traced in order to show the relation of the coal measures and the Waitemata beds may be more graphically shown as follows;—Cretaceo-tertiary formation: 1. Waitemata sands and clays. 2. Whangarei or Oamaru limestone. 3. Marly clays and green sands of marine origin. 4. Fireclays and coal, with grits and conglomerates. 5. Basement rock.

The Waitemata beds occur at the top of the cretaceo-tertiary formation, while the coal occurs at the base, the two being separated by two great geological horizons. This in itself might be taken as strong evidence that no coal of a workable nature would be found in the Waitematas; but we have seen that the coal could form at any geological period if the necessary conditions existed. We, however, receive little encouragement from this source, as the rapidly alternating character of the Waitemata deposits would tend to show that dynamic forces were at work during this period, causing frequent oscillations of the land, thus preventing the accumulation of sufficient vegetable matter at any period to form workable coal seams.

Workable seams of coal exist on the flanks of the Hunua Range, and dip in the direction of the Waitemata, but it is doubtful if they reach as far as Auckland; and, if they do, they would certainly be found at a great depth—probably not much under 800 or 1,000 feet—judging from the thickness of strata which is known to exist between the Waitematas and the coal at other places.

Auckland stands in the centre of a great syncline or trough, and the depth to be penetrated there would be greater than at any other point. Towards Howick on the one side and Riverhead on the other the depth of strata to be passed through gradually decreases, until on the flanks of the Hunua and Maraetai Ranges the coal crops out on the surface. In the case of the upper reaches of the Waitemata, wherever the old floor or basement rock is found at or near the surface, and whether it is composed of hydraulic limestone or slaty shales, a careful search should be made for indications of coal, for it was on such old floors that the coal vegetation grew and flourished in older tertiary times.

If, therefore, there is a probability of coal on the shores of the Waitemata, it will be found in the upper reaches, in the direction of Riverhead, where the edges of the lower members of cretaceo-tertiary formation are upturned against the basement rock.

STAR CHARTING AND SOME RESULTING DISCOVERIES.

BY H. C. RUSSELL, GOVERNMENT ASTRONOMER.

(Read at the Meeting of the Royal Society of New South Wales on July 1st, 1891.)

Last year I exhibited various photographs of stars and nebulæ taken with a portrait camera with a focus of 32 in., and I am now able to show you some of the same objects photographed with the new star camera of 135 in. focus. One could hardly realise the extraordinary difference between the two without seeing it; and I am further able to show you the result of taking a star cluster with an enlarging lens which makes the equivalent focus 564 in. or 47 ft. The success of this new departure is very gratifying, because it shows how much may be added to our knowledge of star clusters by this method of direct enlargement. When possible it is much better to enlarge in the camera at once than to enlarge the photograph after it is taken, because there are always blemishes in the surface used for the photograph which get enlarged with the picture. The first photograph of Kappa Crucis did not cover a space of one-tenth of an inch square, the star camera makes it 18 times larger and the enlarging lens 324 times larger. Where extreme accuracy for measurement is required, as in these cases, the gain is even greater than these numbers indicate, and under the microscope the magnified image may be again magnified 50 times. The smaller one will bear no greater power because it is the imperfections in the surface and image that limit the magnifying power that can be used, the faults of the photo. surface being relatively so much less important in the enlarged picture than in the small one, and this photo., with the enlarging lens, speaks volumes for the stability and accurate motion of the telescope which on such a large scale gives perfectly sharp star discs. The clearness of these star discs affords also a good test of the effect of colour, and there are many coloured stars in it to indicate what I mean; it will suffice to indicate two stars—a red and a blue; the red star is fully a magnitude brighter than the blue. Herschel called it 9th magnitude, and the blue one 10th magnitude; the red one in the photograph appears of the 11th magnitude, or two magnitudes less, and the blue one appears of 9th, or one magnitude greater, or, in other words, the difference in colour, as estimated by the eye and the photograph, makes a difference of 3 magnitudes. I think the members are aware that the photographs I exhibited here last year were made with a 6 in. Dalmeyer portrait lens, and my object now is to bring before you the state of preparedness of the star camera for the work of charting the heavens, and some examples of the actual work, at least plates taken of the dimensions and conditions of the actual plates, and only differing from them in that the *réseau* or grating of lines, though ruled and made by the same machine as those that are to be used, has not been tested in Europe, as all must be before they are accepted. The one I have was courteously sent to me by Admiral Mouchez, the Director of the Paris Observatory, untested, as a sample; the process of testing those to be used being a tedious one, and it will therefore be still some time before the approved ones are available, but for our present purpose it answers admirably. It consists of a piece of plate glass with a thick coating of silver from solution on one side. On this silver two sets of lines at right angles have been ruled with a sharp point which has cut the silver through; these lines are about $\frac{2}{10}$ of an inch apart, equal to 5 minutes of an arc. Each line is numbered. This *réseau* is used in this way: it is placed face upward in a box the exact counterpart of the plate-holder in the telescope, upon this is then placed a sensitive plate and the box is then closed and put in front of the object glass of the camera. A small electric lamp of $2\frac{1}{2}$ candles is then placed in the focus of the star camera and the rays from it pass out from the object-glass parallel, and falling on the silvered *réseau* are stopped in all places except where it is cut through by lines and figures and there it passes on to the sensitive plate and marks it. A number of plates are so treated one after the other and stored ready for use in dark boxes. They are all carefully numbered on the glass and taken out in order and exposed in the star camera on fine nights. The plates are 6¼ by 6¼ inches, and the part actually exposed 6 by 6 inches; of this space 4·7 by 4·7 inches is the part which is finally used, that is 2· by 2·. The margin, rather more than ½ in., is to be for overlap on the plates, and the stars on this can be compared for verification in each adjoining pair of plates. When the plate is developed after exposure the lines (or grating), as well as the stars, appear. So far everything is simple and mechanical; but the resolutions of the conference require that one set of plates shall have on them all stars to the 11th magnitude, and the other set all stars to the 14th magnitude, and the difficulty is in an ever-changing atmosphere, and with plates variable in sensitivenesss to give the exposure necessary to secure these results. The Astronomer Royal for England, as chairman of the committee appointed to deal with these and other kindred questions, has been making experiments on a fairly good night in London, and has come to the conclusion that two minutes will be enough in such weather for stars of 11th magnitude, and 30 minutes enough for stars of 14th magnitude, and that these times must be modified by the weather—that is, increased if the weather is bad. I am able to show you three plates exposed 30 seconds, two minutes, and 30 minutes respectively on the well-known star cluster Kappa Crucis. You will see that 30 seconds is enough to get images of stars to the ninth magnitude, and that two minutes gives images of stars to the 11th magnitude, and takes in a number of 12th and one of 13th magnitudes; but the plate exposed for 30 minutes is not so satisfactory. It should, according to the rule, show with defined discs stars of the 14th magnitude of Argelander's scale; in Herschel's monograph of this cluster he has 11 stars of the 14th magnitude, and four of the 15th; of these, eight are invisible, six are visible, but not measureable, and only one is as it ought to, "measureable"; and there are some stars of 12th and 13th magnitude that are not measureable. The plates were exposed one after the other on a night that seemed to be uniform, and when the two-minutes' plate was a success, the 30 minutes' ought also to have been. I give the result of this experiment to show the difficulty. At first sight this looks like a failure of the method; but I find on further investigation that these faint stars in Herschel's list are either much fainter than he took them for, or they are coloured stars. The matter was tested by taking a photograph of the same object and giving three hours exposure; even then most of the stars referred to above are far too faint to measure, although they can be be seen plainly enough in nearly every instance, and the photograph, hurriedly examined to see if the faint stars were on it, is found to contain at least 20 more faint stars which Herschel did not see. This example will serve to show you better than any statement the difficulty to be met, according to the adopted rule, viz., if two minutes' exposure records stars of the 11th magnitude, then 30 to 35 minutes should record those of 14th; but here in the case of a well known cluster, with every star recorded by a careful observer, it is found that the rule fails, and the question arises, Did he over-estimate these stars or did the rule fail? Over nearly the whole surface of the sky we have no record of stars below the 9th magnitude, and therefore no means of finding whether the photographs do really record what is desired, that is, stars of 14th magnitude, and it is obvious that more experiments will have to be made upon well-known clusters, and thus determine the time necessary for the purpose of making certain of 14th magnitude stars; when that is done, however, we shall have in the photographs a vast number of stars of the 14th magnitude which the eye cannot see through the telescope, just as I found in Kappa crucis. The extended exposure in order to secure visible 14th magnitude stars ended in recording a large number of stars photographically as bright as them, but wholly invisible through the telescope. At the recent meeting of the committee it was decided, on the evidence given by Dr. Scheiner, to extend the time of exposure to 40 minutes, and it is reasonable to expect that, since all are interested and working at this point, it will soon be decided, and times of exposure agreed upon for different states of the atmosphere which will ensure uniformity. At present there seeme to be no possibility of dealing with the colour difficulty, which is a serious one, as I have already pointed out. Great differences are found also in the sensitive plates. We have tried Swan's, Wrotton and Wainwright's, Field Dodgson's star plates, M.A. seed plate (American), and Ilford plates; and the Ilford plates are certainly the best for our purpose. The American plates are, perhaps, less liable to fog, and work very cleanly and regularly; but they are not so sensitive, and the gelatine is not so firm. Again, in my photos of the great Magellan cloud, taken with the portrait camera which I exhibited at the November meeting, the stars, owing to their countless numbers, are condensed into a blurred mass, and the great and remarkable nebula 30 Doradus is only a white spot. With the star camera the picture is all enlarged ten times, and the stars are separated and brought out sharply defined, while the nebula 30 Doradus is revealed in all its wonderful complexity, and shown to be much more extensive than Herschel made it with his great reflector, and quite a new light is brought out regarding the structure of this object. There is one thing about this nebula that is very suggestive. Some of its loops are quite round, and all its features seem to be laid out as if in a plane at right angles to the line of sight. There is no sign of elliptical forms, which so commonly appear in nebulæ, owing to their circular forms being oblique to the line of sight, and therefore projected into ellipses. If we look at the main features of Nubecula major the same remark is applicable: the curves are nearly circles, both those in the main body of it and in the several star clusters and nebulæ; they all, in fact, seem to lie at right angles, or nearly so, to the line of sight. Now, just as the sun with his attendant planets, and the planets with their moons, and especially Saturn, with his rings, show us that there has been a tendency, as theory would also lead us to expect, to arrange the matter that is revolving about them in a plane common to all; and, as it is also evidently the case with spiral nebulæ, the matter is arranged in a plane, of which the diameter is enormously greater than the thickness, so I think we may safely assume that the Nubecula major is a great spiral structure, of which we see the greatest diameter, and that its thickness, measured through in the line of vision, is comparatively small. Now, in addition to the main central spiral, there are two nebulæ, and at least three clusters of stars arranged as spirals, having the same characters as the main one, that is nearly circular, and these are all arranged in space so that they appear to us in the same or parallel planes and near together; and it may, I think, be safely assumed that all are parts of the grandest spiral structure that we know, and all in one plane, because if they are not in the same plane, then, being optically close together and in parallel planes, they must be arranged one after the other in a long vista which happens to be in our line of sight, that is, a series of great spirals one behind the other at different distances towards infinity, and all revolving as if on a common or parallel axis, a conclusion which is highly improbable, and impossible to receive when the simple and more rational alternative of their being all in the same plane is available. Now, accepting the condition of their all being in the same plane, imagine what we should see if transported to some star near the centre. All round us would be an infinity of stars, which, on closer inspection, would seem more crowded together in a great plane, and in the same plane we should see two nebulæ like straight lines, because looking at them from the plane in which they revolved, in some directions the stars would be relatively thinner than in others, because in those the extensions of them are not so great, and there would also be apparent rifts owing to the dark spaces in the great spiral, where we would seem to see into the infinity beyond to other systems, with their nebulæ and star clusters at all angles. If you look at the photograph, and assume, as I have done above, that the whole universe of stars is spread out in the plane of the photograph, you will see that there would be no difficulty in finding positions from which the observer would see through some of the comparatively dark places, as well as in other directions in which countless multitudes of stars of all magnitudes would meet the gaze. In fact, his vision would be much the same as ours—in one plane, that of the whole universe. There would be an inconceivable wealth of stars, with here and there dark spaces, coal sacks, due to the dark rifts above referred to; and looking out of that plane the number of stars would decrease, although they would still be abundant. Now, although amongst the infinitude of heaven we cannot find two star clusters or two nebulæ alike, we can still find classes of different kinds which have many points in common, and I think we have here reasonable ground for supposing that we have presented to us in the Nubecula Major a universe similar to that in which we are, and that instead of seeing it from within, where it is impossible to make out its form, we are here, with the aid of telescopes and the still more powerful star camera, able to see just such a universe, to trace out a rational explanation of the many puzzling features of the stars and milky way around us, and to see how such a universe may be arranged. In reference to another well-known southern object, "the nebula about Eta Argus," it will be remembered that last session I exhibited a photograph of it with three hours' exposure, stating that it had not been exposed long enough. On April 9, 1891, I obtained a clear night and an exposure of eight hours; again, with the short camera, which brings out a host of stars and shows the milky way with a brilliance it has never been seen to have before, at the same time the nebula is more distinctly shown and larger; and in reference to this object—also after a series of trials—I have succeeded in getting several fine photos with the star camera, which make it 18 times larger than the one I used last year. I have been unable to get a continuous exposure of eight hours with this camera; still, in plate 77, taken March 18, 1891, with 5 hours 43 minutes exposure on a fine clear night, and in others taken about the same time, we have a marvellous revelation of the striking details of light and shade in this object, which have never been seen before in any photograph or by any telescope. I fear to attempt a description of what can be seen only in the photograph; the general form is the same as in drawings and in the photos exhibited last session, but there are certain main features which may be indicated. In the first place, there is evidence here that the nebula is much more extended, and the indications of spiral structure are more decided, and are seen to extend even to the details of the familiar branches. The nebula covers a much larger area than that of Orion, and in passing I may mention that it proves conclusively that a conspicuous part of the nebula, which Herschel drew and described in 1838, has entirely disappeared, as I pointed out in 1872; but as I then used a telescope inferior in power to Herschel's, its invisibility to me was not proof that it was gone. Now the star camera is vastly more powerful than Herschel's telescope, therefore how much may be judged from the fact that in one small space, where he could see only one star, the camera shows 10; and in another place examined by Herschel with equal care, and said to contain four stars, the camera shows 20. There can then, I think, be no doubt that in this case a bright nebulous mass has entirely disappeared in 34 years, and it is significant that the part of the nebula where it was is now replaced by a dark round spot; the decided folds of the nebula visible here in 1838 have entirely disappeared. I have photographed the object many times with both cameras, and the dark spot is always there. Can it be that in the 34 years, 1838 to 1872, one of the supposed dark clouds of space has drifted in between us and the nebula? It cannot be a solid body because the stars are there; but a slight misty body would hide the nebula and not affect the stars very much. It would be tedious to attempt to describe the details which the photograph shows, especially to the central part of the nebula; but I may say that while the eye, aided by the best telescopes, sees the nebula of fairly uniform brightness interrupted by certain well-known darker spaces, and especially by that which Herschel calls the Lemniscate, much the same, in fact, as the great nebula in Orion, and just as the photos of that nebula reveal a sort of texture in the nebulous mass—as if it were made up of a series of curved bands of nebulous light—so this photo of the nebula about Eta Argus shows a most complex structure of the same character, and with a greater variety of light and shade;

and just as in the case of the nebula in Orion, the nebula with its vast folds is shown to extend farther from the centre with each increase in the time of exposure, so I find with that about Eta Argus, only the southern nebula is very much more difficult to photograph; and I think it must have some tinge of colour in it, probably yellow, while that in Orion is green, for a photo of Orion with one hour's exposure is more dense than one of Eta Argus with six hour's exposure. Taken as a whole the nebula about Eta Major covers a much larger space than that about Orion, even in these photographs, which indicate that although the southern nebula was longer exposed it is comparatively under exposed; for the central parts of Orion are much over exposed. I have also brought to show you two photos of the moon, taken on 19th and 28th of May last. As you are all aware it is extremely rare to get a night in which there is absolutely no motion or what is called twinkle in the stars, or in other words, when the earth's atmosphere is not disturbed by currents of unequal temperature. Now until we get such a night and a suitable moon it will be impossible to get a perfect photograph of the moon, for any motion in the air such as that referred to has the effect of enlarging every point of light. For instance, a star image may be made two or three times its normal size, and if the stars are close together they are run into one blotch. So on the moon, all the little details are enlarged and mixed up, so that they cannot be seen. But these photos are very good, and show some features of the moon's surface which I have never seen in any other photograph—for instance, the undulations on the surface of the lunar plains—the equivalent to what we should call hills and valleys, as opposed to mountains.

REVIEW.

The twenty-second volume of the Transactions and Proceedings of the New Zealand Institute, although bearing the usual imprint "Issued May, 1891," has only recently been distributed to the members, and consequently an opportunity has not offered of noticing the contents in this magazine until the present issue.

A considerable proportion of the papers are on zoological subjects and the matters noted form a considerable addition to our knowledge of the interesting fauna of New Zealand. Mr. Maskell not only adds considerably to the already long list of native coccids, but describes and figures species from Australia and Fiji. I notice that Mr. Maskell states that the fire at the Government Printing Office destroyed nearly all the remaining copies of his book on the Scale Insects of New Zealand, issued in 1887. Those who have the good fortune to possess a copy, should take care of it.

Another paper on a pest too well known to fruit growers—the Codlin moth—by Mr. G. V. Hudson, points out the lines on which observations are required to grapple thoroughly with this serious nuisance. Mr. Hudson has also worked up the long-neglected New Zealand glowworm and the Cicadæ. Mr. Jas. Hudson records two observations on Coccids in the Nelson district.

As a country of pre-eminent ornithologic interest, New Zealand still keeps up its reputation. Although but a short time has passed since the issue of the magnificent second edition of Sir Walter Buller's Birds of New Zealand, we find several new species described and recognized by Sir Walter, and Mr. Cheeseman has placed on our list the birds of the Kermadec Group recently included in our political area. Other observers have contributed just the kind of short notes from personal observation, which are so frequently thought "not worth writing about," but which in the aggregate greatly increase the sum of our knowledge. Quite a tempest, not to say a storm in a teacup, seems raging between two members *in re* "Kakapo *versus* Tákahe." Mr. Suter continues his patient labours on the interesting, though small, land shells of New Zealand, and, what is much to the point, adds to his descriptions excellent drawings of the species, which however do not receive justice at the hands of the printer.

In a concise and yet useful form Professor Hutton prints a revised list of the New Zealand Bryozoa up to date, work which has been rendered possible by the invaluable Synonymic List of the described species of Bryozoa, lately published in England by Miss E. C. Jelly, a lady who has laboured for many years in this branch of Natural Science, and has greatly simplified the labours of future students. A large number of the tertiary species from New Zealand are now described in various publications. When shall we ever get a systematic description of the thousands of fossil mollusca, &c., which have been accumulated by the Geological Survey officials at Wellington? Only Echo answers, When!

From a biological point of view the short paper on the Origin of the Sternum, by Professor Parker is of great interest, and Mr. Beattie's observations on the extraordinary variation in the fin formula of the Red Cod furnish much material for speculation.

Spiders, though they be but a feeble folk, take a great deal of describing. Sixty-one closely printed pages to describe thirty-four spiders! Some years ago spiders abounded in the district in which I lived, a hundred kinds at least, probably all undescribed; here is work for the industrious!

One of the great sea monsters has paid us a visit during the year and enabled the Curator of the Auckland Museum to "put him on the list;" he was comparatively a small specimen, only 34 feet long, so "he never will be missed." I am afraid to put down in black and white the reputed measurements of individuals of this species (the Basking Shark); they are much too great to be swallowed. Within the past few weeks a strange sea monster has been reported off the East Coast of the North Island, let us hope that it may fall to the lot of our zealous Curator to add this, as yet somewhat mythical monster to the Otago Museum, even if the Council have to erect an extra length of tin shed to exhibit it in.

Two members of our local Society contribute papers on the Crustacean fauna of New Zealand; in the one instance clearing some points in the History of *Squilla* and *Nerocila*, and in the other adding to the list of Fish Parasites.

In the forefront of the Geological section is placed a translation of the monograph by Baron von Ettingshausen on the Fossil Flora of New Zealand. This furnishes the student with a full translation of the original memoir in German—the plates have also been redrawn and reduced. It seems somewhat startling to find a flora in the Shag Valley containing a palm and two species of kauri, an oak, an elm and an alder.

On the local stratigraphical geology of the Tertiary series in Hawkes Bay, Mr. Hill splinters lances with the Geological Survey.

The question of the Moa seems reviving again, and we have two short notes on the subject by the Curator of the Canterbury Museum. The papers in this section number eleven and are all interesting.

In Botany, Messrs. T. Kirk, W. Colenso, Cheeseman, and Petrie contribute papers and make considerable additions to the flora; the paper on the endemic group of Olearias with solitary or racemose flower heads, will, no doubt, appeal strongly to horticulturalists, as all the species are handsome and easily cultivated.

The fourth and concluding section is very appropriately headed, Miscellaneous. There are, however, two articles of sterling interest, one on the Story of John Rutherford, and the other on the Outlying Islands of New Zealand; most of the others serve to produce a volume of unusual bulk.

The great disappointment in the volume is the small number of new names in the list of contributors of papers, the same names running through the volumes year after year. All honour to those who keep their shoulder to the wheel and work in their harness, but where are their imitators? There is still an almost virgin field of research of every kind, but the rising generation seems in earnest in nothing but close and willing study of the motions of a particularly prolate spheroid, in a field containing as essentials, objects called goals. Certainly the pursuit of this study strengthens the body and is commendable, in moderation, but there are times and places for all things.

A. H.

ICE-MARKS AND THEIR COUNTERFEITS.

BY PROF. F. W. HUTTON, F.G.S.

(Read at the Meeting of the Australasian Association for the Advancement of Science, in Christchurch.)

Introduction.

Ice as a geological agent may be divided into land-ice and floating-ice; each of which may be again subdivided—the first into glacier-ice and ice-sheet, the second into ice-berg and ice-floe, or shore-ice.

Glaciers occur only in valleys among mountains. They may exist in any latitude provided the mountains are high enough. At the present time the glaciers of Antisana and Illinissa, in Ecuador, and of Kilimanjaro in Africa, are almost on the equator; but there is no well authenticated account of glaciers having existed in the tropics during the pleistocene period.

Ice-sheets are at present confined to polar regions, extending to 63° N. in Greenland and to 66° S. on the Antarctic continent. During the pleistocene period an ice-sheet extended in North America as far south as the junction of the Ohio with the Mississippi—in 37° 30′ N., and in Europe to 50° N.

Shore-ice is found in high latitudes only. Coast-ice is broken up into rafts or floes in summer, and these floes are often driven on shore and piled up in gales of wind.

Ice-bergs penetrate to about 40° N. and 40° S., but they are isolated. Pack-ice, formed of united ice-bergs, occurs only in high latitudes. It is often called Floe-berg.

Ice-marks.

Roches moutonnées are characteristic of land-ice, and generally shew a difference between the strike side and the lee side. They are counterfeited by the weathering of homogeneous eruptive rocks—such as granite—especially where a concentric structure has been developed.

Ice-scratches and grooves on bed rock—formed by land-ice or by floating-ice. Those formed by floating-ice are rarely straight, and may be much curved. Those formed by land-ice are straight or slightly curved; they occur on surfaces which may be horizontal, inclined, vertical, or even overhanging; and also on curved or mamillated surfaces. The counterfeits are slickensides; rain grooves in calcareous rocks; and sand drift grooves.

Ice-scratched stones. These are common in boulder clay, which is supposed to be the ground moraine of an ice-sheet, but are rare in the remains of glaciers. Often the scratched stones are rounded by water-wear, and scratched all over, but sometimes they are facetted on the scratched side. Shore-ice causes irregular shallow scratchings only. They are counterfeited by stones in fault rock, by stones in landslips or even those that have undergone soil cap action only. But these stones are never facetted and the scratchings are usually irregular and shallow. In some cases of basic eruptive rocks, irregular decomposition produces apparent scratches and grooves. Facetting is produced by sand drift, but the facets are generally curved.

Kettle-holes are small basin shaped depressions in gravel or in morainic matter, caused by the melting of detached blocks of ice which have been covered up by detritus.

Giant Kettles, or Pot-holes, are cylindrical holes worn out in solid rock by the friction of stones under waterfalls or glaciers.

Moraines are always present in recently glaciated districts; and are among the most permanent of ice-marks. Nearly all glaciers leave behind them a terminal moraine across the valley; and in North America a large moraine marks the front of the old ice-sheet. Counterfeits are landslips, but these can generally be distinguished from terminal moraines by their position. Lateral moraines are more likely to be imitated by landslips.

Till Deposits.—There are three types of till, but they are often mixed. (1) Sub-glacial till, or Boulder clay. A compact, tough clay with unassorted sand, gravel, and numerous boulders : the fragments not much weathered but rounded, often scratched and sometimes facetted. The fragments are mostly derived from the immediate neighbourhood, but partly from a distance, sometimes up to several hundreds of miles, This is a ground moraine, and the subjacent rock is always planed, polished, and striated or grooved. (2) Surface till, or moraine till. This lies on the first and is more sandy and looser but unassorted. The rock fragments are larger, more angular, rarely scratched, and more decomposed than those of the Boulder clay. This till is probably surface moraine of the ice-sheet which has been left when the ice melted. (3) Floe till, or berg till. This is composed of more or less assorted sand, and clay indistinctly laminated and containing erratics often scratched. It is either marine or else has been formed in lakes round the end of the ice. Large boulders are sometimes rare. Counterfeits of till are not common. Nevertheless in regions of severe and sudden storms boulders four feet or more in diameter are known to have been transported by the rush of water and left in the midst of mud and fine sand. During the flood in the Waimakariri on the 18th March, 1888, at Kaiapoi, several 30-ton blocks of concrete were carried for nearly a quarter of a mile and buried in sand.

Kames. These are narrow ridges, 20 to 50 feet high, formed of rounded gravel and sand discordantly stratified, the stratification often conforming to the surface, thus proving that they are not due to denudation. They commonly contain large boulders. Sometimes two run together and form a valley without an outlet. Generally they pass into terraces. They are found at the mouths of valleys and are more or less transverse to it. They are also always associated with moraines. They are, no doubt, due to violent currents of water operating near the front of a glacier and are probably the fans of glacier rivers.

Otars, or Serpent Kames are longitudinal to the valley, and the materials composing them have come from greater distances than those of the neighbouring till. No doubt they have been formed by glacial, perhaps sub-glacial streams.

Drumlins are elliptical hills with steep sides and rounded tops formed of morainic matter, the long axis always in the direction of movement of the former glacier. Probably due to ice riding over old moraines.

Perched Blocks, often in precarious positions on the tops or sides of hills or mounds, are very characteristic of ice action. They may occasionally, but not often, be counterfeited by blocks brought down by landslips.

Erratics. May be merely blocks, larger than water could move, brought down a valley. Or they may be blocks which have been lifted up above their place of origin. Or they may be blocks which have passed out of one drainage system into another. The first is characteristic of land-ice, the second of shore-ice, and the third of ice-bergs. Counterfeits: Small erratics may be borne on floating trees or seaweed, consequently their value as evidence of ice depends much on their size. Ships' ballast may also sometimes counterfeit erratics. Ships have been unloaded and careened in many a bay, and have again left with part of their ballast on shore.

Cirques. The origin of cirques by ice-action is doubted by many; but true cirques appear to be confined to glaciated regions. Very close imitations may, however, be brought about by stream erosion, and occasionally they might be imitated by lateral craters.

Rock-basins are generally found on a surface which has been formerly glaciated. The terminal moraine of a glacier marks a point in the valley where no erosion is taking place. Below this point the river gradually deepens its channel, while above it the glacier slowly decreases the slope of the valley; and, however slow a process glacier erosion may be, a rock-basin will, in time, be hollowed out behind the moraine. Rock-basins can also be formed in an arid country by the atmospheric decomposition of level surfaces of rock, the products of decomposition being blown away by the wind. If the climate changes these rock-basins might become lakes; but, evidently lakes with this origin must be of rare occurrence. Other rock-basins are due to unequal movements of the land.

Evidence of former Ice-action.

Evidence of the former presence of *glaciers* consists of terminal and lateral moraines—especially the former. Roches moutonnées and striations occur in the valleys only. A former *ice-sheet* is marked by a ground moraine of boulder clay and till with scratched stones, as well as by groovings and striations on plains and the tops of hills. Evidence of *ice-bergs* consists in large erratics, widely scattered and brought from long distances towards the equator. Former *ice-floe* is known by partially stratified till with marine shells.

Evidence of the former presence of glaciers in a country where they no longer exist is not sufficient evidence to prove a former glacial epoch; for the glaciers may have been due to greater elevation and precipitation of snow. There must also be evidence of a former ice-sheet or floe-ice, widely spread over a large extent of country. A reduction of temperature sufficient to cause a glacial epoch, would necessarily be accompanied by a change in the fauna and flora, and we must expect to find evidence of this also. On the other hand if there is evidence that no extinction of a former flora or fauna and the introduction of newer ones has taken place, then we have a very good reason for concluding that no glacial epoch has occurred. In tertiary, and more particularly post-tertiary times, evidence of a glacial epoch should be abundant and general. In older periods it is more difficult to get evidence, but under any circumstances it is unsafe to rely on a few isolated cases of supposed evidence, which may be deceptive.

GENERAL NOTES.

An Interesting Point in Polynesian Ethnology.—In Dr. A. Lesson's interesting account of the Mangareva or Gambier Archipelago published at Rochefort in 1843, we find a brief description of the flora and fauna of those isles, with the native names added. This is information which is not always supplied by naturalists, though the interest is much increased thereby, especially to those whose studies lead them more towards ethnology than biology.

Among the birds described by Dr. Lesson as living in this little group—which is situated at the south east end of the Dangerous, Low, or Paumotu Archipelago,—is one which he names a *Philĕdon*, the native name of which is *Komako*. Now the interest to the ethnologist in this case consists in this; that we have a *Philĕdon* in New Zealand (*Anthornis melanura*,) the native name of which is—amongst others—*Komako*, better known to the settlers as the Bell Bird, and whose sweet morning notes were at one time heard in every bush in the colony, although now, alas! it is never heard in the North Island. The species may be—indeed probably is—not the same in both countries, but the fact remains that the two birds are sufficiently alike to have given rise to a common native name as applied by peoples separated by so great a stretch of ocean as New Zealand and the Gambier Islands, a distance of about 3,500 miles. The question arises, how did these two peoples come to give the same name to the bird? Both of them are branches of the great Polynesian race, both speaking a language which in many respects is nearer, the one to the other, than that of people who are their nearer neighbours. It has never been suggested that they ever had direct communication with one another since inhabiting their present homes; we must therefore conclude that both people knew the bird, or a somewhat similar one, in some place where their ancestors lived together. In Tahiti, we find from R. P. Lesson's "Voyage autour du Monde" in the French exploring vessel "Coquille" that there is a bird there called *Omàomào*, a word at first sight not much like *Komako*, but if we remember that the Tahitians have in process of time lost the power of pronouncing the "k," we find that by replacing it, that *Omàomào* becomes *Komakomako*, identical with one of the commonest names the Maori has for the Bell Bird. The Tahitian bird however, is not a *Philĕdon*, but the *Muscicarpa pomarea*, a species of flycatcher. The same name is given by Finsch and Hautleb to the *Tatare longirostris*, a thrush-like bird, also a native of Tahiti. In Samoa we find the *Septorius samoensis* bearing nearly the same name, viz.: *Màomào*, which again, if we supply the "k," missing from the Samoan dialect, becomes *Makomako* one of the most common of the Maori names for the Bell Bird. The *Septorius* is a honey eater, like our *Anthornis*. All this tends to confirm what has been deduced from so many other lines of reasoning, viz.: that the Polynesians spread from Samoa eastward to Tahiti and the Society Islands, and from thence again in many directions, including both that of the Gambier Group and New Zealand. The evidence from the geographical point of view of the Tahitian, or rather Raiatean origin of the Maori will be found in a paper by the writer in the forthcoming volume of "Transactions of the Australasian Association for the Advancement of Science." A wide field opens up to anyone who will study the native names of the fauna and flora of the Polynesian islands, and it will surprise those who have not paid any attention to the matter, to find many of our common Maori names of plants, birds, fish, insects, etc., known all over the Pacific, and applied to the same, or nearly the same species.—S. PERCY SMITH.

NOTES ON EELS.—The following notes of occurrences which I witnessed myself will perhaps throw some light on the question as to whether eels go to sea to breed, and as to the possibility of their overcoming difficulties which might seem at first sight beyond their powers. There is a fine stream at the Bay of Islands named Waitangi, the waters of which contain eels in abundance from its source to its mouth. It joins the sea at Waitangi (near where the celebrated Treaty was signed), and there it falls about 30 feet over an old lava flow, the face of which is quite perpendicular and even overhanging. The channel is about 50 yards wide on the top of the falls, but ordinarily the water does not occupy the whole bed. Places are therefore left dry, or over which a very thin coating of water serves to keep the rough surface of the basaltic rock quite wet with little running streams here and there. In 1874, I observed the surface of the rock where the water was trickling over it, to be covered with hundreds of tiny eels averaging from two inches to six inches in length, wriggling their way up the perpendicular face of the rock, and making headway against the the thin rill of falling water from above. The water in the basin below the fall is salt, or nearly so, as the tide flows up to the foot of the fall. The rock in this instance is quite rough, as all basaltic rocks are, and it is no doubt due to this roughness that the eels are able to ascend. The Maoris told me they were well acquainted with the fact, and that they often scrape the little eels into baskets for food. I would not have believed it possible that eels could have ascended this perpendicular face had I not witnessed it.

A considerable portion of the main Chatham Island is occupied by a lagoon named Te Whanga, the water of which is brackish, but which has no permanent connection with the sea, except perhaps by infiltration in two places, where its margins nearly approach the ocean. At one of these places named Te Awa-patiki, there is a wide, dry channel connecting the lagoon with the sea beach, and here at rare intervals and during heavy north-east gales the sea makes a breach into the lagoon. This channel is about ten chains wide, and ordinarily is occupied by dry, soft sand. In 1868, when riding past there I found that the sea had risen over the ordinary level and had been running into the lagoon, but as it was low water the channel was again quite dry. In one part, a small arm of the lagoon extended towards the sea, but ceased at a hundred yards from high water mark. This arm was about 20 feet wide and 2 feet deep. To my great surprise I found it to be full of a wriggling, seething mass of live eels, some of very large size, as much indeed as three or four feet long, whilst the dry sands on either side and towards the sea were covered thickly by dead or dying eels. The eels were so thick in the arm or creek that our horses refused to enter the water. Evidently the breaking in of the sea had attracted the eels from the neighbouring parts of the lagoon, and here they had congregated in vast numbers with the intention of going out to sea. Their number was a most astonishing thing to behold: there were several acres of dry sand covered with dead or dying eels, say one to the square yard, more or less thickly. A rare opportunity was here offered to the sea-gulls, which—as we rode through them—rose in such clouds that they cast a perceptible shade over the sands. Along the margins of the lagoon grows a rank sea grass, which extends out to a depth of three or four feet of water. In the thicker patches of this grass, the eels find food and shelter. So numerous are they that the Morioris beat the grass with clubs, quite in a random manner, and never fail to secure a plentiful supply in a short time. They are coarse and tough to the taste however.

The congregation of the eels at this spot shows a remarkable instinct, by which they must have been drawn from considerable distances so soon as the sea began to break into the lagoon. As the height of the water in the lagoon was apparently the same as it had been a few days before, not much additional salt water could have flown in. How then did the fact of the inflow become communicated to the eels?—S. Percy Smith.

University Extension in New Zealand.—The population of this colony is far too sparse to allow of the introduction of the methods of University extension as carried on throughout England by the Cambridge University authorities. But a praiseworthy attempt has been made in two quarters to provide for young teachers and others in localities at some distance from the colleges already established, such a measure of university education as will enable them to pass the examinations prescribed for degrees by the University of New Zealand. The Southland Collegiate Classes Association owes its existence, we believe, to the efforts of Mr. Robt. McNab, B.A., of Invercargill. It was started during last year with the object of promoting "sound learning within the District of Southland by encouraging a systematic course of lectures during the winter months on such subjects and within such limits as are laid down in the Synopsis of Classes published annually under the authority of the Council." The Association consists of the teaching staff and eight elected members, four to be elected by the teachers and four by the enrolled students; and the management is entrusted to a Council of seven office bearers elected annually by the members. The annual fees charged are ten shillings and sixpence for each class to pupil teachers, but to others an enrolment fee of five shillings for the first class and two shillings and sixpence for each subsequent class, together with class fees varying from ten shillings and sixpence to a guinea and a half. During last session, which extended from May to October inclusive, ninety-six students enrolled themselves. Lectures were delivered on the following subjects:—English, Mathematics, Latin, French, Mental Science, Physics, and Chemistry. The very best men available in Southland appear to have been selected as teachers. The Association claims already to have aided many persons in the prosecution of their scholastic studies, and if well supported there is little doubt that it will prove a valuable adjunct to the cause of University work in the colony.

Following the wake of the Invercargill Association, a similar movement has been started in Oamaru under the title of the North Otago Collegiate Classes Association. The conditions here are not so favourable, as the district is much nearer Dunedin and the population is smaller than that of Invercargill. The promoters have laid themselves out to cover an extensive field of work including Latin, English, German, French, Mathematics, Jurisprudence, and Political Economy. The only question seems to be whether a sufficient number of students will offer themselves to enable the classes to be continued. At the start the encouragement has not been great. Towns like Napier and Nelson offer better facilities for this kind of work than such a town as Oamaru, and even Wellington might hasten the day when it will have a properly equipped college of its own, were its educational enthusiasts to band themselves into an organisation somewhat on the lines already adopted by the Southern associations. What can be done in the way of accomplishing good educational work by private (as opposed to State-aided effort) is shown by the success attending the work of the Technical Classes Association in Dunedin, which in this third year of its existence has over three hundred young men and women attending its classes.

The Polynesian Society.—An effort is being made in Wellington to establish a Polynesian Society, the objects of which as set forth in a preliminary circular are "to afford a means of communication, co-operation and mutual criticism between those interested in, or studying Polynesian anthropology, ethnology, philology, history, manners and customs of the Oceanic races, and the preservation of all that relates to such subjects in a permanent form." For the present it is proposed to afford the means of communication by the publication of a periodical journal, to be called the "Journal of the Polynesian Society," and it is believed that 250 members each subscribing 20s. a year, will suffice to start the Society and carry on the publication. While thoroughly sympathising with the feelings of the promoters and ready to give what support lies in our power to their project, we cannot say that we are sanguine of success to the venture. Our own experience is that any enterprise of this kind is certain to be so poorly supported that it will end in financial failure. We would recommend as a much more feasible plan, and one mutually beneficial to all concerned, that the Association be formed with half the proposed annual subscription and that this Journal be the accredited Journal of the Society, until the population of these southern seas justifies the specialisation now proposed. In the case of this Journal we asked for a minimum of 200 subscribers: reference to a slip inserted in this number will show how far the appeal has been met.—Edit.

MEETINGS OF SOCIETIES.

WELLINGTON PHILOSOPHICAL SOCIETY.

Wellington, 17th June, 1891.— Edward Tregear, Esq., F.R.G.S., President, in the chair.

New Member.—H. Farquhar.

A copy of Volume XXIII. of the Transactions of the New Zealand Institute was laid on the table; also proof sheets and specimen plates of Mr. Hudson's work on the Entomology of New Zealand. The plates were considered very beautiful.

The President then delivered an address, of which the following is an abstract.—Mr. Tregear commenced by congratulating Sir James Hector on receiving the founder's medal of the Royal Geographical Society. He then referred to the recent discovery of the bones of the *Dinornis* in Queensland and remarked that soundings recently taken showed solid land once to have existed from New Zealand to Australia and through the Malay Archipelago to Asia; whether the moa had been evolved from the emu by gradual transformation or the emu from the the moa would be for the geologists and naturalists to discuss. The address then referred to the theories as to man's origin, whether from a single pair or from many sources; described the primitive state of the human race, with the progress upward from the cave-dwellers to the pastoral peoples, then to cultivators of the soil, then to dwellers in cities. Referring to the question of marriage, the paper described the emergence of the communal form into the slave period and thus to the belief in the wife being private property of the husband. The speaker called attention to the agreement between anthropology and the other sciences as to the great lapse of time necessary for mankind to have existed, and to have passed through the palæolithic and neolithic periods to the building of great cities, which we now know to have been in existence 6,000 years ago. Great portions of Asia and Africa, fertile and abounding in all descriptions of animal and vegetable life were still unsettled. Many extracts from the reports of travellers just returned from the wilds were read, showing the adaptability of those places to the uses of the emigrant. But the speaker did not believe that the colonization of Africa and other places in the possession of native races was as practicable as was generally believed. The enormous fecundity of the dark races, if relieved of the checks caused by bloodshed and war, would inevitably squeeze out the incomers and prevent men of high organisation existing in force sufficient to control the lower and more persistent racial types. Mr. Tregear concluded by expressing his opinion that the future of the world was not so entirely in the hands of intellectual nations as he had once thought, but that if the advance of mankind was threatened by the overflow of barbaric peoples, he trusted that the time of submersion would be short, and the world soon resume its path of progress refreshed and invigorated with new and stronger life.

Sir James Hector in proposing a vote of thanks to the President for his most interesting address, reminded members that within the last few months they had been indebted to Mr. Tregear for a most useful addition to our local scientific literature in his Comparative Dictionary of the Polynesian Languages. His address showed that outside mere Philology Mr. Tregear was able to take a wide grasp of the great problems of anthropology. With the President's permission he took this opportunity of introducing Professor Pond, who had just arrived from Cambridge to take the Classical Chair in the New Zealand University at Auckland.

Prof. Pond considered it a high honour that he should, on his first landing, have the opportunity of attending the meeting of such a Society. He complimented Mr. Tregear on the admirable arrangement of his new dictionary,—the method was excellent. He was told at Cambridge before leaving, that he ought to consider it a high privilege his being selected for his appointment in the New Zealand University as the Examiners in England thought most highly of the work done by the New Zealand students.

Mr. Travers in seconding the vote of thanks spoke in flattering terms of the address.

2. Sir James Hector exhibited a young salmon which had been caught in the Aparima River and forwarded to him by the Marine Department. He said that there could not possibly be any mistake with regard to the specimen being a true salmon. The fact that salmon, after years of fruitless experimenting, had now been acclimatised, was highly satisfactory, though he feared that the formation of our coast line was such as forbade the return of salmon to their own rivers. Should however the salmon prove its attachment to the streams in which they were hatched, the colony would have gained a most valuable asset and one which it would be well to protect with the greatest care.

3. Sir James Hector exhibited samples of the different coals and rocks from the coal fields lately visited. With reference to the Black Bull mine a tunnel of 1,230 feet had been driven to reach the coal and two seams had been cut of first-class quality coal, making a total of 20 feet thick of coal. Samples of the rocks from the tunnel were also described. Samples of the coal from the New Cardiff and Mohikinui Company's lease were exhibited, and also samples from the Kaitangata mine, Otago, and a number of fossils found in the new shaft at Castle Hill (Kaitangata), were also on the table and described. Samples of coal from Orepuki were shown, together with a series of fossils from the Middle Waipara in the northern district of Canterbury. These latter were described as being geologically of the very greatest importance on account of the presence of *Belemnites australis* in association with *Dicotyledonous* leaves, and in the same boulders remains of *Leiodon haumuriensis,* this being the first time that these secondary fossils have been found in the Canterbury District.

Wellington, 8th July, 1891.—Edward Tregear, Esq., F.R.G.S., President, in the chair.

New Member.—William Percival Evans, M.A., Ph.D.

Papers.—(1) "Mill on demonstration and Necessary Truth," by W. W. Carlile, M.A. (Abstract) In regard to the questions what constitute necessary truths, English opinion was much divided. Hume consistently put all the truths of pure mathematics in one class, truths of matters-of-fact in another, and thus avoided the hair-splitting and contradiction of the modern Humist school. Mill took all the axioms out of the class of necessary truths and put them into the class of truths of experience. Bain called "things that are equal to the same thing are equal to one another" a truth of experience, but not, like Mill "two straight lines cannot enclose a space." Mansell, a Kantian philosopher, precisely reversed this. Bain affirmed that the axiom "things that are equal to the same thing are equal to one another" was a generalisation from experience. In support of this he said that equality was properly defined as "immediate coincidence." If so, "coincidence" could be used convertibly with "equality," but it was plain that it could not. Equal lines are not lines that coincide, but lines that would, if superimposed, coincide, a very different matter. Coincidence was learnt by sense, equality only by thought. Probably incomprehensible to the Damaraman or Bushman. The key to the possibility of geometrical demonstration lay in this, in the power we possessed of contemplating a line, for instance, as remaining the same though in an altered position and environment. The want of a true theory of identity in the opinion of Bosanquet was the great want of philosophy of the English school. Spinoza asked what is the efficient cause of a circle, answered it was the space described by a line one point of which was fixed, the other moveable. We need only to contemplate this line, the radius, as being the same in all its positions to deduce all the properties of the circle. In the IV. proposition, Euclid plainly postulated for the mathematical figures with which he dealt the capacity of being lifted and moved about and put on top of one another, or of themselves moved as others. This was the great postulate of Euclid and should be prominently set forth as such, instead of being merely taken for granted. If it were, it would be seen, at a glance, that the construction in the V., the famous *Pons Asinorum* was mere surplusage. If the big triangles formed by the produced sides could be lifted up and put on top of one another, why could not the isosceles triangle itself be lifted up, reversed, and put on top of itself. If it were, we should have two triangles superimposed on one another fulfilling all the requirements of the IV. proposition. It was plain indeed, that a matter so simple as the equality of the angles at the base did not really rest on anything so far fetched as the conventional proof in Euclid. Mr. Mill seems always to contemplate the lines and figures of geometry as if they were specimens picked up in our rambles instead of being those which we supposed ourselves to have just constructed. To sum up, with regard to necessary truths. (1) They were always concerned with abstractions. (2) The opposite of them was in the strict sense inconceivable, not merely unbelievable. (3) This was so because if we put their opposite in words, the last half of the proposition "sublated" the first. (4) They were truths which could be seen to be truths by merely thinking of them. (5) They were truths of sequence only, not of fact. That brought them face to face with a difficulty that might seem formidable, as of course geometrical propositions were used in the world of fact. The difficulty however, was not peculiar to the mathematical reasoning. They had seen that even what were called identical propositions rested on assumptions. Geometry only became of real interest and value when it was ascertained that propositions which were literally and necessarily true of the lines and circles that we supposed ourselves to construct were approximately true of the lines and circles of nature.

Sir James Hector thanked the author for his most interesting paper; it was a subject difficult to criticise until the paper had been carefully read.

Mr. Maskell agreed with Sir J. Hector that the best thanks of the Society were due to Mr. Carlile for his excellent paper which invested a dry and difficult subject with much more interest than probably anybody expected. For himself he found several very suggestive points in the paper, not so much as to the particular question treated as on general grounds. In the first place it reminded him of what seemed to be the general fault of all English writers on philosophy and logic, that they never seemed to refer to any but English, Scotch, or a few German authors. Now if they would study French, Spanish, or Italian works also they might enlarge their views and possibly gain insight into quite new and correctly suggestive trains of thought. Then again Mr. Carlile, he thought, had attached far too much importance to the notions of Professor Huxley, a man who to the speaker's mind, was as bad a specimen of blatant assumption and of illogical absurdity (except of course when dealing with actual facts of natural history) as the modern era has to show. There was one point, only incidentally referred to in the paper, which would perhaps require correction. Mr. Carlile parenthetically remarked that the axiom that two things which are equal to a third are equal to each other would be incomprehensible to a Bushman or a Damaraman. Taken as referring to any particular or existing savage, this would be probably true: taken as a general statement, with the inference that any necessary difference exists between the brain and intellect of a savage and the brain and intellect of a cultivated Englishman it would certainly not be correct, in spite of the prevailing theory of the present day which usually affirms it, if not in terms, at least by implication.

The President said: Greatly as he admired the work of Professor Huxley in the domain of natural science, he shared with others the regret that the learned Professor should ever step outside the limits of his own domain and enter the fields of politics and theology, where his logic was by no means unassailable. He (the president) had been struck with astonishment when reading Huxley many years ago to find that he had stated that all dream images were vague and undefined. This is contrary to the facts of experience with most observers. Undefined images might occupy the mind of one who was discussing a subject like "Man" from a racial point of view, but in the case of "triangle" there was no mental conception possible of a triangle generally; it was absolutely necessary to conceive the idea of a triangle as either equilateral, scalene, isosceles, &c. As to necessary truths, it was almost certainly held that the axioms of Euclid were necessary truths, but he had read a clever psychological article in a recent Magazine in which it was asked how it was possible to possess one of these "self-evident" truths except by inheritance without breaking the chain of cause and effect. Such a statement as that "Things which are equal to the same thing are equal to each other" was not a "self-evident" truth; it required reasoning from experience before the mind could place faith in it. The purely mental conception of a line as having "length without breadth" could not be called useless (although it could not be practically represented) because arithmetical figures used in trigonometry proved that boundaries of geometrical figures really had position but not magnitude (of breadth). So that this is almost a necessary truth, and although abstract truths were little more than hypotheses, still if they were "working hypotheses" they were of enormous value. He might instance the value of the 47th problem of the 1st book of Euclid; the discoverer of the principle in this problem offered up a hetacomb of oxen to the gods for so great a truth being found, and it had proved of inestimable value to the world in astronomy, navigation, engineering, &c. He could understand the schoolboys' delight if allowed to prove the truth of the fifth problem of the first book of Euclid by turning the triangle on its back, but he hardly thought such a simplification would be allowed, although many of the propositions in Euclid might be swept away as being evident at sight, and not made clearer by the attempted proof. As to Mr. Maskell's assertion that the Bosjeman or any savage had as much intellectual power as the civilised European, there would be difficulty in measuring the amount of latent power in any individual, but it was certain that the expression of that power was immensely unequal. It would be almost impossible to assert with gravity that the mind of an African who, with great difficulty, could be taught the use of numbers beyond 2 or 3, was equal to any one of the minds of Bacon, Newton, or Herschel, although a potentiality of mind equal to great intellectual effort might lie unrecognised in the brain of the savage.

Mr. Carlile, in reply, expressed his gratification at the appreciative criticism his paper had received. The President had already explained some of the matter to which exception had been taken. He had not meant to suggest that the simplification of the proof of the V. proposition which he suggested in any way detracted from its validity and importance. There were several of the propositions at the beginning of the first book which were rather obscured than illustrated by the proof furnished of them. The XIII., for instance. If we regarded a point in a straight line as an angle of 180°, it was certain that drawing any number of lines through this point could have no tendency to alter the size of this angle, yet this was what was elaborately proved. He thought a desideratum among the definitions was a definition of what was meant by the size of an angle. We proceeded to speak of the size of angles without furnishing any criterion for their measurement. If this were furnished, it would necessarily carry with it the proof of the IV., V., and VIII., and a host of other propositions. The size of an angle and the length of the subtending side in any triangle were, it seemed to him, two names for the same thing. There was no need of propositions to prove the fact of their concomitant variations.

(2) "On the shifting of the Sand Dunes," by H. C. Field. The paper gave results of forty years' observations on the coast from Paika-

kariki to Patea, and pointed out how the country generally in this part of New Zealand had undergone alterations by the shifting of the sand through the action of the wind. The author gave data for fixing the rate of such movements. The paper also contained much interesting information regarding the relics of the native race.

Sir James Hector, speaking on the paper, said he thought it a most important one. In a new country they should be very careful as to how they interfered with the natural changes of the coast line. He was of opinion that Mr. Field had done good service in bringing this matter before the Society. They in New Zealand would have to guard against selling lands situated in dangerous positions on the coasts. They should also prevent mischievous people from interfering with mouths of rivers and thus prevent natural changes. Mr. Field's paper had opened up a subject of extreme practical importance to the Colony.

Mr. J. Beetham thought this a valuable paper. He would encourage those who had the opportunity to note carefully such changes as had been spoken of. There is no doubt great alterations had taken place on our coasts and in our rivers owing to the reasons given by Mr. Field.

AUCKLAND INSTITUTE.

Auckland, June 22nd, 1891.—Professor Brown, President, in the chair.

New members.—Messrs. E. Craig, C. Malfroy, and P. Sylow.

Papers.—(1) "On the Prospects of finding Workable Coal on the Shores of the Waitemata," by James Park, F.G.S. (See p. 208.)

(2) "On the Geyser Action of Rotorua, by C. Malfroy, C.E. (See p. 203.)

OTAGO INSTITUTE.

Dunedin, August 11th, 1891.—Professor Gibbons, President, in the chair.

Papers.—(1) "On the Anatomy of *Boltenia*," by J. Watt, M.A., (communicated by Professor Parker). The paper, which was originally prepared as a thesis for honours, was illustrated by very numerous sections prepared by freezing. Among other points brought out was the remarkable variation existing between different individuals in the relative lengths of the body and the peduncle, and in the arrangement of the external ridges of the body.

(2) "On the extinction of Native Birds on the West Coast," by Jas. Richardson. The author cited the experience of Mr. Mueller (chief surveyor of Westland) and of Mr. Wilmot (district surveyor) regarding the scarcity of the kiwi and kakapo in the region between the Haast river and the head waters of the Dart river, where these birds were formerly numerous; and related how he had himself noted their disappearance from the region of Lakes Te Anau and Manapouri, the fact being attributed to the depredations of ferrets, weasels, and stoats.

Mr. Richardson also alluded, on the authority of Mr. Wilmot, to the depredations of the ferrets in the extensive forest lying between Port Molyneux and Waikawa. He claimed to have placed before the Institute evidence of the presence of the ferret at different points from the Haast river in Westland to Catlin's river, and of the rapid destruction of the kakapo, kiwi, and other ground birds in the western forests. Apart from the regret which must be felt by the naturalist, the wholesale massacre of these interesting fauna, must, he said, seriously interfere with the progress of exploration and prospecting. In the past a party could venture into the untrodden wilds lying at the back of the Sounds, carrying in the way of provisions nothing beyond salt and oatmeal, tea and sugar, relying upon always securing an ample supply of animal food, but in future the last-named essential would also have to be transported. The increased danger to life would also tend to deter prospectors from continuing investigation of a portion of the province which had already furnished indications of rich mineral deposits. There could be no doubt that very shortly it would be dangerous to camp out in many parts of Otago, especially in those which offered the greatest attractions to tourists and prospectors. He quoted the suggestion of Mr. T. O. Potts that areas of land should "be set aside and held under tapu as to dog and gun. There was, for instance, Resolution Island, amongst the Sounds. It might be proclaimed a public domain, where animals should not be molested under any pretence whatever. Some of the islets of the north-east coast of the North Island might be similarly dealt with." To the localities indicated by Mr. Potts, the speaker thought there might be added the larger islands of Te Anau, Manapouri, and Wakatipu. Mr. M'Kinnon had already successfully transferred the kakapo to Centre Island, Te Anau. By promptly adopting the proposal of Mr. Potts, we might hope to preserve small colonies of those rarer orders of New Zealand bird life whose regrettable disappearance had formed the subject of the paper.

Mr. F. R. Chapman said he had had an opportunity of observing similar facts to those noted by Mr. Richardson. When he first knew the back country one had only to kneel down and tap a gun stock, and 20 or 30 wekas would appear in places where probably not one would be seen now. He was told when he was at Orepuki three or four years ago that in the large forest from the Waiau to Jacob's river the weka had now disappeared, or almost so. Why it had disappeared there he did not know. What they had now to see to was whether any practicable suggestion could be offered for preserving the birds. He was not quite sure that they would wholly disappear from the ranges, but in a country like that of Stewart's Island he thought that it would be possible to preserve them, for, as there would be no rabbits, there seemed to be no particular reason for taking ferrets there. What he would suggest was that, following out Mr. Richardson's suggestion, homes should be made for the native birds where there would be a chance of saving them. Codfish Island, Stewart's Island, and other islands on the east and west coast, Bench Island, even the Snares and the Auckland Islands occurred to him as experimental places, and Captain Fairchild, he had no doubt, would, if applied to, be glad to take the birds from point to point and land them. At the Solanders also the birds would be tolerably safe. If the birds were to be destroyed on the main island, he thought that the steps he had suggested would be the most effectual for their preservation.

Mr. Richardson remarked, with regard to the disappearance of the weka from the forest between Jacob's river and the Waiau, that there were no rabbits there, but the ferrets had evidently gone there in advance of them.

Mr. G. M. Thomson stated that in 1882 he had crossed the Waiau at Clifton and walked to Lake Hauroto, on the shores of which he camped. He skirted all round the lake, and there were rabbits in abundance within 20 miles of the head of Preservation Inlet. He worked into the Princess Mountains, 12 miles from the head of Preservation, and at that time there were numerous birds to be seen. The tent was surrounded by kiwis and kakapos, and in the bush there were any number of crows; but these had now disappeared. In January last, at the meeting of the Australasian Association at Christchurch, the biological section passed a resolution asking that Resolution Island should be declared a reserve for Native birds. A great deal of blame had been thrown upon the Acclimatisation Societies for their indiscriminate and, he might say, ignorant work in introducing animals, and plants also; but, so far as the Otago Acclimatisation Society was concerned, he wished to say that from the very first it had every year passed a resolution protesting against the introduction of any animal of the weasel tribe, but there were men of sufficient interest with the Government to get them to introduce these animals in spite of the protest. One natural enemy of the rabbit was the weka, and the wekas had increased very much; but one effect of the introduction of the ferret was that for the last few years one could hardly come across a weka. He was sure that the rabbits had not been put down one bit by the ferrets, and a few months ago he was on the hills to the seaward of the Taieri plain when he saw rabbits playing about in numbers, while he knew that ferrets were also in abundance. He was afraid that the matter of the preservation of native birds had got beyond bounds on the mainland of New Zealand.

Mr. Richardson understood that during the Union Steam Ship Company's annual excursions to Milford Sound shooting was considered to be part of the entertainment, and he was told that last year one man, a moneyed tourist from Home, shot 160 ducks in one day during the breeding season. He thought that was a thing which should be distinctly put a stop to. A party of High School boys also had during the summer time at Manapouri left absolutely nothing till their supply of cartridges gave out.

Mr. E. Melland remarked that any islands which were set apart for preserving birds would have to be a good distance from the shore, for ferrets smelt a long way off, and also swam very well. He would suggest the Kermadecs as a place where kiwis might do very well. The rapidity with which the ferrets cleared away the wekas he regarded as remarkable. Years ago the wekas on a run at Lake Te Anau were sufficient to keep down the rabbits, which they killed apparently for sport; but two years after the ferrets had been turned out the wekas had completely disappeared from the run he spoke of, and since then rabbiting had to be resorted to every year. Speaking from experience, he never knew the ferrets to keep down the rabbits in England. He had himself protested against ferrets being turned out on the far side of Lake Manapouri, but after one shipment had by a timely accident been drowned, another shipment was sent.

Sir Walter Buller deplored very much the insane conduct of the Government in introducing stoats and weasels; but there was, he thought, a danger of exaggerating the mischief done by these animals. They were apt to put everything down to the stoats and weasels, but he thought there were other causes in operation, for many New Zealand species had commenced to disappear long before the introduction of stoats and weasels. He instanced the kakapo and other birds in the North Island, for which a refuge was found on the Great Barrier and Little Barrier Islands. The introduction of weasels and stoats had tended to accelerate the destruction of the birds, but the kiwi and kakapo were very scarce long before. Fifteen years ago these birds were exported by hundreds, and that tended to considerably thin their numbers. His argument was that there were other causes in operation beyond that suggested. He had thought the thing out very carefully, and the conclusion he had come to was that the introduced rat was the cause of the mischief. They all knew how prolific the rat was—some parts of the colony were overrun with it—and it was significant that birds that deposited their eggs on the ground, and were an easy prey to rats, were the first to disappear. This cause, he pointed out, had been in operation ever since the colonisation of these islands. Take the quail, for example, they could not blame the stoats and weasels for the destruction of that bird, for it was extinct before the introduction of those animals, and there was not one to be found now—the last quail that was sold in Italy brought £75. He referred also to the early disappearance of the swamphen, woodhen, and thrush. The remedy was the establishment of preserves, and it was necessary to have insulated areas for these. Experience showed that expiring species always lasted longest on islands, and we ought to draw a lesson from experience and place the native birds on islands. He thought the idea to utilise Stewart's Island an excellent one, but they must get it proclaimed and have heavy penalties imposed for trespass and spoliation. Sir George Grey was the first to take any steps towards the preservation of native birds, and when he purchased the Island of Kawau he proceeded to stock it with kiwis, kakapos, and other birds, all of which had lived—indeed the weka became a positive nuisance. The speaker thought they ought to insist upon an absolutely close preserve for the use of the future generation. Lord Onslow was thoroughly alive to the importance of the matter, and if the societies co-operated he believed they might confidently appeal to his Excellency, and something might be done. Unless something was done to arrest the loss of these species before this generation had passed away not one of the native birds would be left, and it would be a reproach to them that it should be so.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

Christchurch, August 6th, 1891.—Prof. F. W. Hutton, F.G.S., President, in the chair.

Paper.—(1) "On the ancient relations between New Zealand and South America," by Dr. H. von Jhering, (of Rio Grande do Sul), communicated by Prof. Hutton. Abstract:—The author points out that Mr. Wallace in his geographical distribution of animals has not made sufficient distinction between those groups of animals—such as birds and mammals—whose living genera appear only in the tertiary era, and the fishes, reptiles, &c., which are represented in the cretaceous, and the land and fresh-water molluscs many of which were living during the secondary or even the palæozoic era. He thinks that the fresh-water fauna in general gives us the most reliable guide to the knowledge of the geography of our globe during palæozoic and mesozoic times. He then discusses the relations of the fresh-water fauna of South America, as well as its geology, and arrives at the following conclusions:—

A Pacific continent existed during the whole of the mesozoic era, from which first a number of Polynesian Islands, then New Zealand, and finally Australia and New Guinea became separated.

South America was separated form North America from the cretaceous to the end of the pliocene period. A South American continent has existed only since the oligocene period. At that time it consisted of two parts united by the narrow isthmus of the Andes, which were completely separated from one another before the oligocene.

These two parts form Archiplata (the area occupied at present by Chili, Argentina, Uruguay and South Brazil), and Archiguyana (comprising the high plateau of Venezuela and Guyana).

Each of these territories had its own fauna and flora which differed from each other as much as those of Africa and North America do at the present day.

Archiguyana was united by land to Africa, a remnant of which remains in St. Helena, whilst Archiplata extended to the south in a South-Pacific-Antarctic continent which during the whole of mesozoic times kept this area in communication with the Pacific continent.

The theory of Wallace is to be rejected not only for South America but also for Australia and Polynesia, for neither lizards nor land and fresh-water shells can be transported across the sea. But we must not forget that it was he who gave to zoogeography its modern solid basis, its new methods of procedure by which progress may be made, as well as its aims and its problems.

LINNEAN SOCIETY OF NEW SOUTH WALES.

Sydney, June 24th, 1891.—Professor Haswell, M.A., D.Sc., President, in the chair.

Papers.—(1) "Angophora Kino," by J. H. Maiden, F.C.S., F.L.S. Kinos of this genus have not previously been described, although their occurrence has long been known. The author has described those of *A. intermedia* and *A. lanceolata,* and given an account of their composition. He also gives notes of those of other species.

(2) "On the Incisors of Sceparnodon," by C. W. De Vis, M.A., Corr. Mem. The author describes a large perfect adult upper incisor with portion of the premaxilla still encasing it: also a smaller not fully grown tooth with a greater extent of working surface, which is regarded as a lower incisor. From the characters of these the author accordingly concludes that *Sceparnodon* is not a synonym of *Phascolonus*. The specimens described are in the collection of the Queensland Museum.

(3) "Contributions to a more exact knowledge of the Geographical Distribution of Australian Batrachia, No. II.; with description of a new Cystignathoid Frog," by J. J. Fletcher, M.A., B.Sc. Some additions are made to the lists previously given, several collections are recorded from new inland localities, with observations on the habits and colours of the living animals of several species; and a new species of *Crinia* from Victoria, for which the name *C. Froggatti* is proposed, is described as new.

(4) "Description of a new Cone from the Mauritius," by J. Brazier, F.L.S. The new species described as *Conus Worcesteri*, has a smooth shell, white beneath a dirty yellowish epidermis, variegated with four purple or pinkish-brown bands flowing down here and there in flexuous streaks.

Sydney, July 29th, 1891.—Professor Haswell, M.A., D.Sc., President, in the chair.

Papers.—(1) "Notes on Aboriginal Stone Weapons and Implements (continued)," by R. Etheridge, Junr. Descriptions are given of a large number of tomahawks and axes from the Collections of Sir W. Macleay, Dr. J. C. Cox, the Queensland Museum, and others, including some modernised axes of the Queensland Aborigines from the last-named collection, made from old scrap-iron. The author also suggests a tentative classification for museum exhibition purposes of the stone weapons described.

(2) "Synonomy of *Helix (Hadra) gulosa*, Gld," by J. Brazier, F.L.S.

(3) "The Silurian Trilobites of New South Wales, with References to those of other parts of Australia. Part i.," by R. Etheridge, Junr., and John Mitchell. The authors give an epitome of our previous knowledge of the *Proetidæ* in Australia; discuss the general question of the genus; and describe three species, two of which were previously known, viz., *Proetus bowningensis*, Mitchell, *P. Rattei*, E. & M., and *P. australis*, E. & M. The characters of the three species are given at length, their relations one to the other, and finally with those of other countries.

(4) "Observations on the *Chloraemidae*, with special reference to some Australian forms," by Professor W. A. Haswell, M.A., D.Sc. This paper has reference chiefly to a remarkable member of the family which occurs on the Queensland coast; but the opportunity has also been taken to give some account of two other undescribed Chloraemids obtained by the author in Port Jackson.

FIELD NATURALISTS' CLUB OF VICTORIA.

ANNUAL CONVERSAZIONE.

Melbourne, May 23rd, 1891.—Baron F. von Mueller, K.C.M.G., F.R.S., in the chair.

The annual address was delivered by the retiring president, Mr. A. C. Topp, M.A., LL.B., F.L.S., who expressed his regret that during the past year he had been obliged to absent himself from so many meetings of the club, but his public duties had prevented him from taking the active part in the affairs of the club which he should have liked. The most important field work accomplished by the club during the year had been in connection with the excursions to the Kent group of islands and to the Upper Yarra, and it was a matter for congratulation that these somewhat prolonged excursions seemed now to be firmly established as a necessary part of the annual doings of the club. Apart from the actual results in the shape of new fauna and flora discovered, and new knowledge acquired of geographical distribution, such trips promoted one of the objects of the club in giving young naturalists a training and experience which would be of value to those of them who in later life might take up on a larger scale the study of natural history in unexplored or at least unsettled localities. Mention ought also to be made of the visit of Messrs. Howitt, Dendy, and Lucas, members of the club, to the Mount Wellington district in Gippsland, a report of which was read at the February meeting. In addition to the results derived from these excursions, it was encouraging to notice that during the 12 months the diligent collecting and trained observations of members had resulted in the addition of several new species of animals and plants to the Victorian fauna and flora, and many papers of interest had been read at the periodical meetings. It was a matter for regret, however, that geology still continued in the background. The annual wild-flower show in October was, perhaps, a completer exhibition of spring flowers from all parts of the colony than had previously been shown. Allusion was made in the report to several other matters and publications of interest to members as connected with Australian natural history, and satisfaction was expressed at the fact that arrangements had been made by the Mining department for a continuance of a systematic geological survey of the colony. The circumstance that so excellent a geologist as Mr. A. W. Howitt was now the head of the department was a guarantee that this work would be thoroughly and exactly carried out. Congratulatory reference was also made to two explorations which, it might be hoped, would before long give results of great scientific interest, namely the expedition despatched by Sir Thomas Elder to the interior of Australia, and the Swedish-Australian expedition to the South Pole now being organised by Baron Nordenskjöld, and promoted by the Victorian Antarctic committee.

Baron von Mueller added a few words respecting the work of the club and the expedition to the Antarctic regions, which, he now felt assured, would soon be an accomplished fact. He moved a hearty vote of thanks to Mr. Topp for his work as president of the club, and for the excellent address which he had just delivered.

An exhibition of lantern slides illustrative of the club's excursions was given, and a numerous list of exhibits was shown.

Melbourne, July 13th, 1891.—Professor W. B. Spencer, in the chair.

New Members.—Mrs. C. French, and Messrs. E. Bolter, H. C. Crofts, P. Dattari, C. Draper, S. Plowman, F.R.C.S., C. A. E. Price, J. V. Smith, C. Troedel, and T. J. Watts.

Paper.—(1) "Introduction to the Study of Sponges," by Dr. A. Dendy, F.L.S. The writer grouped his remarks under the two great divisions of calcareous and non-calcareous sponges, and described in detail the anatomy and canal system of various types. The lecture was illustrated by diagrams and many beautiful specimens, so that the subject could be followed quite easily by the uninitiated.

(2) Messrs Luehmann and French read a note and exhibited the skin of a tree-climbing kangaroo from Northern Queensland, to which they gave the name *Dendrolagus Muelleri.* This remarkable marsupial has a body about 2 ft. in length, with a tail somewhat exceeding 2 ft. The disproportion between the forelegs and the hind legs is not nearly so great as that of the ordinary kangaroo and wallaby; the toes are strong and curved, to enable it to climb tall and straight trees, on the leaves of which it exists. This species is more nearly allied to the one which was discovered a few years ago in Queensland than to the two species from New Guinea. The specimen shown was got from a straight tree, about 90 ft. above the ground.

Other natural history notes were communicated by Messrs. J. Shephard, F. G. A. Barnard, T. Steel, and E. H. Hennell.

Specimens were exhibited by Dr. A. Dendy, Mr. C. French, Jun., Rev. W. Fielder, Messrs. L. O. Grundt, R. Hall, J. G. Luehmann, W. Macgillivray, Baron von Mueller, and Mr. J. Shephard.

ROYAL SOCIETY OF NEW SOUTH WALES.

Sydney, July 1st, 1891.—H. C. Russell, Esq., Vice-President, in the chair.

New members.—Messrs. A. Bowman, J. H. Campbell, J. K. Chisholm, G. Clarke, C.E., B. Demstan, J. Gill, F. B. Guthrie, Hon. W. Halliday, M.L.C., C. Hedley, F.L.S., R. Hickson, M. Inst. C.E., C. W. King, T. W. Seaver, A. W. Stillwell, T. Ward, S. C. Watkins, M.R.C.S., F. Wells, M. Inst. C.E., R. A. Wilson, M.D., P. M. Wood, M.R.C.S.

ABORIGINAL CAVES.

Mr. W. G. Cox, of Windgidgeon *viâ* Gilgandra, wrote stating that he knew where there was another aboriginal cave similar to one recently described in a Sydney paper. It was situated close to the Munghorn Gap in the Main Dividing Range, on the road from Mudgee to Woollan. The cave is situated in an isolated freestone rock of mammoth size. These caves, he said, were generally known as the "Red-hand Caves," as all the figures represented therein were in a red colour, supposed to have been so coloured with the gum taken from the apple tree. There were also several other caves in Dunn's Mountain, in the dividing range, to the south-east of Rylstone.

ANTARCTIC EXPLORATION.

Baron von Mueller, who is taking a very active interest in the question of antarctic exploration, wrote pointing out the need for intending contributors to the exploration fund forwarding their contributions at once. He stated that an endeavour would be made that the exploration party should start from Sweden in March next year.

The Chairman stated that the secretary would be glad to receive any contributions the members had to give.

Papers.—(1) "Nos. 13 and 14 Compressed-air Flying Machines," by Lawrence Hargrave.

(2) "Some Folk-songs and Myths from Samoa, translated by the Rev. G. Pratt," by Dr. J. Fraser. The paper was in continuation of a series commenced in November last, and dealt with four myths now for the first time translated. Dr. Fraser said that of the four the most interesting was one about Mafuie, the Samoan Vulcan, and his sister Ululepapa. Mafuie had his home down below, but, unlike his classical compeer, he did not work in metals; he only cultivated taro, yams, etc., and had a huge ironwood tree, ever burning, with which to lighten his abode and help him and his men to cook their food. On the earth above there was no fire and no cooked food; everything was eaten raw. But a courageous youth named Tiitii changed all this. Like Ali Baba, he discovered a password—"Rock, rock, split open"—by means of which he descended to the regions below, picked a quarrel with Mafuie, and, wrestling with him, broke his leg and his arm, compelled him to submit, and brought away fire, touchwood, and taro. Ever since the Samoans have had cooked food. Another myth bore a striking resemblance to the Biblical account of the Fall; and yet an old native of Upolu certifies it as a genuine Samoan tale.

(3) "Preparations now being made in the Sydney Observatory for the Photographic Chart of the Heavens," by H. C. Russell. (See p. 211.)

(4) "On Cyclonic Storms," by H. C. Russell.

Sydney, August 6th, 1891.—H. C. Russell, Esq., in the chair.

New members.—Messrs. C. O. Burge, C.E., T. R. Firth, S. Jamieson, B.A., M.B., G. W. Sutherland, M.B., C.M.

The Chairman announced that the society's bronze medal and prize of £25 had been awarded to the Rev. J. Milne Curran, F.G.S., for his paper on "The Microscopic Structure of Australian Rocks."

The Rev. J. Milne Curran read extracts from his paper. In the introduction he referred to the work of previous observers in the same field, and also the particular methods resorted to in petrographic research. He explained how micro-chemical and microscopical observation as well as micro-photography were made available in the study of Australian rocks. The great development of acidic intrusive rocks in New South Wales was dwelt on, though these rocks were for the most part in the pre-Tertiary age. The presence of granite and its microscopic structure was recorded for the first time from the Lower Macquarie. Here in the heart of the great Tertiary plains, granites were found forming the tops of buried mountains. Many interesting rocks not hitherto studied were described, such as the gabbros of Carcoar, the leucite rocks of Harden, the diabases of Blayney and Wellington, and the basalts of Orange, Mendoran, Bathurst, and other localities in the New England districts. The Tertiary effusive rocks were treated of in great detail, revealing some very remarkable structures.

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THE NEW ZEALAND JOURNAL OF SCIENCE

DEVOTED TO THE FURTHERANCE OF
PURE AND APPLIED SCIENCE THROUGHOUT THE COLONY.

Judicio perpende: et si tibi vera videntur
Dede manus: aut si falsum est, adcingere contra.

CONTENTS:

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EARTHQUAKES IN NEW ZEALAND—WHAT AND HOW TO OBSERVE.

BY GEORGE HOGBEN, M.A., TIMARU.

It may be necessary to answer a preliminary question, 'Why should we observe earthquakes at all?'; for there are some people who consider that by calling attention to the subject we shall be in danger of gaining for New Zealand an unenviable notoriety. As a matter of fact, however, a very limited examination of the earthquake-history of the colony shows that, if indeed the objection be seriously urged, no fear need be entertained on that ground. Out of nearly 800 earthquakes recorded in New Zealand only two or three can be called *severe*,*—namely, those of October, 1848, January, 1855, and perhaps one other, (about which little definite information can be obtained, but which seems to have had marked effects in the district between Mts. Tarawera and Edgcumbe in the year 1836). A few more come under the head of *sharp*, and all the rest—the vast majority—are certainly not entitled to a more serious adjective than *slight*. No earthquake in New Zealand, at least in historic times, has been at all comparable with the *terremotos* or destructive earthquakes of South America. The minds of the timid may therefore be re-assured by the thought that the experience of the past does not lead us to expect greater danger from earthquakes in New Zealand than in England.

Besides removing this objection we may, perhaps, be expected to give some positive reason why earthquakes should be observed. The object is mainly a scientific one, though, as in many other inquiries purely scientific at the outset, practical conclusions and results may follow. Seismology is merely one branch of a larger subject, the Physics of the earth's crust, a complete study of which involves questions connected with the figure of the earth, the nature of its interior—whether liquid or solid, or partly liquid and partly solid, or solid by reason of the pressure though liquid in potentiality; its temperature, and rate and mode of cooling—by conduction if solid or viscid, by convection if liquid; the nature of the internal movements, if any; the consequent nature and causes of the compressions and movements that take place near the surface. The most important evidence towards forming probable theories about these matters is yielded by the phenomena connected with volcanic eruptions, and with the various earth-movements—earthquakes, earth-tremors, earth-tides or pulsations, and those larger and slower movements revealed in the elevation or depression of the land. Other effects of the forces

* It would take too long to attempt a definition of the terms *severe*, *sharp*, *slight*. Their use is not free from vagueness, but they give a convenient classification of shocks, based upon such easily observed phenomena as the stopping of clocks, the falling of bottles from shelves, injury to chimneys and walls of buildings, and so on—the appropriateness of the particular adjective depending also upon the more or less general occurrence of these events in any given district.

at work on the earth's crust are shown in faults, fissures, foldings, cleavages, and in other ways known to geologists. The vast questions here suggested are very far from being solved, and if ever they are solved at all, it can only be by theories based on the widest possible collection of data. It is, in short, as part of a world-system of observations that our observations in New Zealand will become useful.

How is this connection between New Zealand and the rest of the world to be made? The Australasian Association of Science has, by by appointing a Seismological Committee decided to do what it can. What, then, can be done?

Whatever is done in New Zealand should also be done for each of the other Australasian Colonies, and, if possible, for the islands of the Pacific, so that the general collation and comparison already referred to may be made.

The first step is for some one in each Colony to compile a list of all recorded earthquakes up to the present time, including in that list all the important details, as far as they are given in the records. For this purpose it is necessary to search official tables, scientific journals, personal narratives and the newspapers. Sir James Hector has drawn up such a record for New Zealand, which I hope soon to see published, and in a paper read by myself before Section A of the Australasian Association, 1891, a similar list was included. In gathering together the materials for the latter I asked for the following particulars:—1. Place, 2. Time, 3. Nature of Shock, 4. Apparent Direction, 5. Apparent Duration, 6. Effects—other remarks, 7. Time-checks, 8. Authority. I asked for the omission of all inferences and of unimportant details, and the replies were forwarded to me, tabulated, on foolscap sheets. Nothing was to be omitted, were it only the fact that a shock was felt on a certain date at a certain place.

When made, this list serves many useful purposes; its principal one is to indicate the directions in which the subsequent earthquake-hunting is likely to be successful. It may show roughly the distribution and comparative frequency of earthquake-shocks in different districts, suggest positions of centres or lines of disturbance, and may point to shocks in one colony synchronous or identical with shocks in another more or less distant.

The next step, which of course need not be delayed until the first is completed, is to establish a uniform system of recording earthquakes as they occur. These records should be such as can be used for determining earthquake origins, and as far as possible also the velocity of propagation, the depth of the origin and the velocity of the shock, that is the velocity of the several particles that vibrate. Good time-observations are sufficient for the first two of these, and in favourable instances for the third also, but for the fourth elaborate instruments would be necessary—indeed, even with the best instruments satisfactory results are rarely attainable, and doubt may still be thrown upon the best observations. For the observation of the time of the shock, and therefore for ascertaining the position and depth of the origin and the velocity of transit or propagation, much simpler instruments would be sufficient. They should be seismocopes, all of the same type, capable of showing the time of the earthquake and the particular phase of the earthquake to which the time recorded belongs. They should be corrected electrically with a clock regulated by some standard time. There should be as large a number of these instruments as possible, and the advantage obtained by their use would be that almost any earthquake felt at five or six places should afford sufficient data for the determination of the epicentrum (or portion of the earth's surface vertically above the real origin or centrum), and of the velocity of propagation;—and any earthquake felt, say at ten places, should give us the depth of centrum as well. Theoretically, five good times from places favourably situated should give us all these, but in practice it is better to have ten at least.

Instruments, however, cost money, and at present there seems small hope of obtaining them either from the Government or private individuals. Without crying "sour grapes," we can nevertheless console ourselves with the fact that, though instruments would yield the required data with greater certainty, yet much may be done without instruments. In fact, an observation by a careful observer, who takes the necessary precautions to check his notes of the time and the various facts of the movement, is worth at least as much as the observation of a moderately good instrument, and far more than an observation recorded by an instrument not kept in scrupulously good order.

The Charleston earthquake of August 31st, 1886, was probably one of the best, if not the very best-recorded earthquake hitherto, and yet Major Dutton tells us: "At the time of the earthquake there was not within the United States a single seismocope or other suitable instrument of precision on guard and so connected with a clock as to give an accurate record of the time at which the impulses arrived. Nevertheless there were several circumstances which gave hope that a fairly satisfactory result might be reached. . . . . The fact which gave the highest encouragement was the existence and successful working of the standard time system, whereby once each day a signal is telegraphed from an astronomical clock to every telegraph station in the country at an appointed hour, minute, and second." And he goes on to show that the habit formed by large numbers of intelligent men of daily using these facilities led to the amazingly large and accurate set of returns on which his calculations were based. (See Charleston Earthquake Report, U. S. Geological Survey, 1890.) In short, the history of the Charleston earthquake has taught us two things—the great value of time-observations, and the possibility of obtaining fairly good time observations in any country where comparison can be made with a standard time. This can be done in New Zealand, as any telegraph office gets, or can get New Zealand Mean Time from the Head Office at Wellington; and I suppose it would be equally possible in the other colonies.

By the courtesy of Dr. Lemon, Superintendent of Posts and Telegraphs, a system has been in working for nearly two years in New Zealand, by which the telegraph officers at any stations at which an earthquake is felt forward memoranda of the fact to Dr. Lemon, who sends them on to me. These memoranda are made on forms supplied to them. (See below.) A few private persons have kindly given me assistance by filling up and forwarding memoranda, and I shall be happy to send blank forms to any willing to help by recording the earthquakes that come within their own observation.

Last year I received in this way 79 memoranda with notes of 47 shocks, and was able to determine with tolerable exactness the origin of one earthquake, and approximately those of several others. This year I have received 75 so far, but the results are not yet worked out. I quote these facts to show that something may be done without the aid of instruments; but, even if the instruments were obtained and set up at chosen places, it would be desirable to continue the present system for the purpose of checking and corroborating the conclusions arrived at by their means.

I shall conclude by a few brief remarks on one or two of the headings of the form supplied to the officers of the telegraph department.

1. *Time of beginning of shock. If possible, N.Z. Mean Time.* What we really want to get is the time at each place of the same phase of the earthquake, and it is generally agreed that the best time to observe is the beginning of the first maximum. Now that is generally the moment at which most people begin to notice the motion, and therefore anyone answering the question precisely would in all probability give what is wanted. It is important that the time should be checked by communication with Wellington as soon after the shock as convenient; if any considerable time has elapsed the rate of the watch or clock by which the time was observed should be found, and allowed for.

4. *Apparent Direction.* People are very often deceived, sometimes unavoidably, as to the direction from which a shock proceeds. The best indicator generally available would be any object hanging freely and swinging to and fro (*e.g.* a chandelier or lamp). The direction of the swing may be seen by fixing the eye upon some point on the ceiling or wall. Other means of noting direction of shock are by the overflow of milk or other liquids in open vessels, by the rattling of pictures against or along the wall, or by the falling of crockery, etc., from shelves. By far the best of all these ways is that given by the swinging of suspended objects, and the beginning of the swinging should be noted, if possible. The direction taken by falling objects depends very much on the nature of the previous support. Two directions,—one belonging to the normal, the other to the transverse vibrations, commonly but not always at right angles, are often observed,—both should be noted.

The other particulars asked for serve to check and confirm the conclusions formed from the notes of time and direction, and may now and then give means of guessing at the intensity of the earthquake as shown by the velocity of the earth-particles, *i.e.* the velocity of shock. So far, I believe, no estimate has been formed of what this velocity may have been in any New Zealand earthquake. From calculations made, I believe the velocity of shock of the earthquake of September 1st, 1888, to have been between 12 and 19 feet per second. Though we cannot really determine this element without good instruments, we may be able to find limits within which it must lie.

I trust I have succeeded in showing that there is something worth observing in regard to New Zealand earthquakes, and that to observe it does not require any special training but only ordinary care and intelligence; as in everything else a high degree of accuracy only comes with practice, which as far as earthquakes are concerned, most of us would willingly dispense with. Perhaps at a future time the Editor may have space for some account of the results of the work already done by various individuals in the department of New Zealand Seismology.

EARTHQUAKE AT ____________ N.Z. *Date* ____________ *189*

[*Please answer precisely any or all of the following Questions.*]

1. Time of beginning of shock. *If possible, N.Z. Mean Time.*	
2. Whether clock was verified by N.Z Mean Time.	
3. Nature of shock—*slight, sharp, or severe.*	
4. Apparent direction—[*e.g.*—S.E. to N.W.; then N.E. to S.W.]	
5. Apparent duration.	
6. Effects, [*e.g.—clocks stopped; bells rung; crockery broken; chimneys thrown down.*]	
7. Remarks. [*e.g. previous tremors or rumbling; spilling of liquids, with direction of overflow; landslip in neighbourhood; special instruments used in observation.*	

Signature of Observer ____________

Address ____________

Date ____________

For the purpose of accurate observation of earthquakes the immense advantages of a system of standard time and the habit of referring to that time are sufficiently shown by a comparison of of the respective reports of the Charleston Earthquake of 1886 and of the East Anglian Earthquake of 1884. These advantages are still further emphasised by a reference to a paper in the "Geological Magazine" of the present year (On the British Earthquakes of 1889, by Charles Davison, M.A.) It is true that the areas over which the earthquakes investigated were felt were so small that very accurate time-observations would have been required to determine the epicentrum; but the nature of the time-notes taken shows generally that the opportunities for good time-observations are fewer in Great Britain than in New Zealand.

The interesting point for us is the careful way in which the epicentrum is determined by the intensity of the shock at various places—namely, by drawing isoseismals (or lines on the map so as to pass as nearly as possible through places where the intensity was the same). As the chief mode of finding the origin of a shock this is more likely to be successful in thickly-settled countries; nevertheless, it might be useful in these colonies to supplement and correct inferences derived from time-observations.

It is necessary, of course, that the same way of describing degrees of intensity should be employed by all observers. Nothing better, probably, can be suggested than the Rossi-Forel scale used by Mr. Davison. He gives a translation of it (reprinted below), and remarks thereon: "This scale is very generally adopted by Italian and Swiss seismologists, and, though rough and undoubtedly variable to a slight extent, is well suited to the nature of the evidence at our disposal, the range of variability of any degree of the scale being probably less than the limits of error of ordinary observations."

Rossi-Forel Scale of Intensity.

I Recorded by a single seismograph, or by some seismographs of the same model, but not by several seismographs of different kinds; the shock felt by an experienced observer.

II. Recorded by seismographs of different kinds; felt by a small number of persons at rest.

III. Felt by several persons at rest; strong enough for the duration or the direction to be appreciable.

IV. Felt by persons in motion; disturbance of moveable objects, doors, windows, cracking of ceilings.

V. Felt generally by everyone; disturbance of furniture and beds, ringing of some bells.

VI. Generally awakening of those asleep; general ringing of bells, oscillation of chandeliers, stopping of clocks; visible disturbance of trees and shrubs. Some startled persons leave their dwellings.

VII. Overthrow of moveable objects, fall of plaster, ringing of church bells, general panic, without damage to buildings.

VIII. Fall of chimneys, cracks in the walls of buildings.

IX. Partial or total destruction of some buildings.

X. Great disasters, ruins, disturbance of strata, fissures in the earth's crust, rock-falls from mountains.

ON THE CLASSIFICATION OF THE MOAS.

BY CAPTAIN F. W. HUTTON, F.G.S., &c.

(Abstract of a paper read to the Canterbury Philosophical Institute, on 1st October, 1891.)

In all but three of the species of Moa described by Sir R. Owen the bones of the leg had to be put together conjecturally from collections sent him at different times between 1843 and 1872. In consequence, the bones have, in many instances, been misplaced, and the skulls have also often been attached to the wrong species. These mistakes were, at the time, unavoidable, but the collections in the colony are now sufficiently large to enable us to detect most of the errors; and this paper is an attempt to reduce the confusion to order, to clear up the characters of the different species, and to provide a basis for further investigation.

The Moas are all included in one Family—the Dinornithidæ—but are divided into seven genera and twenty six species. The genera are founded chiefly on the skulls, but also have characters derived from the sternum, the pelvis, and the robustness of the leg-bones. The species are distinguished almost entirely by size, but sometimes characters derived from the skull can be given. In many cases the species run one into the other and the lines between them are drawn so as to give about an equal range in variation to each species. In Owen's species the metatarsus is taken as the type, except in *D. ingens*, where the tibia forms the type.

Genus Dinornis.

Skull depressed, the lambdoidal ridge flattened and the parietals hardly rising above it; the breadth at the squamosals greater than the length from the supra-occipital to the nasals. Beak rather longer than the head, depressed and obtuse at the tip; the lower jaw much curved. A scapulo-coracoid without any glenoid cavity.

Sub-genus *Dinornis*.

Top of the head flattened. Extinct Birds of N.Z., Plate 64.

D. altus, Owen—South Island. Larger and more slender than *D. maximus*.

D. maximus, Owen—South Island.

D. excelsus, sp. nov.—North Island. Same size as *D. maximus* but more slender.

D. validus, sp. nov.—South Island. Larger and more robust than *D. giganteus*.

D. giganteus, Owen—North Island.

D. robustus, Owen—South Island.

D. firmus, sp. nov.—North Island. Same size as *D. robustus* but more slender.

D. ingens, Owen—North Island.

D. potens, sp. nov.—South Island. Same size as *D. ingens* but more robust.

Sub-genus *Tylopteryx*.

Top of the head elevated. Extinct Birds of N.Z, Plate 82.

D. gracilis, Owen—North Island.

D. torosus, sp. nov.—South Island. Intermediate in size between *D. gracilis* and *D. struthioides*.

D. struthioides, Owen—Both Islands.

Genus Palapteryx.

Skull depressed; the breadth of the squamosals less than the length from the supra-occipital to the nasals. Beak about as long as the head, more compressed than in Dinornis; the lower jaw nearly straight. Extinct Birds of N.Z., pl. 45. A scapulo-coracoid with a glenoid cavity and probably a wing.

P. dromioides, Owen—North Island.

P. plenus, sp. nov.—South Island. Rather larger and stouter than *P. dromioides*.

Genus Anomalopteryx.

Skull very convex, the maxillo-jugals curved. Beak short, slightly compressed and rounded at the top; the lower jaw strong and nearly straight. Trans. Zool. Soc., vol. ii., pl. 52. A small scapulo-coracoid.

A. didiformis, Owen. = *D. parvus*, Owen—Both Islands.

A. antiquus, sp. nov.—Timaru, in older pliocene rocks. Smaller than *A. didiformis*.

Genus Cela.

Skull convex. Beak short, slightly compressed and rounded at the tip; the lower jaw nearly straight and rather slighter than in *Anomalopteryx*. Trans. Zool. Soc., vol. xii., pl. 31. No scapulo-coracoid.

C. geranoides, Owen—North Island.

C. curtus, Owen. = *D. Oweni*, Haast—North Island.

Genus Mesopteryx.

Skull convex, angled behind. Beak shorter than the head, moderately curved, much compressed and pointed at the tip; the lower jaw slender. No scapulo-coracoid. Extinct Birds of N.Z., pl. 78.

M. didinus, Owen, = *D. Huttonii*, Owen—Both Islands. A more robust species than *A. didiformis*, with which it has been confused.

Genus Syornis.

Skull convex, rounded behind. Beak shorter than the head, moderately curved, much compressed and pointed at the tip; lower jaw strong. Extinct Birds of N.Z., pls. 76 and 73. No scapulo-coracoid.

S. rheides, Owen—South Island.

S. crassus, Owen—South Island.

S. casuarinus, Owen—Both Islands.

Genus EURYAPTERYX.

Skull moderately convex. Beak very short and stout, slightly compressed and rounded at the tip; the lower jaw moderately curved. No scapulo-coracoid. Extinct Birds of N.Z., pls. 77 and 72.

E. elephantopus, Owen—South Island.

E. ponderosus, sp. nov.—South Island. Intermediate in size between *E. elephantopus* and *E. gravis.*

E. gravis, Owen—South Island.

E. pygmæus, sp. nov.—South Island. Smaller than *E. gravis.*

TABLE
OF THE AVERAGE MEASUREMENT OF THE SPECIES.

In the leg bones the girth is taken at the middle of the shaft. In the pelvis the length is that of the pre-acetabular portion only, the breadth is taken at the anti-trochanters. The breadth of the sternum is taken across the body, just below the costal region. In the skull the length is from the supra-occipital to the nasals, the breadth is taken at the squamosals, and the height is the vertical from the basi-temporal.

	Metatarsus		Tibia		Femur		Pelvis		Sternum	Skull		
	Length	Girth	Length	Girth	Length	Girth	Length	Breadth	Breadth	Length	Breadth	Height
D. altus ...	21·5	6·3										
D. maximus ...	20·0	6·5	39·0	8·5	18·5	9·4						
D. excelsus ...	20·0	6·0	37·5									
D. validus ...	18·5	6·4	35·0	7·0	16·5	8·0				3·8	4·7	2·2
D. giganteus ...	18·0	6·0	35·0	7·0	16·0	7·3						
D. robustus ...	16·0	6·0	31·0	6·5	15·0	7·6	10·0	10·0	8·3	3·7	4·2	2·1
D. firmus ...	16·2	5·2	32·0	6·0	14·8	6·7			8·2			
D. ingens ...	15·0	4·5	28·5	5·2	13·5	6·3						
D. potens ...	14·5	5·3	28·0	6·0	13·5	7·4	8·5	9·5	7·5	3·5	4·1	2·1
D. gracilis ...	13·5	4·5	26·0	5·0	12·4	6·2				3·2	3·7	1·8
D. torosus ...	12·5	4·4	24·7	5·2	12·0	6·0	8·0	8·3	7·1	3·2	3·7	1·8
D. struthioides ...	11·5	4·0	22·7	4·6	11·0	5·2	7·7	6·7		2·9	3·1	1·7
P. dromioides ...	10·0	3·6	19·7	4·0	9·6	3·9				2·7	2·4	1·3
P. plenus ...	10·4	3·8	21·0	4·2	9·5	3·6	7·5	6·0	5·2			
A. didiformis ...	6·5	3·0	14·0	3·5	8·0	3·6	5·7	5·4	3·7	2·8	2·6	1·7
C. geranoides ...	5·7	3·0	12·4	2·9	7·3	3·5	5·2	5·2			2·4	1·8
C. curtus ...	4·8	2·6	10·1	2·6	6·0	3·0	4·0	3·5	2·7		2·4	1·4
M. didinus ...	6·8	3·6	14·9	3·8	9·1	4·4	6·4	7·6	4·2	2·7	2·4	1·6
S. rheides ...	9·3	5·2	21·2	5·3	12·0	6·3	9·0	11·0				
S. crassus ...	8·5	5·0	19·0	4·8	11·0	5·8	8·1	10·1	6·5	3·8	3·4	2·0
S. casuarinus ...	7·6	4·3	17·1	4·0	9·8	5·0	7·0	9·0	5·2	3·7	3·2	2·0
E. elephantopus ...	9·5	6·5	22·4	6·2	12·3	7·3	7·0	11·7	8·4	2·9	2·8	1·8
E. ponderosus	8·5	6·0	19·5	5·5	10·5	6·0	6·0	10·0	7·2	2·7	2·7	1·8
E. gravis ...	7·4	5·0	16·7	4·2	9·2	5·0	4·5	7·0	6·5	2·4	2·6	1·7
E. pygmæus ...	6·0	4·0	13·5	5·0	7·5	4·5						

NOTES ON THE GEOGRAPHICAL RELATIONS OF OUR LAND AND FRESH-WATER MOLLUSCA.

BY H. SUTER, CHRISTCHURCH.

In No. 4 of this Journal, page 151, an article by Dr. Von Jhering appeared, dealing with the geographical distribution of the fresh-water mussels. He says that Dr. Günther unites the fresh-water fishes of Chile and New Zealand, and that the study of the *Najadæ* confirms this fact, as *Unio mutabilis*, Lea., from New Zealand and Australia has its nearest ally in *Unio auratus* of Chile. The mere resemblance of certain mussels from Australasia and Chile could hardly be taken as a conclusive proof of the former existence of a large continent extending between Australasia and South America, but here Dr. von Jhering helps us out of the difficulty by his most important and interesting discovery of the mode of hatching the embryos. The South American *Najadæ* hatch their embryos in the internal branchiæ, while those of Europe and North America perform it in the external branchiæ. The embryos of both are very different also.

In his last letter to me Dr. von Jhering expressed his opinion that the *Najadæ* of Australasia would very likely show the same peculiarity in the mode of hatching the embryos as those of South America, and asked me to work together with him in this direction, as well as to ascertain by a large number of measurements of *Unio* from many parts of New Zealand, whether we have only one or very few species of *Unio* with many local varieties, or really 6 to 8 distinct species.

I made a start with the work at the end of July, when Mr. W. W. Smith, of Ashburton, very kindly sent me several hundred specimens of *Unio* from Albury Creek, and a few from Ashburton River. It was rather late in the season, as Professor Hutton says that our *Unio* breeds in June, but I was fortunate enough to find a good number containing embryos, all of those mussels being of medium size. On opening the mussels carefully I found the small, white and globular embryos lying, without exception, before the *internal* branchiæ, thus proving that these *Unios* show the same peculiarity in hatching their embryos, as those of South America. It may be objected that I did not find the embryos *in* the internal branchiæ, but only accumulated before them. To this I may reply that the mussels had been lying alive in a box several days before they reached me, and according to an observation made by Prof. A. Forel, of Morges, Switzerland, the *Najadæ* expel their embryos when in want of oxygen. This was certainly here the case. Moreover the embryos are widely different from those of the *Najadæ* of the Northern Hemisphere. Anyone who knows the latter ones would not think it possible, in looking at the embryos of our *Unio* under the microscope, that they really were embryos of *Najadæ*. It is well known that the embryos of the *Najadæ* of the Northern Hemisphere attach themselves to the slimy skin of fishes for further development, and fresh-waters containing no fish are also devoid of *Najadæ*. Dr. von Jhering never found embryos of *Najadæ* on the skin of South American fishes, and it will be the same with those of New Zealand. The embryos of the South American and New Zealand *Najadæ* possess neither the sharp and angulated rudimentary shell, nor a byssus to fix themselves on the skin of fishes, and very probably begin their existence in the sand or mud of the water, after having been expelled from the mother mussel.

Now this is evidently conclusive proof of a former land communication between New Zealand and South America, as the *Najadæ* cannot live in brackish or salt water, and I think it very likely that the *Najadæ* of Australia and Tasmania will show no difference in the mode of hatching the embryos and the structure of the latter.

Besides the *Unio* we have some more mollusca very nearly allied to those of South America, especially of Chile. *Carthœa Kiwi*, Gray, belongs to the family of the Orthalicidæ, found in South America, which are mostly living on trees. Our shell has retained this mode of living, as the leaf-sheaths of the Nikau palm are a favourite hiding place for it. *Amphidoxa*, of which 10 species are known in our colony, and of the Patulidæ the group *Stephanoda* may be common to Chile and New Zealand, though the dentition of the American species is not known. *Tornatellina* and *Realia* also are found in both countries. There is another of our land shells which will perhaps prove to be closely allied to South American forms, namely, our *Dandebardia neozelanica*, Pf., of the Waikato district. I think Pfeiffer was quite wrong in placing this mollusc in the genus *Dandebardia*, which is known only from some parts of Europe, Western Asia, and Algeria. I have but litle doubt of its belonging to a South American genus, but the question can only be decided on examining the animal. I have not been able to obtain it either alive or preserved in spirits, but should be greatly obliged to anybody who could procure it for me.

Very little is yet known of the anatomy of the land and fresh-water shells of most parts of the Southern Hemisphere, though New Zealand in this regard no doubt takes first rank. But of the land and and fresh-water mollusca of Tasmania, of a great part of Australia, Polynesia, and western South America, we know very little beyond the descriptions of the shells. Judging from the form of the shells only it is very hazardous to say which forms are nearly allied, and one might very often be mistaken. I will only mention here that Mr. Ch. Hedley of Sydney, on examining the animals of shells from Lord Howe Island, which he and Mr. Brazier considered to belong to the genus *Rhytida*, found them to be *Patula*. I have had similar experiences here in New Zealand. *Hyalina corneo-fulva*, Pf., I found to belong to the genus *Amphidoxa*, and what I considered to be a *Diplomphalus* has proved to form a peculiar group of *Patula*.

I have satisfied myself that the land and fresh-water fauna of the Southern Hemisphere, with the exception of a few cosmopolitan genera, is entirely different from that of the Northern Hemisphere, much more so than the conchologists of the latter admit.

I quite agree with Dr. von Jhering that the study of the fresh-water fauna will help us to gain a proper knowledge of the geographical distribution of the organisms during the Secondary epoch as well as for the distribution of land and water during that time.

Let us now see what relations our land and fresh-water mollusca show to those of Tasmania. The only *Unio* from Tasmania, *U. Legrandi*, Pett., seems to be closely allied to our *U. aucklandica*, Gray, but nothing is yet known of the mode of hatching the embryos in the Tasmanian species. The occurrence of *Unio* in the rivers of the northern part of Tasmania only, as asserted by Messrs. Petterd and Beddome, is very interesting, especially from the geological standpoint. Of the very greatest importance in the occurrence of fresh-water shells is the genus *Potamopyrgus*, which is found in New Zealand and Tasmania only, though Tryon mentions it from Cuba. P. Fischer in his "Manuel de Conchologie," gives only New Zealand as the habitat of *Potamopyrgus*, and it is also not mentioned in the list of shells from Cuba. If Tryon's notation is correct it coincides with the genera *Gundlachia* from Tasmania and *Microphysa* from New Zealand, which both are also found on the Antilles. This would lead to the supposition of a former land communication between Tasmania, New Zealand, and the Antilles!

Potamopyrgus is not found in Australia, and there are only two possibilities to account for this fact, viz.: either there was once a direct land communication between New Zealand and Tasmania, or it was by way of Southern Australia; in the latter case we must admit that the genus *Potamopyrgus* became extinct in Australia, perhaps by being existent in those parts only which are now submerged. I am inclined to stand to the first theory. The present considerable depth of the Tasman sea is no obstacle to it, and it is a fact, pointed out by several conchologists and observed by myself, that our molluscan fauna is most nearly allied to that of Tasmania. In two papers which appeared in the "Transactions of the New Zealand Institute," vols. 22 and 23, I referred to the close relation between *Patula subantialba* and *P. mutabilis* of New Zealand, and *P. antialba* and *P. Eastbournensis* of Tasmania. The genera *Rhytida*, *Patula*, *Pupa*, *Bulimus*, *Planorbis*, *Amphipeplea*, *Limnœa*, *Amphibola*, etc., are common to both in many similar forms, and *Gundlachia* of Tasmania has no doubt its nearest ally in *Latia* of New Zealand. We know very little at present of the anatomy of the Tasmanian land and fresh-water shells, except *Potamopyrgus*, but I am convinced that when it is known, a much closer alliance between the molluscan fauna of both countries will be shown to exist. A further support for my standpoint is shown in the small number of forms common to southern Australia and New Zealand, if we ignore the cosmopolitan genera, which no doubt would be much larger had our former land communication with Tasmania only been by way of Australia.

The relationship of our molluscan fauna to that of Australia is, as just mentioned, not very great. Besides the cosmopolitan genera there are only *Rhytida*, *Paryphanta*, *Janella*, and *Amphibola* especially to be mentioned. Of *Paryphanta* there is only one species (*P. atramentaria*) known inhabiting Victoria, whilst New Zealand has five species. This genus is limited to New Zealand and Victoria. *Helix Taranaki*, *H. reinga*, and *H. ophelia* are North Australian species, said to have been found also in New Zealand, but the first two are not in any of our collections, and the third one has not been compared from both localities. Judging from the hypothesis of a former land communication between New Zealand and Australia it is quite possible that the three species are common to both countries. It would be of the highest interest and importance to explore the high north of New Zealand for land and fresh-water shells. The fresh-water shells *Bulimus*, *Planorbis*, *Amphipeplea*, and *Limnæa* are found in nearly allied forms in New Zealand and Australia, and *Unio mutabilis*, Lea., is also said to inhabit both. I have not seen any description or figure of this *Unio*.

A good number of our shells point to a former land communication with the islands of Lord Howe, Norfolk, Kermadec, New Caledonia, Polynesia, and Phillipine Islands, but there remains much to be done before we are able to make decisive conclusions. Mr. Charles Hedley, of the Australian Museum, Sydney, has lately published a very good and interesting paper on the land and fresh-water shells of Lord Howe Island, in which he points out that the occurrence of the genus *Placostylus* speaks eloquently of a recent land communication extending on one side to New Caledonia and on the other to New Zealand. Our genera of *Diplommatina* and *Realia* are also mentioned from this island, and they are also found on Norfolk Island. With the Kermadec Islands we have one species common, *Vitrina (Helicarion ?) ultima*, *Houss.*, which formerly has been found near Auckland. New Caledonia has the genera *Rhytida*, *Placostylus*, *Janella*, *Amphibola*, *Melanopsis*, *Diplommatina*, etc., common with New Zealand. Our genera *Vitrinoidea* and *Leptopoma* (probably *Lagochilus)*, show that land formerly extended so far north as to the Phillipine Islands and very likely up to Asia.

A large number of the New Zealand genera are also distributed over Polynesia, of which I would only mention *Rhytida*, *Pitys*, *Tornatellina*, *Bulimus*, *Amphibola*, *Diplommatina*, *Cyclophorus*, *Realia*, and *Hydrocena* as the most important ones.

Of many of our shells we do not know how far they are related to similar forms of Polynesia, as the anatomy of the latter is unknown at present. I am willing to undertake the work as far as time permits, if only I could get the shells with their animals, either alive or preserved in diluted methylated spirits, or our "national drinks,"—whisky, brandy, gin, could be used for the same purpose. I should be very thankful to anybody who would kindly procure me land and fresh-water shells with the animals from any part of Polynesia, Chile, Australia, Tasmania, and New Zealand, and I am always ready to give the necessary instructions for collecting, etc.

This paper is by no means intended to be exhaustive on the subject, I merely wish to point out how far the present knowledge of our land and fresh-water shells may help us in geological speculations with regard to former extensions of land and water on the Southern Hemisphere, and to show how much work remains to be done.

P.S —Since I wrote my short notes on the geographical relations of our mollusca, I collected a number of *Unio* in the River Avon, and amongst them I found six to be in a spawning condition. About one-third, the central part, of the *internal* branchiæ was entirely filled up with the small white embryos, just in the same way as is the case with the *Najadæ* of the Northern Hemisphere. The embryos showed the same aspect as those of the *Unio* from Albury Creek. The external branchiæ contained a few scattered embryos only.

I said that our *Carthæa Kiwi* belonged to the family of the Orthalicidæ. In saying so I followed Mr. T. F. Cheeseman, who placed our shell in this family (Trans. N.Z. Inst., XIX., p. 170). This is no doubt a mistake. The other day I studied the dentition of *C. Kiwi*, described and figured by Prof. F. W. Hutton in vol. XVI. of the Transactions, and I have come to the conclusion that it belongs to the genus *Bulimulus*, Leach, sub-genus *Orthotomium*, C. & F., section *Rhabdotus*, Albers, of which about five representatives are found in Chile.—H. SUTER.

REVIEW.

Introductory Class-Book of Botany, for use in New Zealand Schools. By George M. Thomson, F.L.S., Science Master in the Dunedin High Schools. (Wellington, Didsbury, 1891.)

Mr. Thomson has produced a book which ought to be of great use to science teachers. The ordinary text books of Botany are concerned in great measure with the plants of the Northern Hemisphere, and without access to large and costly original works it is often extremely difficult to get any information about the common native plants. On the other hand so many Northern forms are now thoroughly acclimatised that a book dealing only with natives would be of limited application. Mr. Thomson has wisely selected his types partly from the native, partly from the introduced flora of the Colony, and his book is therefore one which should be useful both in districts like Dunedin, where native plants are still abundant, and in those like Christchurch, in which only introduced forms are to be had.

The descriptions are clear and accurate, and are illustrated by three plates and by no fewer than 227 woodcuts interspersed in the text. The only fault one can find in them is one for which the author is not responsible—they are often very badly printed; the drawing, however, is excellent, and the numerous sections of flowers and of pistils, figures of anthers, floral diagrams, etc , are just such as are required to aid the student who uses the book as it ought to be used—with the plants before him and with pocket-knife and magnifying glass ready to hand.

A great deal of useful and suggestive information is given incidentally about such branches of the subject as insect-fertilisation, the "sleep" of plants, modes of climbing, etc., etc. This department might have been extended with advantage, and one would have been glad to see something about the general physiology of plants—the nature of their food and the method by which it is taken in and distributed. It is always worth taking some trouble to impress upon students the fact that the plant is a living, feeding, breathing, organism, and not a mere lifeless "specimen."

If I may venture to criticise the methods of so experienced a teacher I should like to say that Mr. Thomson appears to me to err on the side of undue elaborateness of terminology, and especially in introducing technical terms before the necessity for them is apparent to the pupil. For instance, a beginner who has only examined the buttercup cannot be expected to see the necessity for applying the term *aposepalous* to the calyx, but by the time he has got to the Sweet Pea the need for distinctive terms forces itself upon him. Some of the terms of the systematic botanist are quite unsuitable and even mischievous to beginners. What, for instance, can be more absurd than to say that the *cohesion* of the sepals of buttercup is aposepalous, or in plain English that they do not cohere at all.

But it would be manifestly unfair to blame Mr. Thomson for not having reformed the terminology of botanical science in a school text book; he has produced a book which will sustain his reputation and which ought to have the effect of diffusing the study of botany—the best of science-subjects for the purposes of the average school.

T. J. P.

GENERAL NOTES.

"On Moa Bones."—In the number of the "Journal of Science," just received, there are two matters mentioned, on which a few words may be of use to you and others interested in scientific matters.

Mr. W. W. Smith speaks of the "ancient dog which was the companion of the moa-hunters" in the Middle Island. The fact of dogs' bones being found in company with those of the moa is, to me, proof positive that the birds were killed by Maoris, as the Maoris seem all to agree in stating that the dog was brought here by their ancestors from Hawaiki, which I feel certain was Central America, and not Polynesia, though possibly some of the eastermost Polynesian islands may have formed a stage on the journey, as they are all evidently peopled from the same source, and all agree in describing it as to the eastward. The native names of places in America are all Polynesian, and have meanings in Maori and its kindred dialects, with only such changes of spelling or sound as actually occur in one or other of those dialects; while some of the names actually occur in New Zealand. Some old neighbours of mine, who had lived many years in Australia, often spoke of it as a curious fact, that the Negritos there had never domesticated the dog; for though these animals were found there in a wild state, they were the only placental mammals, except the ubiquitous rat and mouse, and had unquestionably been introduced by the Papuans, who visited the northern portion of the country. There is therefore no reason to suppose that the Negritos, whom the Maoris found in New Zealand, and who have left such strong racial traces here, knew anything about the dog, far less possessed and tamed them. As regards the extinction of the moa, I do not feel sure that they are extinct, even now, in remote localities, as the Maoris believe in their existence, and it seems perfectly certain that the last of them hereabouts were killed with firearms, about the time of the introduction of Christianity, as the natives assert. I have myself found moa-bones which had unquestionably been cut in two, and had the flesh chopped off them with keen steel weapons. and during my early residence in the colony, I met many Maoris who seemed to have perfect knowledge of the bird, and said they had often eaten its flesh. Probably it held its ground far longer in this wooded region than in the open country on the eastern sides of both islands: and this has led to the differing views respecting it, entertained by enquirers in the two localities.—H. C. FIELD.

MIGRATION OF EELS. — Mr. S. Percy Smith contributes some notes as to the migrations of eels, which I can corroborate. These fish come up from the sea in large shoals, about the months of October and November, when about two inches long and as thick as a straw, and work their way up the tributary streams to very high levels, large numbers living in swamps. They surmount the waterfalls by wriggling upwards among the wet moss beside the falls; and the Maoris assert that each fish takes hold of the tail of the one in front of him with his mouth, so that they all help each other to ascend. This much is certain. If the head of the column is dislodged, the whole fall down; and the Maoris take advantage of this to catch large quantities of these "tuna-riki" (little eels), by holding flax baskets below a column and then detaching it. They then dry them for winter food, just as they do the whitebait, and the little eyeless fish of the volcanic springs at the head of the Roto-aire lake. I know streams, tributaries of the Mangawhero and Wangaehu rivers, which swarm with eels that have surmounted falls 200 feet to 300 feet high. Again on the west side of the Wanganui river, near the heads, there was formerly a large swamp, the surplus water of which trickled into the river over a flat of sand several chains in width. In the autumn of 1856 or thereabouts, a gentleman who had been to the pilot station, and was returning late in the evening, found a great number of large eels wriggling their way across the sand from the swamp to the river, and brought a string of them, as heavy as he could carry, back to town with him. For some nights afterwards, several of us visited the spot, and secured a large number. The migration lasted for about a week. The Maoris are perfectly well aware that the large eels migrate to the sea with the first autumn rains, and catch great numbers of them with traps at that season. The rain, no doubt, causes the water of the streams and lakes to rise, and so increases the pressure as to warn the fish to migrate. It was probably in this way that the eels of the Chatham Island lagoon, mentioned by Mr. Smith, knew that their way to the sea was open, The doubt as to the migration of eels, raised by Mr. Dingan in 1875, was founded on an entire mistake. He spoke of the Virginia lake here as having no communication with the sea, and yet as being one of the best fishing grounds hereabouts for eels. The actual facts are as follows. There are several lakes near here in which there are no eels; and any Maori would, at once, tell you this was because those lakes do not communicate with the sea. The Virginia lake was one of these. Up to 1855 or 1856, there were no eels there. Just then, however, the main road northward from Wanganui was constructed; and to enable it to be carried along the southern margin of the lake, a trench was dug through the lowest adjacent ground, and the water was lowered 3 feet or so. In the following spring eels ascended to the lake in considerable numbers, though they had to surmount a fall of about 20 feet in height. Several years later this trench was deepened, in order to enable a supply of water for a flourmill in town to be drawn from the lake in dry weather. After this, more eels found their way up to the lake, and this continued till the lake was utilised as a source of water supply for the town about the year 1873, when the outlet was closed. Mr. Dingan was a new-comer here at that time; and it was no doubt through his having no knowledge of the facts which I have just stated, that he, in October, 1875, arrived at the erroneous conclusion respecting the eels in the lake. It was soon found that the lake could not be relied on as a source of water supply, as it drains no appreciable area of land; and therefore pipes were laid to bring into it water from another larger lake two miles distant. This last lake is connected with the sea and contains eels; and every autumn, some of the large ones, endeavouring to migrate seawards, come through the pipes into the Virginia lake. We know this for certain, because some of them stick fast in the pipes and cause a stoppage. This happened twice last autumn to my own knowledge. The presence of eels in the Virginia lake is no mystery; but they certainly are not bred there, as there are no small ones. Only a few people residing close by take the trouble to fish there, and they do not get above two or three in an evening (two is the most I have ever known taken by one person in an evening), but they are all of such a size as to be worth catching. I have fished in the lake repeatedly during the last two seasons, and occasionally before that, but have never known an eel under 2lb weight to be caught there since the Westmere water was introduced, and the average size gets larger year by year. Early in this year I saw Mr. Dingan hook one, which he judged to be 7lb or 8lb in weight, and which broke his tackle.

There is another circumstance connected with this lake which may be worth mentioning. Fifteen or twenty years ago, English perch were put into several of our lakes by our Acclimatisation Society. In some of these lakes they have bred so rapidly that it is not unusual for an angler to take from fifty to sixty in a few hours, but he seldom gets a fish of over ¼lb weight. There is one such lake about two miles from the Virginia, and similarly situated in every way except that it is far shallower. The largest perch that I have ever caught there weighed only 1½lb, and the largest that I have heard of as taken from it was only about $2\frac{1}{2}$lb. In other lakes none at all have yet been caught, though possibly more experienced anglers might succeed in getting some. In the Virginia lake there seem to be but few, but they are very large. From two to five are the most that any one catches in an afternoon; but out of several dozen which I took there last season, the smallest weighed 1lb 7oz., and the largest more than $3\frac{3}{4}$lb. One gentleman told me that he saw a number of young fry last summer, which he thought were perch from their being in company with large ones and from the redness of their fins, but no one else has noticed any. Several years ago the neighbouring lake which I have mentioned, got so low during a dry summer, that the fish in it were dying; and the secretary of our Acclimatisation Society netted all that he could and took them to Virginia lake; and latterly several of us have made a practice of transferring our smaller fish from the one lake to the other; yet still the rule holds good that the perch increase rapidly in the one lake, and apparently not at all in the other. Possibly the eels in the Virginia lake may have something to do with it; but they do not stop the increase in other lakes. Some blame the shags, but these are far more numerous in other lakes where the fish increase notwithstanding. The only thing in which the Virginia lake differs from the others is that, many years ago, two Murray river cod were put into it, and one of these was certainly still alive last summer, as it was seen, and had grown to an immense size. It is hard to suppose however, that one or two fish could keep down the increase in a lake more than twenty acres in extent. Trout and carp were also put into the lake about the same time as the perch. Some of the latter are seen occasionally, and also what appear to be the former rise in considerable numbers of an evening; but no one has caught any of either, though we have tried to do so repeatedly. There are numbers of small fish in the lake which have all the appearance of smelt, but which I believe to be small trout; as on one occasion I caught a trout in a pond in Hampshire, which had lost its red spots and become quite silvery.—H. C. Field.

New Otago Plants.—In the Reports of the Dunedin Naturalists' Field Club, for the years 1879 to 1881, there were printed very complete lists of the native phanerogams and ferns growing in the neighbourhood of Dunedin. The lists contain some errors, which do not call for special notice here, my object being simply to record the names and localities of a number of additional species found near Dunedin. Several of them have been described for the first time since these reports were made up. Other plants no doubt remain to be discovered in the district, but it is unlikely that any future list of discoveries in the district will reach such length as the present one.

The most interesting novely to the Dunedin district is *Trichomanes colensoi*, Hook. f. This delicate fern grows in the valley of Morrison's Creek, one of the western feeders of the Water of Leith. It has been very plentiful at one time in the spots where it still grows, but the clearing off of the bush has made the habitat too dry and open for it to thrive under the altered conditions. Probably, however, it occurs in other localities in Dunedin, and some of these may well be more favourable to its survival in the district.

Ranunculus tenuicaulis, Cheeseman—Flagstaff Hill.
Coprosma rubra, Petrie—Town Belt.
Coprosma areolata, Cheeseman—Town Belt.
Coprosma rigida, Cheeseman—Saddle Hill; Opoho.
Olearia fragrantissima, Petrie—Vauxhall; Saddle Hill.
Celmisia linearis, Armstrong—Maungatua (2900 ft).
Gnaphalium Traversii, Hook. f—Town Belt; Flagstaff; Signal Hill.
Helichrysum Purdiei, Petrie—Vauxhall and Rothesay.
Forstera tenella, Hook. f.—Flagstaff and Maungatua.
Phyllachne Haastii, Berggren—Maungatua. I am indebted to T. Kirk, Esq., F.L.S., for detecting this species.
Dracophyllum prostratum, Kirk—Maungatua
Gratiola nana, Bentham—The Flat; Strath Taieri road.
Glossostigma submersum, Petrie—Lake Waihola.
Plantago uniflora, Hook. f. var.—Tomahawk Lagoon.
Atriplex Buchanani, Kirk—Gathered near Dunedin by the Rev. Mr. North, as I hear from T. Kirk, Esq., F.L.S.
Corysanthes rotundifolia, Hook. f.—Waitati Valley.
Pterostylis mutica, Br.—Outram and Lee Stream.
Thelymitra pulchella, Hook. f.—Signal Hill (rare).
Potamogœton pectinatus, L.—Lake Waihola.
Zannichellia palustris, L.—Waikouaiti Lagoon.
Lepilœna biloculata, Kirk—Taieri Plain (ditches)
Zostera nana, Roth—Otago Harbour
Astelia grandis, Hook. f.—Town Belt.
Juncus lamprocarpus, Ehr—Sawyer's Bay.
Gaimardia setacea, Hook. f.—Maungatua.
Centrolepis pallida, Bentham—Maungatua.
Schœnus concinnus, Hook f.—Waikouaiti Beach.
Cladium glomeratum, Br.—Signal Hill.
Oreobolus strictus, Berggren—Flagstaff Hill.
Uncinia cœspitosa, Boott—Pine Hill (Bush).
Uncinia rupestris, Raoul—Town Belt.
Uncinia rubra, Petrie—Signal Hill.
Uncinia rigida, Petrie—Waitati Valley.
Uncinia riparia, Br.—Town Belt.
Carex colensoi, Boott—Maungatua.
Carex testacea, Solander—Environs of Dunedin.
Carex Buchanani, Berggren—Lake Waihola.
Deyeuxia Billardieri, Kunth—Lawyer's Head.
Danthonia pilosa, Br.—Signal Hill.
Deschampsia tenella, Petrie—Morrison's Creek.
Poa pusilla, Berggren—Signal Hill.
Poa Kirkii, Buchanan—Maungatua.
Festuca scoparia, Hook. f.—Brighton.
Triodia australis, Petrie—Maungatua.
Trichomanes colensoi, Hook. f.—Morrison's Creek.

—D. PETRIE.

The Disappearance of Spear-Grass.—It is well known that the large species of Spear-grass *(Aciphylla)* are rapidly disappearing in all parts of Otago, and it is very probable that this once common and characteristic element in the native vegetation of the district will soon become as rare as it was formerly abundant. The causes of this change in the prevailing vegetation of large tracts of country seem to merit some consideration. It might be thought that plants naturally so admirably defended against the attacks of herbivorous animals would be practically exempt from their ravages All kinds of stock eat the foliage readily enough, but the larger animals are for the most part prevented from indulging any liking for it by the habit of growth of the plants and the dense array of sharp points that meet their lips and tongue. Rabbits however are not so easily repelled, for owing to the small size of their heads they can attack single leaflets while keeping clear of those standing near them. Accordingly spear-grass plants are eaten by them more or less at all seasons, but especially during the winter and in elevated situations where snow lies on the ground for considerable periods. In such stations the plants suffer very seriously from their attacks, and in many extensive districts have been already all but exterminated. As a rule the leaves are eaten right back to the ground and the plants die off at once. In lower situations the rabbits are not so troublesome, but even there the disappearance of the plants, though less rapid and complete, is going on steadily and surely. I do not know to what age the life of a spear-grass plant may extend, but it can hardly exceed fifteen or twenty years. In that time we may suppose that all the well-established plants will die off from old age. Seeds are produced as a rule in great abundance, but in spite of this the number of young plants that may be observed growing up is very limited, and in ground that is well stocked and closely cropped hardly any are to be seen. On the other hand if a patch of land is securely fenced against cattle and sheep great numbers of plants of all ages are to be found. This may be very well seen in the somewhat extensive railway enclosures in the valley of Manuka Creek on the Lawrence branch railway line. Within this enclosure plants of *Aciphylla squarrosa* of all ages abound, and easily hold their own against all competitors in the struggle for existence. Outside the railway fences on the other hand plants of any age are extremely rare, even on land that has never been touched by cultivation, and seedlings are hardly to be met with anywhere. Rabbits are not very plentiful in this district, and the disappearance of the spear-grass cannot in any way be attributed to their interference. Everything goes to shew that as the old plants die off, the young ones are not suffered to grow up to take their place. This is most likely due to the fact that cattle and sheep readily eat up the tender and less pungent, rigid, and compact leaves of the young plants. There cannot, I think, be any doubt that stock readily eat the foliage when they can attack it without danger from the prickles, and this they can easily do when the plants are in the seedling state. The rapid disappearance of spear-grass therefore, seems due in the lowlands to cattle and sheep eating up the tender seedlings, and in the higher and bleaker situations to the attacks of rabbits, more especially in the winter season. In rabbit infested country of considerable elevation, the larger Aciphyllas at any rate are doomed to speedy extermination. In the closely stocked lowlands their extinction though less rapid seems equally certain. And it is chiefly in stations intermediate in elevation between these and where the country is not very closely stocked, that these interesting and curious plants are likely to survive as a permanent but scarce element in the native vegetation.—D. PETRIE.

NOTE ON LEUCOPOGON FRASERI, A. CUNN.—In May of the present year, I gathered in the neighbourhood of Kelso, a number of specimens of *Leucopogon Fraseri*, in which the inflorescence presents a peculiarity which I have not seen noticed in any account of the plant. The flowers instead of being solitary occur in pairs that are sessile on the ends of the short peduncles. In these specimens a solitary flower on each peduncle is quite exceptional. Each flower of the pair is sometimes of the same size as the other, but more commonly one is larger and better developed than the other, which is however by no means rudimentary.

I do not know whether it is generally known that the flowers of this species are well formed in the autumn, and the buds undergo but slight further growth before opening in spring. The stamens and pistil are wrapped up in a very dense coating of long hairs that grow outwards and downwards from the upper half of the corolla. It is evident that one of the chief functions of this outgrowth of the corolla is to shelter the reproductive organs contained in the bud, which are exposed to all the frosts of the sharp winter of this district. It has been supposed that the sole use of the hairy coating of the corolla was to minister to cross fertilisation by the agency of insects, but it is more likely that its primary use is to serve for the safe nursing of the bud during the winter. This view is in no way inconsistent with its further use in promoting cross fertilisation; the double use, indeed, affords only another illustration of the fact that an organ originally fitted to serve one purpose, is often turned to account for another of secondary, but still of important utility to the organism.

In *Pentachondra pumila*, Br., a similar coating of hairs invests the interior of the corolla, and it would be interesting to know, if in this case also, it was primarily designed to form a protection for the bud during the winter season. I have not as yet had opportunity to examine the winter state of this plant, but I hope soon to be able to throw some light on the question.

In the "Handbcok of the New Zealand Flora," the specific name of the present species of Leucopogon is printed *Frazeri*, but in Cunningham's "Præcursor" the name is printed *Fraseri*. I do not know on what grounds the spelling *Frazeri*, was adopted by Sir Joseph Hooker.—D. PETRIE.

HISTORY OF THE MOAS.—From a popular article under the above title, written by Professor Hutton, for the "Weekly Press," we extract the following concluding portion :—

Throughout the pliocene period the Moas flourished greatly; but in the pleistocene they must, in the South Island, have died in large numbers, for how else could such immense quantities of bones have got together in the peat-beds at Glenmark and at Hamilton in Central Otago. It has often been suggested that flocks of birds, attempting to escape from fires, rushed into the swamps and perished. But when we remember that these Moas died thousands of years ago, long before there were any human inhabitants to light fires, it will be seen that this surmise is quite out of the question. Only two hypotheses appear to be possible to account for the facts. Either the birds walked into the swamp and were drowned or else their dead bodies were washed in. The first hypothesis is probably the explanation of the deposit at Te Aute near Napier, because many of the leg bones were found upright in their natural position. But at Glenmark and at Hamilton the bones were lying in all directions, as often upside down as in any other position, and the peat-beds were only a few feet thick, and filled with bones up to the very top. We cannot, therefore, suppose that these Moas were swamped, and there is evidence in both of these cases to shew that the dead bodies of birds were washed in by floods. We find corroborative evidence of this in the alluvial plains of Central Otago, for these always contain numerous bones wherever a stream enters them from the hills.

But how are we to account for the number of dead birds washed down from the hills? There are two remarkable facts connected with these bone deposits at Hamilton and Glenmark. One is the very large proportion of bones of young birds from one-half to three-quarters grown; and the other is the absence of moa egg shell. These two facts seem to show that the birds perished in the autumn or the winter, when the birds of the year were not full grown, and when the females did not contain any hardened eggs. Also, it is evident that dead moas could not be washed into swamps under the present climatic conditions, and the explanation of the puzzle must lie in the fact that in pleistocene times, when these bone deposits were formed, the climate was very different from what it is now. At that time the eccentricity of the earth's orbit was very great, and when winter in the Southern Hemisphere happened in aphelion, long cold winters were followed by short and very hot summers. It seems probable, therefore, that the early winter snows killed large numbers of moas and other birds on the hills, that their bodies were floated down by summer floods and avalanches caused by the melting snow, and that they were deposited in hollows at the foot of the hills. As the pleistocene period passed way the climate got more equable and the surviving moas once more increased and multiplied, until they were ultimately exterminated by the hand of man.

All are now agreed that the moas were exterminated by the ancestors of the Maoris, and the only question upon which opinion is still divided is, How long was this ago? The case seems to me to stand thus. In the North Island there are several names of places in which the word moa is incorporated, but in the great number of Maori tales and poems which have been collected by Europeans the allusions to the bird are very slight and obscure, generally, indeed, fabulous. There is also one very ancient poem called "The Lament of Ikaherengatu," in which the phrase "Ka ngaro i te ngaro a te moa" (Lost as the moa is lost) occurs, which certainly shows that the bird was not in existence when the poem was composed. The so called traditions of its habits appear to be, in large part at least, late deductions from these words and phrases, and we must conclude that, in the North Island, the moa was exterminated by the Maoris soon after their arrival in New Zealand; that is not less than 400 or 500 years ago.

In the South Island there are no names of places containing the word moa; but here remains have been found—either skeletons lying on the surface or bones with skin and ligaments still attached—which give the impression that the birds were living here not more than ten or twelve years ago. Now the bones which are said to have strewn the surface so abundantly when the first settlers came, had all disappeared in fifteen years; so that it is plain either some change in the surrounding conditions caused the bones to decay, or that none of the bones which were so abundant in 1861, were more than fifteen years old. But as we cannot believe that moas were abundant in Otago in 1846, we must fall back on the opinion that the fires lighted by the early settlers to clear the scrub so altered the conditions under which the bones had been preserved that they soon decayed, in which case we cannot say how long the bones may have been lying there. It is something the same with those bones which still have dried skin and ligaments attached. They are so fresh that, unless the birds lived a few years ago, they must have been preserved under specially favourable circumstances; and there are reasons for thinking that the small district of Central Otago, in which alone these remains have been found, is one specially favourable for preserving animal remains. If this be so we cannot say for how many years they may have been preserved, perhaps for centuries, and as we have every reason to believe, upon the authority of the Rev. J. W. Stack, that the ancestors of the Ngai Tahu, who have inhabited the South Island for the last 200 or 250 years, never had any personal knowledge of the birds, we must allow that the moa has been extinct for at least that time. On the other hand, it is quite certain that the moa was exterminated by the Maoris, and the Maoris are not supposed to have inhabited the South Island for more than 500 years, so that the time of extinction must fall between these dates. It seems improbable that the Ngatimamoe, the last remnant of whom inhabited the West Coast sounds a few years ago, were moa-hunters. The moa-hunters of the South Island were not cannibals, and as Te-rapuwai and Waitaha, the tribes who preceded the Ngatimamoe, are said to have been peaceful and to have "covered the land like ants," it lends support to the Maori tradition that it was they who exterminated the moa and made the shell heaps on the beach. If this be so the moas were exterminated in the South Island about 300 or 400 years ago; that is, about a hundred years later than in the North Island.

REVIEW.

Illustrations of British Fungi, by M. C. Cooke, M.A., LL.D., 8 volumes, Williams and Norgate, London. The Handbook of British Fungi, Second Edition, Parts i., ii., and iii., by M. C Cooke, M.A., LL.D., Williams and Norgate.

This fine work, "Illustrations of British Fungi," has occupied fully ten years in publication, and forms the first part of an Atlas to Dr. Cooke's revised edition of the "Handbook of British Fungi." It was originally intended to include representatives of all the Hymenomycetous Fungi found in the British Isles, but the issue is for the present arrested with the completion of the Agaricini, owing to the death of many subscribers, and the indisposition of others to continue their support to the end.

The work contains 1,200 coloured plates, representing 1,400 species and numerous varieties, many of which are figured for the first time; it is unquestionably the finest series of drawings of Agaricini that has been published in any part of the world. The plates are beautifully drawn and not over-coloured, the original drawings having in nearly every instance been made and coloured for the printer by the author, while the printing, of the later portion of the work more particularly, is nearly all that could be desired by the most exacting.

Sowerby's coloured figures of British Fungis, commenced in 1797, contained only 165 species of Agaricini, while the larger and more recent work of Krombholz only gives 230: the present work, which is restricted to the species found in the British Isles, comprises fully one-fourth of all known species: it is therefore not surprising to find that the work has received a large measure of support in British colonies and foreign countries.

When the putrescible nature of most of the Agaricini is considered, and the paucity of opportunities for close observation of many species is taken into account, it will appear to be no cause for wonder that differences of opinion exist as to the specific validity of many forms, and the right identification of others. The author has, however, succeeded in reducing errors of this kind to a minimum, and the wonder is, not that a few errors have crept into the work, but that they are not vastly more numerous.

The descriptive portion of the work forms parts 1, 2, and 3, of second edition of the "Handbook of British Fungi;" the descriptions although brief are remarkably lucid and easily understood. In some instances, however, it is matter for regret that synonyms are not more freely given.

While the completion of the Agaricini affords good ground for congratulation, it is certainly cause for regret that the whole of the gill-bearing fungi of the British Isles are not represented: *Boletus*, *Polyporus*, *Hydnum*, *Auricularia*, *Clavaria*, *Tremella*, are not nearly as well known as those included in the "Illustrations," although in some respects they are more interesting; it is hoped that the four additional volumes required to illustrate these genera may be issued at some future date.

The Agaricini of New Zealand have received but little attention; about 30 species are described in the "Handbook of N.Z. Flora," and although this number has been trebled of late years, it can scarcely amount to more than a small fraction of the total, even if we admit that this group is less developed with us than in the British Islands. The reason for this doubtless lies in their putrescible nature, the difficulty of preserving them, and the difficulty attending identification in the almost total absence of works of reference. For this reason it is hoped that a copy of this grand work may speedily be found on the shelves of the libraries of the various societies affiliated with the New Zealand Institute. No worthier application of their funds could possibly be made.

T. K.

THE NEW AUSTRALIAN MARSUPIAL-LIKE MOLE—*NOTORYCTES TYPHLOPS.*

On February 3rd, Professor E. C. Stirling, of Adelaide University, read a paper on this remarkable animal before the Royal Society of South Australia, The following particulars taken from this paper are extracted from a notice by Mr. P. L. Sclater, which appeared in NATURE of September 10th:—

"It appears that the first specimen was captured by Mr. Wm. Coulthard, manager of the Frew River Station and other northern runs belonging to the Willowie Pastoral Company. Attracted by some peculiar tracks, on reaching his camp one evening on the Finke River, while traversing the Idracoura Station with cattle, he followed them up, and found the animal lying under a tussock of spinifex or porcupine grass (*Triodia irritans*). Though he is an old bush hand, with all the watchful alertness and powers of observation usually acquired by those who live lives of difficulty and danger, this was the first and only specimen of the animal he ever saw. As previously stated, this found its way to the Museum through the agency of Messrs. Benham and Molineux. The three received subsequently shortly afterwards, as well as the last lot recently secured by Mr. Bishop during our journey through the country, were also found on the Idracoura Station. This is a large cattle-run comprising several hundred square miles of country in the southern part of the Northern Territory of South Australia, which lies immediately to the west of the telegraph line between the Charlotte Waters and Alice Springs Stations. The great dry water-course of the Finke River, which runs from north-west to south-east, bounds the run for some eighty miles on the north and north-east. Its distance from Adelaide is, roughly speaking, a thousand miles. Flats and sandhills of red sand, more or less well covered with spinifex and acacias constitute a large portion of the country, and the rainfall is inconsiderable. Curiously enough, all the specimens of *Notoryctes* hitherto received by me have been found within a circumscribed area, four miles from the Idracoura Head Station, which is situated on the Finke watercourse itself, and almost invariably amongst the sandhills. I have it, however, on very fair authority, that the animal has been seen on the Undoolya Station, which lies immediately south of the McDonnell Ranges, and that one also was found drowned after heavy rain at Tempe Downs, a station situated about 120 miles west-south-west of Alice Springs. These points will sufficiently define its range, so far as is known at present. They do not appear to be very numerous. Very few of the white men in the district have seen it, even though constantly travelling; and not many of the natives whom I came across recognised the well-executed drawing I carried with me. It must be remembered, however, that I did not pass through the exact spot which so far appears to be its focus of distribution. Nor did a very considerable reward, which I offered, cause any specimens to be forthcoming between the first lot received, over two years ago, and that recently secured during my trans-continental trip. With a few exceptions, the animals have been captured by the aboriginals, who, with their phenomenal powers of tracking, follow up their traces until they are caught. For this reason they can only be found with certainty after rain, which sets the surface of the sand, and enables it to retain tracks that would immediately be obliterated when it is dry and loose. Nor are they found except during warm weather, so that the short period of semi-tropical summer rains appears to be the favourable period for their capture. For this suitable combination of wet and warmth, Mr. Bishop had to wait three months before he was able to get them, and in all cases they were found during the day-time. Perpetual burrowing seems to be the characteristic feature of its life. Both Mr. Bishop and Mr. Benham, who have seen the animal in its native state, report that, emerging from the sand, it travels on the surface for a few feet at a slowish pace, with a peculiar sinuous motion, the belly much flattened against the ground, while it rests on the outsides of its fore-paws, which are thus doubled under it. It leaves behind it a peculiar sinuous triple track, the outer impressions, more or less interrupted, being caused by the feet, and the central continuous line by the tail, which seems to be pressed down in the rear. Constantly on the look-out for its tracks, I was often deceived by those of numerous lizards, which are somewhat similar in these respects.

"It enters the sand obliquely, and travels under ground either for a few feet or for many yards, not apparently reaching a depth of more than two or three inches, for whilst underground its progress can often be detected by a slight cracking or moving of the surface over its position. In penetrating the soil, free use as a borer is made of the conical snout with its horny protecting shield, and the powerful scoop-like claws (fore) are also early brought into play. As it disappears from sight, the hind-limbs, as well, are used to throw the sand backwards, which falls in again behind it as it goes, so that no permanent tunnel is left to mark its course. Again emerging, at some distance, it travels for a few feet upon the surface, and then descends as before. I could hear nothing of its making, or occupying at any time, permanent burrows. Both my informants laid great stress on the phenomenal rapidity with which it can burrow, as observed in both a state of nature and captivity."

To these notes of Prof. Stirling I may add the remark that this is certainly one of the most extraordinary discoveries in zoology made of late years. *Notoryctes typhlops*, as shown by Prof. Stirling's full and elaborate description and figures, is unquestionably a new and perfectly isolated form of Marsupial life, and must be referred to a new section of the order Marsupialia. We must all congratulate Prof. Stirling on his success in bringing before the world such an important novelty.

MEETINGS OF SOCIETIES.

OTAGO INSTITUTE.

Dunedin, 13th October, 1891.—Professor Gibbons, President, in the chair.

New members.—Messrs. R. H. Walcot and D. Harris Hastings.

CORRESPONDENCE.

A letter was read from the Lands department intimating that the necessary steps had been taken to set apart Resolution Island as a place for preserving native fauna and flora; but that no such steps could now be taken regarding Little Barrier Island, as it was not Crown land.

Mr. A. Morton, secretary of the Australasian Association of Science, wrote stating that it is absolutely necessary that the titles of all papers to be read at the meeting at Hobart should be sent in by the beginning of next month, as the programme is to be printed early in December.

Paper.—(1) "The History of the Greenstone," by F. R. Chapman. In his introductory remarks, Mr. Chapman said that all present were no doubt familiar with greenstone, which was the material of many of the implements and favourite ornaments of the Maori race, and which was now worked up by lapidaries, and was to be seen in every jeweller's shop in the colony. This stone was specially interesting in that it was found only in two or three places in the world. A similar mineral was found somewhere in Central Asia; in the great range between China and Tartary, and it was used in China for ornaments, and to some extent for implements, and had found its way at very remote times into Europe. What he had to describe was the greenstone of the Maoris. There had been some correspondence on this subject between Professor Ulrich and a leading specialist on the subject in Germany, and he (Mr.

Chapman) had been asked by Professor Ulrich to assist, and had entered into correspondence with Maoris in both islands, and had collected a considerable amount of information, which had been to some extent published in Germany. The paper he now presented set forth the information he had gathered on the subject during the last 18 or 19 years. True greenstone was found at only one place in the colony. The Teremakau and Arahura rivers on the west coast of this island, and the beach between them comprised the whole extent of country where the true greenstone was found in this colony. There was another place at Milford Sound where there was a kind of greenstone largely used by the Maoris, but it was said to be a chemically different stone from the true greenstone. However, supposing this was really greenstone, the localities where this mineral could be obtained were very restricted. Recently it was said it had been found somewhere in America, and that some kind was found in New Caledonia, or on one of the Pacific islands, but practically, Tartary and New Zealand were the only spots where it was known. Mr. Chapman then, with the aid of a map and numerous specimens of greenstone in different stages of manufacture, gave a very large amount of information respecting this rare and beautiful stone. The old Maori roads from the east to the west coast, along the Waitaki and Clutha rivers, and over the Haast Pass to the greenstone country were indicated, and the methods of manufacture by cutting the stone with sandstone or other stone, and sand and water, were explained, and so, also, was the drilling process, which must have demanded positively marvellous patience. Many of the specimens were the property of Mr. J. White, of Anderson's Bay, others belonged to Mr. Chapman, the Maori drill was lent from Dr. Hocken's collection of Maori curios, and a beautiful "mere," which was given by Titokowaru to the Native Minister as an emblem of submission, was lent by Sir R. Stout. As showing the quantity of greenstone that must have been brought from the West Coast, he said that it was no exaggeration to say that not less than 1,000 greenstone articles, had, to his knowledge, been found within 20 miles of Dunedin. Mr. Chapman also made reference to the Maori wars, some of them wars of extermination, such as Te Rauparaha's, which had been urged for the possession of the highly-valued greenstone.

Dr. Hocken said it was most satisfactory to know that at last they had the history of the greenstone written, as he was sure it deserved to be, because it was not only of interest to people here but to scientists in Europe. Mr. Chapman had given enormous labour and research to the subject, and had pretty well exhausted it. He was, however, inclined to think that the favourite greenstones amongst the Maoris were not the beautiful specimens, but the very dark ones, because they were the hardest and the most suitable for drill points and implements.

ANNUAL MEETING.

Dunedin, November 10th, 1891.—Prof. F. B. de M. Gibbons, President, in the chair.

New member.—Mr. J. Dove Dunn.

Papers.—(1) "Note on the nest and habits of *Arbanitis Huttoni*," by P. Goyen, F.L.S. The tube which this spider inhabits is branched. The entrance to the main tube is quite uncovered, but the branch which makes a more or less acute angle with the main tube extends to the surface of the ground, and is there covered by a rude sort of hinged lid, which so closely resembles the surrounding surface as to be indistinguishable from it. The spider is too heavy and sluggish to escape from its enemies or catch its prey in the open. It therefore lies in the branch of its tube, whence it can attack its prey in flank or rear; or, if an enemy too powerful for it should enter its tube, it can make its escape to the surface. The author exhibited specimens of the tubes.

(2) "Description of a new species of *Marptusa*, with notes on its habits," by P. Goyen, F.L.S. This spider is found along the coast of Otago on cliffs and rock, just above, at, or just below high-water mark. These rocks are frequented by two or three species of flies which the spider resembles in colour and mode of progression. "So striking is this resemblance that I for some time mistook it for a fly. The resemblance extends to the habit of running forward quickly, stopping, and rubbing its pulpi, just as a fly rubs its fore-legs, until it is within striking distance of its prey, when it jumps upon it with unerring aim." The author considers the case exceedingly interesting as affording in a class of animals in which it has not been before observed a striking example of aggressive mimicry.

(3) "On the genus *Aptornis* with more especial reference to *Aptornis defossor*, Owen," by A. Hamilton. The author gave a historical account of the various finds of bones of *Aptornis*, from those sent home by the Rev. W. Williams to Dr. Buckland in 1842, to the present time. The last and most important find of these bones was made in 1889, in some limestone caves in Southland by Mr. W. S. Mitchell of Lake Manapouri Station. Six or seven individual birds are represented, and in four cases the skeletons can be reconstructed without much doubt as to the bones having belonged to individual birds. Most important of all, the bones are not mixed with those of any other species. Descriptions of the most important bones are given in the paper, and the author exhibited an almost complete skeleton of this species.

(4) "On Moa gizzard-stones," by A. Hamilton. This paper describes the occurrence of numbers of heaps of gizzard-stones, in some cases along with small quantities of fine sand, on the peat-mosses of Swampy Hill, near Dunedin, at an elevation of over 2,000 feet. In two cases the heaps were found in a completely isolated position among the peat, the stones being held more or less together by interlaced masses of comminuted vegetable matter of a pale yellow colour, quite distinct from the hue of the enclosing peat. Along with much matter which could not be distinguished, this vegetable material was found to contain great numbers of seeds of *Pentachondra* and *Coprosma*. The weights of stones in the two masses were respectively 4½ and 6lb; the largest separate pebble being a little over 1½oz. The nearest locality from which quartz

pebbles of the kind found, can be obtained, is at the outcrop of the schist formation, a distance of about 4 miles The samples of peat were found to have a distinctly acid reaction, and to this cause is attributed the almost complete absence of moa bones, the only portion found being the decalcified proximal end of a metatarsal bone. A similar deposit of gizzard-stones, with absence of bones, occurs near Mt. Excelsior, on the Mararoa station. Mr. F. R. Chapman has found similar collections of gizzard-stones and sand at Maungatua, a mountain range about 3,000 feet high, some 20 miles to the south-west of Dunedin.

(5) "On some Maori bone pendants from Otago," by A. Hamilton.

(6) "On the cleistogamic flowers of *Melicope simplex*," by Geo. M. Thomson, F.L S. In the ordinary form of this species the flowers open when ready for fertilisation, the 4 petals spreading laterally, and exhibiting 8 stamens in two whorls, of which those opposite the petals are longer, or rather stand at a higher elevation than do the sepaline stamens. In the 4 carpels which are normally produced, the styles are united by their whole length. When botanising on Pigeon Island, Lake Wanaka, two years ago, the author observed that in the numerous plants of *Melicope simplex* growing there, the fruit seemed to be developed directly from the flower buds. On examination and comparison of spirit-specimens, it was found that these flowers were truly cleistogamic. The petals did not open in any case; the sepaline stamens were present but with greatly reduced filaments, while those of the petaline whorl were represented by rudiments only. The carpels were all free and their styles greatly shortened so as to remain inside the unopened flowers. No cause was assigned for the prevalence of this cleistogamic form.

(7) "Notes on sea-fishes," by Geo. M. Thomson, F.L.S. A number of years ago, the late Mr. W. Arthur entered into communication with various fishermen, harbour masters, and others, with the object of inducing them to keep records of the fish taken by them. On his death his papers were handed over to the author, who extended their range by getting the Marine Department of the Government to issue forms to the various lighthouse keepers round the coast. Duplicates of these forms which had now been accumulating for some years were furnished to the author, and the present paper represents a summary of these observations. While many returns had been kept in a very perfunctory manner, others had been carefully filled up. The present paper contained a few points of value in regard to the range of our common sea fish, their food, time of spawning, etc., etc.

(8) "Notes on some New Zealand Amphipoda and Isopoda," by Charles Chilton, M.A.

(9) "On the metallurgy of silver," by D. Wilkinson, F.R.S.M.

(10) Professor Parker exhibited and made remarks upon a species of *Branchellion*, a leech with external gills belonging to the family Rhyncobdellidæ, and occurring as an external parasite on the common skate (*Raja nasuta*). A single specimen had been found

some years previously; but on the present occasion a skate, dissected in the biological laboratory, presented a colony of thirty or forty of the parasites on an area of three or four inches in circumference. They varied in length from about $\frac{1}{4}$ in. to $1\frac{1}{2}$ in., and were all so firmly attached by the posterior sucker that on their removal the fish's skin presented a number of smooth circular convex areas. The smaller specimens, treated with Flemming's chrom osm. acetic solution, flattened under a compressor, and mounted entire, make very beautiful microscopic objects. The only species of this interesting genus mentioned in the ordinary works of reference is *R. torpedinis* of Europe, a parasite on the torpedo. If the present form turns out to be new it might be called *B. rajæ*. Professor Parker also mentioned that he had found at Port Chalmers a single specimen of the polychætous worm (*Dujardinia*), interesting from the length of its cirri.

(11) Professor Parker called attention to a very beautiful and accurate model in plaster of paris of the neighbourhood of Dunedin, made to scale for the Otago Museum by Mr. A Hamilton, Registrar of the University, and expressed the opinion that the teaching of geography in the primary schools of the colony would be vastly improved if similar models could be obtained and employed, instead of compelling the children, as was too frequently the case, to learn lists of names of natural features, regarding which they could form no accurate opinion.

The annual report was then read and adopted. The following is a brief extract :—

Six meetings were held during the session. At these 17 papers were read, and one lecture on the Early History of New Zealand was delivered. Six new members have been added to the roll. The library has received a number of additions. The ordinary revenue was £204 11s. 0d., (including a balance of £97 9s. 0d.), while the expenditure was £91 17s. 5d., leaving a balance in hand of £112 13s. 7d. There is also on fixed deposit a sum of £286 13s. 5d.

The following were elected office-bearers for the next year:— President: C. W. Adams, Esq., C.E.; Vice-Presidents: Prof. Gibbons, M.A., and Dr. Hocken; Hon. Sec.: A. Hamilton, Esq.; Hon. Treas.: E. Melland, Esq.; Auditor: D. Brent, M.A.; Council: Prof. Parker, F.R.S., Prof. Scott, M.D., Rev. H. Belcher, M.A., LL.D., Messrs. F. R. Chapman, Alexr. Purdie, M.A., Geo. M. Thomson, F.L.S., and D. Wilkinson, F.R.S.M.

The retiring president then delivered an address on "The rise and development of the science of Political Economy."

WELLINGTON PHILOSOPHICAL SOCIETY.

Wellington, 29th July, 1891.—E. Tregear, Esq, President, in the chair.

Papers.—(1) "On the Necessity for the Establishment of an Expert Agricultural Department in New Zealand," by W. M. Maskell, F.R.M.S. (Abstract). Mr. Maskell said that, because there was a gentleman in the Cabinet with the title of Minister of Agriculture, and under him a Department of Lands and a Department of Stock, most people in the colony were under the impression that there is in New Zealand a Department of Agriculture properly established. This however was not the case, the titles mentioned being practically (except perhaps for Stock) misnomers. In point of fact there is not at present in the country any official and responsible machinery for investigating the various enemies to cultivation and for informing and advising cultivators thereon. Agriculture, he might say in passing, was not necessarily farming: there are large numbers of persons engaged in, or interested in, gardening, tree-growing, fruit-growing, floriculture, cultivation of all sorts, who are not farmers, and this should be borne in mind, as will be mentioned presently. Now, on the appearance of a new enemy to the cultivator, of a new pest amongst crops or trees or gardens, or even of a new friend or a new method of procedure, what has to be done by the existing machinery? There is nobody in the colony placed in an official and responsible position, and the so-called Minister for Agriculture has to go outside his department and obtain amateur advice. Take, for instance, the "Tauranga sheep disease" as it is called: professors of different colleges are sent for to investigate it, and that is not a college professor's duty. Take the Hessian fly: an official in the Post Office who happens to be an excellent entomologist, is sent up to attend to it. Take the so-called "blights": recourse is had to an officer of the university; and when a friendly beetle comes to help men to fight these "blights," again the university officer is appealed to. In such cases as the appearance of the horse bot-fly in Canterbury and Auckland, or the fear of some fungus-pest injurious to apple growers, there is no official responsible person to whom the colonists can go for advice or help. It is not a question of ability or of desire to be useful. All the persons just named have no doubt always been glad to assist and would always be ready to give the Government and the country their very best services: and undoubtedly the advice tendered to them has been thoroughly honest and well-considered. But it is essentially and necessarily amateur and irresponsible, and what is wanted is the stamp of an expert official who can command rather than deserve public confidence. It is no disparagement of the gentlemen who have been hitherto called in as advisers to say that an expert department would be far more satisfactory and produce better results.

In other countries people have realised this fact, and have established expert Agricultural Departments. In the United States there is the Central Office at Washington, and besides that nearly every state of the Union has its own. In England there is the Board of Agriculture with a professional staff. In Australia, the three colonies of New South Wales, Victoria and South Australia have expert Departments: so has India. The speaker exhibited to the meeting specimens of the periodical publications of some of these: the "Insect Life" of the Washington Office, the "Agricultural Gazette" of the Sydney Board, the "Indian Museum Notes" of Calcutta, the Reports of the State Boards of New York, California, Nebraska, Iowa, and others. One thing was specially noticeable about all these (which were issued at short intervals, some monthly): and that was that they were specially adapted to the circumstances of the country they appeared in. Now in New Zealand we have nothing, or almost nothing of the kind. The Government issued lately a little pamphlet about the Phylloxera and other vine-diseases: it is good enough as far as it goes, but it is nothing more than a compilation from facts known in other countries and does not specially apply to New Zealand.

Two things ought to be very earnestly borne in mind in considering this question. One (noticed in an earlier part of the speech) is that the department required must deal not only with farmers but with all sorts of persons interested in all sorts of cultivation: it results from this that a mere "practical farmer" would be entirely insufficient to direct it. Independently of the general disinclination of the "practical farmer" to look an inch beyond his nose, a much wider and deeper knowledge is necessary than he is at all likely to possess. Secondly the Department must deal with every kind of friend or foe to cultivation: animal foes such as insects are not always more destructive than vegetable foes such as the various fungi or noxious weeds: consequently the Department, if not the officer in charge of it, must be two-sided. In New South Wales, and in Victoria, and in the United States, the various Boards include separate staffs of entomologists and botanists. It is of course difficult for any Minister in New Zealand to pluck up courage enough to tell Parliament that two salaried officers are wanted. But he might at least start with one, and the speaker in a letter sent lately to the Minister of Lands strongly urged that in England an officer could be obtained competent to at least make a good start with a Department, and sufficiently expert in economic entomology and in economic botany. The suggestion made in the letter was that, say, the Royal Agricultural College at Cirencester should be applied to, or Professor Wallace of the Edinburgh University, to recommend such an officer.

Complaints are sometimes made that the subjects treated of at meetings of this Society are not sufficiently practical. Well, here at least is a practical question demanding a practical solution. Whether the solution would be given by the Government and the parliament might nor might not be likely: at all events it was good to put on record the opinions just expressed, and the speaker trusted, that if his views were considered to be correct, the Society would endorse them by passing the resolution which he proposed to move presently.

The Hon. Mr. R. Pharazyn said that he quite agreed with Mr. Maskell that it was of the greatest importance that such an expert department should be established, and he would be glad to do all in his power to support such a movement. It had been found that a department of this kind had worked well in other countries and had proved of the greatest benefit to those engaged in agricultural pursuits.

Mr. Geo. Beetham also agreed with the author's views on this subject; he believed that if properly represented, the Government and the parliament would favourably consider such a proposition. He complimented Mr. Maskell on the valuable work he had done in this branch of science, and said that the thanks of the Society were due to him for having brought this important matter forward.

Mr. Carlile thought that the farmers would highly approve of the establishment of such a useful department, and he thought the various incorporated societies would assist in urging its formation.

The President agreed with all that had been said. He now called on Mr. Maskell to read his resolution.

Resolution—"That in the opinion of this Society the establishment of a well equipped expert Agricultural Department is of urgent necessity in New Zealand."

Mr. Harding, in seconding the resolution, said that if only in the interests of economy, Mr. Maskell's proposition deserved all support.

The resolution was carried, and a copy of it was ordered to be sent to the Hon. Minister of Lands.

(2) "On Animal Intelligence," by W. W. Carlile, M.A. (Abstract.) The importance of the study had come to be recognised only of late years In the one fact of its having drawn attention to the great principle of heredity, especially of the heredity of acquired faculty, it had revolutionised the current mode of thought not only in psychology but also in ethics, politics and history. Dr. Kuno Fischer in his work on Francis Bacon of Verulam had contrasted the "Anglo-Gallic Enlightenment" with the German, pointing out to what an extent the prevalent mode of thought in the former from Bacon to Voltaire and Rousseau, and from these to Mill and Macaulay, was anti-historical. Of this the incurable breach with history in the French Revolution was the practical outcome. If he had traced the course of English empirical philosophy farther down, to the period subsequent to the discovery of natural selection, then he would have found that it had learnt to think historically, that it had converged with the stream of German thought flowing in upon us through the channel of Carlyle's writings. If Hegel or Carlyle affirmed that the whole past was with us still in the depths of our present, the modern evolutionist said the same and gave the scientific grounds of his belief. He cited some passages in point from Mr. Bagshot's "Physics and Politics." Principle of heredity might in any case have been recognised, but Animal Intelligence was for it the "Prærogativa instans," in regard to which it could not be overlooked. Ribot mentioned case of small dog convulsed with terror at scent of old piece of wolf's skin. The terrifying associations were drawn not from the animal's own consciousness but from that of dead and buried ancestors. We were becoming familiar with the notion of hereditary memory. Science might soon have to grasp the idea of hereditary identity, and would then recognise that in a sense Plato was right about the pre-existence of the soul.

So much as to the importance of the study: as to its fascinations we had all felt it, but on that very account had reckoned it trivial. Only of late the attempt had been made from the scientific point of view to collect authentic information about the display of incipient reason in animals. Such an attempt was embodied in Professor Romanes' book on Animal Intelligence.

Any of us who lived in the country would occasionally have instances analogous to those cited by Professor Romanes brought under notice, possibly supplementary or correcting them. A few had come under his own. He cited instances of hunted kangaroos making for water as it was then able to drown the dogs; of horses on property at Wanstead in Hawkes Bay, during the drought felling cabbage trees; of wild dogs feeding their pups by gorging themselves with flesh, then vomiting it out on arrival at home; and of dog slipping his collar, with his *modus operandi* described.

He alluded to Bain's view of the "link of feeling and action," set forth in the "Emotions and the Will." It was that a young child or animal escaped a painful sensation or attained a pleasurable one in the first instance purely by chance. Its spontaneous activity prompted it to innumerable movements in all directions. Some such movements were attended with relief from pain or augmented pleasures, and only after many repetitions perhaps came under the control of selective volition. It was a case of "firing innumerable shots to hit one bird." Had we not in these early manifestations of reason in ourselves an analogy to the operation of reason in the living universe? Nature tries innumerable variations before the one useful variation is hit on and survives. We ourselves had all done the same. Might we not then catch a glimpse, behind the apparently fortuitous processes of nature, of the operations of a mind analogous to our own.

Sir James Hector said the author had succeeded in making a very abstract and difficult point in philosophy quite interesting. He agreed with the side he took in the much discussed question of whether animal intelligence differed from our own in kind or only in degree, and whether the production of the highest intellect was the result of progressive and accumulated development. The story of the horses gnawing down the cabbage trees to obtain moisture is parallel with the well known habit of the mules in Mexico kicking the great cactus trees for the same purpose.

Mr. Hulke remarked that the reasoning of animals differed from that of man only in degree; he mentioned several facts relating to insects and animals to illustrate what he meant.

Mr. Hudson gave an account of experiments made by Sir J. Lubbock with ants, which appeared to indicate that insects when placed out of their ordinary sphere of action exhibited very limited reasoning powers.

Mr. R. C. Harding said that the vulgar discrimination between instinct and reason might not be so unscientific as some of the speakers had assumed. It appeared to him to be based on a difference which was not one of degree. Instinct be regarded as the intuitive perception of interior qualities as distinguished from the merely exterior properties made known to us by the five senses. The instincts might therefore be taken as supplementary senses, on a different plane from the five ordinarily recognised. Between the perception by means of a sense and the intellectual result of rational effort there was an evident distinction, and a parallel distinction could be traced between instinct and reason.

The terror of a horse at the odor of an unknown wild beast might be accounted for by inherited memory; but it seemed more reasonable to attribute it to the immediate perception of a maleficent quality. Protective instincts like this were found throughout nature, but were so rudimentary in man, that physically, as compared with beasts and insects, he was the inferior animal. The nearer man approximated to the lower animals in his mode of life and intellectual development, the more powerful these instincts seemed to be; but as his rational capacity increased, they were ignored and seemed gradually to disappear. Yet they were by no means to be despised, as where they existed, they enabled him to arrive by a short cut at a point which could otherwise only be attained by great and laborious mental effort. Sometimes a child was found to possess almost in infancy faculties which showed how great the undeveloped possibilities of mankind were in this direction. There were well-attested cases of children knowing neither letters nor figures,—one a negro boy—who had a natural perception of qualities and relations of numbers, and a skill in dealing with them, exceeding that of trained mathematicians. The mental quality that could at once recognise a prime of almost any number of figures at sight, and the power of analysis which could resolve any divisible number into its factors, were not to be attained by the severest training; but this gift was actually possessed by a calculating child. Young Mozart, in early infancy, possessed a similar grasp of the qualities of sound—a practical as well as a theoretical perception, for he was able to play any instrument at sight. Hereditary memory would scarcely account for phenomena like these, which were interesting as showing how immeasurably human instinct, in its higher forms, transcends that of the animal creation. Regarding Sir John Lubbock's celebrated experiments with ants, careful and systematic as they were, and completely as they failed to show anything like intelligent or concerted action, he did not think their results warranted us in rejecting the accumulated testimony of past ages on the subject.

The President said that Mr. Carlile's illustration of heredity recalled to his mind that many years before when riding a very quiet horse the animal suddenly leapt aside and began trembling in great fear on seeing a piece of *rata* vine coiled up and lying in the road exactly as a snake would be coiled. This horse was two generations from an Australian progenitor. It had been said that instinct is "inherited memory"—and although that might seem to explain such facts as the orderly movements and almost automatically-regulated actions of ants and bees, it by no means explained any unusual cleverness or exceptional genius. For instance, the musical genius of Mozart could hardly be expected to be produced out of thin air, and yet it could certainly not be called "inherited." Reason had little to explain to us why Mozart as a child was a finished musician, and analogies drawn from one order of beings should be used with great caution if applied to explain difficulties in regard to other kinds of creatures. Experiments had recently been made which show that when insects are subjected to the different bands of light thrown down by the spectroscope they display different modes of action, lying dormant under one colour, growing intensely excited under another, and so on. It is possible that they live in quite another world than ours, so far as impression produced by the senses is concerned; that phenomena which appear beautiful or terrifying to us make no impression upon them, and that knowledge which to us is a sealed book may be to them as an open scroll. The sense of touch in human beings is absolutely null and void compared with that sense in the ant which almost certainly communicates intelligibly with its fellows by means of contacting antennæ, while the sense of smell in civilized man is almost as feeble as it is useless. It is quite conceivable that other creatures have other senses the effects of which are no more to be appreciated by us than the tints of a landscape or a flower would be by a blind man.

Mr. Carlile, in reply, said he found he had not been wrong in his anticipation that his instances of animal intelligence would be capped by others drawn from the recollections of other gentlemen present. He could not see how Mr. Harding's view that what appeared to be results of hereditary memory could square with the facts. The qualities of a thing were simply the impressions it made on the senses, its colour, smell, and so on, and to say that the horror which a New Zealand bred horse felt for what looked like a snake was possibly not owing to hereditary memory to the horse's perceptions of some—to us occult quality—conveyed no meaning to his mind. The theory of an inverse ratio between instinct and reason, started, he thought, by Sir W. Hamilton, accorded with some of the facts of natural history, but was far from being true universally. He cited from Wallace's "Malay Archipelago," what seemed an instance in point of its truth. A baby orang-outang which they captured, belonging as it did to the anthropomorphous apes, showed all the characteristics of the human baby as regarded its utter helplessness, the result being that its captors nursed and tended it and became greatly attached to it. The young of monkeys lower down in the intellectual scale were much more capable of taking care of themselves at an early age.

Wellington, 9th September, 1891—W. L. Travers Esq., F.L.S., (in absence of the President) in the chair.

New Member.—Mr. R. T. Turnbull.

Papers.—(1) "Instances of Instinct in Insects," by G. V. Hudson, F.E.S. (Abstract.) This paper was an account of a few recently observed instincts in insects, chiefly borrowed from the "Entomologists' Monthly Magazine." The author attributed the remarkable faculties exhibited to the action of natural selection and inheritance, and endeavoured to explain how beneficial variations in structure and instinct might be eventually perfected by these two forces. In the concluding portion of the paper the differences between reason and instinct were thus dealt with.

During the discussion which followed the reading of Mr. Carlile's paper, Mr. Harding contrasted instinct and reason, and showed how, in many respects, the former attribute was superior to the latter. If it is admitted that instinct is the inherited experience of the race whilst reason is that of the individual only, then the explanation of the superiority of instinct is obvious—instinct is the result of continued selections from the experiences of countless generations, whilst reason is only the experience acquired during the brief lifetime of a single individual. It is not surprising then that instinct so vastly transcends the intellectual power of the animal that exhibits it. I think that we may look for the development of human instinct when most of our individual experience or knowledge has become hereditary. At present only the capacity for acquiring knowledge is inherited among human beings, but, judging from the facts above considered, knowledge itself must in time be inherited also. So far from supposing then that we have lost our instincts through civilisation, I do not think that they have yet been evolved. Now nearly all our results have to be attained by long training and laborious mental calculations, but in the future we may hope to arrive at far greater results by almost unconscious instinctive processes.

Mr. Phillips said he disagreed with the author as regards the hereditary instinct of animals; he believed that animals and man derived their intelligence in constructive ability in a similar manner from a "Common Vital Force," a subject on which he had written a paper before the Society a short time ago. He did not agree to place everything to evolution. A spider's web is superior to anything that man can construct,—there is a force in nature given to man or insects which is equal and not necessarily hereditary.

Mr. Maskell said he was obliged to dissent from the conclusions of the paper. Whatever the reality might be of the three or four facts given by Mr. Hudson, they seemed entirely insufficient to form a basis for a theory of instinct such as was proposed. For example, in the case of the falling insect mentioned. Mr. Hudson adduced this as an instance clearly pointing to acquired faculties, the result of long series of minute variations and progress. But the case was of extreme weakness unless Mr. Hudson was prepared to assert, of his own knowledge, that the remote ancestor of this moth, the very first of the race, did not do precisely the same thing. Assuming (what did not seem to be proved) that the moth which fell on this occasion did so from fright: assuming that a moth could see far enough to detect an approaching enemy (also not proved), how could anyone say that the very first created moth of the species did not do the same thing under similar conditions? And if it did, where would the progressive inherited variation leading to the instinct of the moth now referred to come in? The foundation of theories tending to sap and destroy the first principles of human belief, on such vague and unproved assertions as those of the paper, is mischievous in the extreme, and the speaker regretted that so many young students of the present day were apt to give way to the temptation of indulging in them.

Sir Walter Buller said he was somewhat disappointed with Mr. Hudson's paper, because its ambitious title had led him to expect much more than it gave in the way of original research. He could not conceive of a more fruitful subject than the one selected by this author; but instead of the large array of facts from his own experience one might have expected, Mr. Hudson had recorded only two instances of remarkable instinct in New Zealand insects, the rest being quoted from English authors. The paper appeared to him a little crude, but he felt sure that Mr. Hudson was on the right track. It seemed to him impossible to reject this theory of hereditary instinct with such evidences before us. Take, for example, the hexagonal cell of the common honey bee. What the first bee may have done it was impossible of course to know, but within the memory of man this bee had constructed its cell on exactly the same model, as the result of hereditary instinct.

Sir James Hector said that the paper was evidently an attempt to meet statements, attacking the theory of evolution, that were made at previous meetings. He held there was nothing about first causes in that theory, and that it was a powerful aid to the working naturalist in unravelling and unfolding the various steps in the scheme of creation. He recommended members to read some interesting anecdotes bearing on the question of modification of instincts into individual reasoning powers, which are related in "Good Words" by Dr. Gunther. He referred especially to the nesting habits, in confinement, of the magpie and house sparrow, which showed that inherited memory or instinct, though very potent, could be overruled by individual effort.

Mr. Harding called attention to what he had said at the last meeting, on Mr. Carlile's paper. He did not think we could have both reason and instinct. He related how a beaver in captivity showed instinct but very little reason. There was a communal instinct which enabled savages to construct bridges and such things without the aid of architects or surveyors. Mr. Hudson's paper, as a clue to the mystery of nature, was worthless; but it was a good working theory for a naturalist. It was a mistake to put forward such statements as Mr. Hudson had done as if they were actual facts.

Mr. Travers described how the gull carried the shell-fish to a height and then dropped it, when it broke and disclosed the fish inside which it fed upon. This was probably the result of an accident in the first instance, followed by reason in repeating the action. The bird could not acquire this from any created habit. Mr. Wallace seemed inclined to abandon the idea of instinct. Dr. Gunther's example of the magpie is remarkable. He did not think Mr. Hudson intended, as Mr. Maskell inferred, to dogmatise. The paper is valuable and contains most interesting facts. We must enquire into all facts of this kind if we wish to add to our knowledge in natural history.

Sir Walter Buller said he wished to supplement Mr. Travers's account of this instinct displayed by *Larus dominicanus* in breaking shell-fish. During his travels, he had, thousands of times, watched the operations described by Mr. Travers, the bird ascending obliquely to a certain height in the air, then dropping the shell, and coming down to feast on the contents. But what had specially struck him was this: the sagacious bird never dropped the shell on soft sand or ooze, but always selected the hard portion of the beach where the impact of the falling shell would produce the desired result. That fact alone exhibited a certain amount of intelligence on the part of the bird. But there was this curious fact also. The young seagull never resorted to this mode of breaking shells. It took from two to three years for the bird to attain its full livery of black and white plumage; it was easy, therefore, to distinguish the young bird in its spotted grey dress, and he could not remember having once seen it rise in the manner described. This would seem to tell against the theory of hereditary instinct, because the habit was evidently an acquired one, and the result of imitations.

Mr. Hudson said, in reply, that he was very much gratified at the interest the Society had taken in his paper. He was sorry however that the title bad been misleading. He merely offered it as a supplement to Mr. Carlile's paper, and did not pretend that it was in any way exhaustive. With reference to Mr. Phillips's remarks on the so-called "vital force," he was not aware that the existence of any such power had been demonstrated. In connection with Mr. Maskell's remarks he wished to direct attention to the extensive modifications which man had produced in many domestic productions by exercising selections in certain directions. Natural selection having such a much wider scope and so much more time to act in must have produced far greater results than man's selection. With regard to the term "natural selection," he was aware that there were certain objections to its use, but it was shorter than the more accurate one "survival of the fittest." In stating that the instincts of insects were inherited in the same manner as their structure and colouring he was only following the almost universal opinion of entomologists. In fact it appeared to him impossible to explain the phenomena of the insect world in any other way. How, for example, would it benefit an insect to inherit a resemblance to some inanimate object unless it also inherited the instinct to assume the peculiar position necessary to complete the deception? He could not understand Mr. Harding's statement as to the superiority of the savage over the civilised man in works of engineering skill. In conclusion he was surprised at objections being raised to the idea that knowledge would gradually become an inherited attribute in the human race. How much better, for example, it would be if we could inherit all our elementary learning and thus have so much more time for more advanced studies? There were many instances where insects inherited the faculty of performing most complex actions without being taught, and he did not see why the same law should not apply to man when a sufficiently long interval of time had elapsed to render his activities hereditary.

(2) Mr. Maskell brought to the notice of the meeting a specimen of the Bot or horse fly, which has appeared in New Zealand during the last year; it affected horses in a most serious manner, driving them mad. He thought it right to make known the appearance of this pest.

Mr Travers greatly feared that the direct steamers would be the means of introducing many such obnoxious insects.

(3) "Notes and Observations on certain Species of New Zealand Birds—with specimens to illustrate the paper," by Sir Walter Buller, K.C.M.G., F.R.S. (Abstract.) Among the species treated of were

notably the following:—(1) *Platycercus unicolor*, a green parrakeet from Antipodes Island, rediscovered by Captain Fairchild half a century after the type specimen had been placed on the shelves of the British Museum. *Platycercus erythrotis*, another parrakeet from Antipodes Island, intermediate in character between *P. unicolor* and the New Zealand bird *(P. novæ-zealandiæ)*, which was also referred to. The author stated his views as to the manner in which the specific characters of *Platycercus unicolor* had, by isolation for countless generations, become developed, under the natural operation of the laws of evolution. He accounted for the presence of an intermediate form subsisting side by side with *Platycercus unicolor* by the theory of an irruption or colonisation by *Platycercus novæ-zealandiæ* at a later period of time, but sufficiently remote to have produced a certain amount of divergence. He described the differences that presented themselves, remarking that these were first such changes and modifications as would naturally mark the gradual transition from *P. novæ-zealandiæ* to *P. unicolor*. (2) *Ocydromus earli*, a live example of which had been brought by Captain Fairchild from Macquarie Island, thus supplying a very interesting fact in geographical distribution, seeing that the range of this particular species of Woodhen, so far as hitherto known, was restricted in New Zealand to a portion of the West Coast of the South Island. (3) *Ocydromus greyi*, of which species a very singular albino was described. (4) *Diomedea canta*, (the Shy Albatross), of which a very interesting account was given, the result of personal observation. (5) *Diomedea regia*, (the Royal Albatross), which had been described and named by the author at a previous meeting of the Society, and in relation to which some further particulars were given. The author stated that the distribution of the various species of Albatross on their breeding grounds is very curious. Although Mollymauks are plentiful on the Snares and on the Bounty Islands, neither *Diomedea regia* nor *D. exulans* are to be found there. On Campbell Island where *D. regia* reigns supreme, *D. exulans* is never seen. On the Auckland Islands, with the exception of the small colony of *D. regia* mentioned in a former paper, all the breeding birds belong to *D. exulans*. At the Antipodes Island, again, there are no *Diomedea regia*, whilst the breeding birds of the other species are for the most part in the dark plumage of immaturity. (6) *Adamastor cinereus*, of which rare species several specimens had lately been captured by Captain Fairchild half way between Wellington and the Chatham Islands. (7) *Tachyptes aquila*, (the Great Frigate Bird), of which an example—only the second known in New Zealand waters, and exhibited at the meeting—struck itself against the lantern at the Cape Farewell lighthouse on the 15th April last, and was picked up in an injured state, and (8) the following seven species of Penguin, respecting each of which most interesting information was given as to habits and distribution, namely:—*Aptenodytes longirostris*, *Eudyptes chrysolophus*, *E. rachorhynchus*, *E. sclateri*, *E. chrysocome*, *E. antipodum*, and *Eudyptula undina*. In treating of this group the author stated that he had satisfied himself as to *Eudyptes chrysolophus* being only the young of *E. schlegeli*; but that the former name, being of older date, would have to take precedence according to the accepted rules of zoological nomenclature.

WELLINGTON FIELD NATURALISTS' CLUB.

The first excursion took place on Saturday, 10th October, when the subject selected was geology. Mr. A. McKay, F.G.S., was leader, and explained the several rocks and formations met with on the way to Karori. The new gold mine, near the Devil's Bridge, was also visited, and an examination made of the more recent formations on the Karori Flats. An extremely pleasant afternoon was spent, the weather being very fine. On Thursday, October 15th, the usual meeting was held at the Museum, the president, Mr. C. Hulke, F.C.S., in the chair. Mr. McKay read introductory notes on geology, and also exhibited by means of the optical lantern, a number of slides illustrating the various terms used by geologists in describing the different formations of rock, which were explained to the members by the president. The photographs of many extinct animals were also shown in the same manner. They included illustrations of a very perfect specimen of *Pterodactyl*, or winged lizard, recently discovered in America; the curious "fish lizard" or *Ichthyosaurus*; a remarkable bird *(Archæopteryx)*, having a long tail composed of several vertebræ; as well as photographs of the *Deinotherium*, Irish Elk, and several other extinct mammalia. The most recent forms of life were illustrated by a picture of the members of the club who took part in the last expedition, and portraits of the leader, Mr. McKay, and the president, Mr. Hulke, which created great interest The meeting was in every way a most enjoyable and successful one.

LINNEAN SOCIETY OF NEW SOUTH WALES.

Sydney, August 26th, 1891.—Professor Haswell, M.A., D.Sc., in the chair.

The Chairman announced to the meeting with deep regret the death, only that morning, of the Government Geologist, Mr. Charles Smith Wilkinson, F.G.S., F.L.S. Mr. Wilkinson was an original member of the Society, for several years was a member of the Council, in the years 1883 and 1884 was President, and since 1885 had been one of the Vice-Presidents. His enthusiasm in the cause of Geological Science, his extensive knowledge of the geological features of Eastern Australia, his many personal qualities, and his decease at the comparatively early age of 47, combine to render his loss one which will be severely felt.

On the motion of Mr. Henry Deane it was resolved that a letter of sympathy from the meeting be sent to Mrs. Wilkinson.

The reading of papers and other business was deferred, and the meeting then adjourned to September 30th.

ROYAL SOCIETY OF NEW SOUTH WALES.

Sydney, 3rd September, 1891.—H. C. Russell, Esq., (Government Astronomer), in the chair.

Papers.—(1) "On a Wave-propelled Vessel," by Lawrence Hargrave.

(2) "Notes on a Disease among Rabbits," by Adrien Loir. M. Loir has been for some time conducting experiments with bacteria at Rodd Island. During April last, the Chief Inspector of Stock (Mr. Bruce) sent him 30 rabbits to the island. After a few days one died, and within the six days following seven more. He placed the remaining animals in separate cages, and two days later the ninth succumbed. This, however, was the last death, and since then the disease has completely disappeared. Two months ago, however, M. Loir received an additional consignment of 30 animals, which were placed in the cages occupied by the first lot. Up to the present no deaths had occurred, nor had the disease yet shown itself. Post mortem examinations were made of the dead animals, from which the lecturer learnt that the disease was inoculable from one rabbit to another, and to any animal of another species, though the former seemed the more susceptible. The blood of a rabbit having died of the disease when inoculated in ordinary veal broth produced a cultivation of a microbe (*streptococcus*). A drop of the cultivation inoculated to another rabbit gave death with the same disease. Judging from the appearance of the microbe, and from the physiological reaction which it produced in animals, M. Loir believed that he had a microbe which was the cause of a spontaneous disease in rabbits not hitherto described.

(3) "Notes on some recent Celestial Photographs taken at the Sydney Observatory," by H. C. Russell, Government Astronomer. The author stated that in order to complete the photographic apparatus at the Observatory, it was necessary to obtain such an attachment to the star camera as would serve to record highly magnified images of double stars, the moon and other objects. This had recently been added, so that now he could record double stars photographically on a scale which gave ample dimensions for accurate measurement. After describing the principal characteristics of a large number of photographs, which were laid before the meeting for inspection, he said that photography had altered their view of what nebulæ in detail were like. The sensitive film seemed to grasp details which the eye could not see, and he was disposed to think that this was not owing to the faintness of the light, but to some inherent difference which the camera could and the eye could not see.

(4) "Some Folk-songs and Myths from Samoa," by Dr. John Fraser, translated by Rev. G. Pratt.

CIVIL ENGINEERING SECTION.

Sydney, 10th September, 1891.—C. W. Darley, Esq., in the chair.

The discussion upon the paper read by Mr. J. I. Haycroft, on "Methods of Determining the Stresses in Braced Structures," was resumed by Mr. H. W. Parkinson and Mr. Grimshaw.

Professor Warren in the course of an interesting paper on the subject, dealt in an exhaustive manner with the latter portion of Mr. Haycroft's paper, in which the Cowra bridge, now under construction by the Roads and Bridges Department, was referred to. He said both the department and Mr. Haycroft had calculated the stresses by graphic and analytical methods, which agreed with each other; but the results arrived at by Mr. Haycroft differed from those arrived at by the department. Dealing with American bridges, he said he thought every English bridge engineer freely admitted the skill and ability displayed by the Americans in the construction of bridges. Although we have the Forth Bridge, he said, we cannot claim that our ordinary bridges are superior to those constructed in America. We certainly could not claim that we disposed our materials in a more scientific manner, for we have the facts clearly pointed out by Sir B. Baker on this subject. American engineers had adopted for their ordinary iron and steel bridges a form of truss or girder very similar in appearance to their timber bridge, and which resembled the form adopted by the Roads and Bridges Department for timber bridges. It would be found on examining a variety of the best designs, such as those of the Union Bridge Company, that in iron and steel bridges where the stresses were definite, they adopted the form known as the American truss bridge, and for timber bridges a truss which was almost identical with the Roads and Bridges truss, with the identical bars which, according to Mr. Haycroft, were untrussed. Before condemning the Cowra bridge, he thought it desirable to show that a better composite bridge could be constructed. He submitted that neither Mr. Haycroft's paper nor the discussion had shown that the Cowra bridge was unsafe or liable to become so. He had seen a great many timber bridges in Australia and New Zealand, but he considered the Cowra bridge, in spite of the ambiguity in the determination of the stresses developed in it, to be superior to any other.

FIELD NATURALISTS' CLUB OF VICTORIA.

Melbourne, August 10th 1891.—Professor W. Baldwin Spencer in the chair.

New members.—Messrs. J. H. Craig, jun., B. Eugène, F. Gladish H. A. Lamble, F. Marsh, J. Mitchell, and N. T. Wilsmore, B.Sc.

Paper.—(1) "Mode of Reproduction of *Peripatus Leuckartii*," by Dr. A. Dendy, F.L.S. Last May, Dr. Dendy obtained three specimens from Macedon, and kept them, in company with one from another district, in a small vivarium, and at the end of July some 12 or 15 eggs were laid. These eggs were easily seen, being fairly large, oval in shape, and covered with a tough, thick, elastic membrane. Microscopic examination of one of them showed that the membrane enclosed a thick, milky fluid, full of yolk granules, the enclosing case being exquisitely sculptured in a regular design. This discovery is of importance, as in all other species whose life history is known, the viviparous habit—

where the young are born alive—is one of the most remarkable characters of the genus. Dr. Dendy is carefully watching these eggs, with a view to their further development.

The usual exhibition of specimens took place afterwards.

Melbourne, September, 14th, 1891.—D. Best, Esq., in the chair.

New members.—Messrs. L. J. Balfour, A. D. Denny, J. P. Fiddian, B.A., A. E. Hill, F. A. Officer, and J. J. Porter.

Papers.—(1) "The Supposed Human Footprints on Æolian Rocks at Warrnambool," by C. G. W. Officer. In introducing the subject, Mr. Officer described in detail the formation and nature of the sand dunes and their connection with the underlying strata, as shown by the similarity of the stone now being quarried there. Overlying the dunes in many places are sheets and veins of limestone, varying from a few inches to several feet in thickness. Last December a slab was discovered in one of the quarries bearing impressions which suggested that they were made by human beings. This slab was secured by Mr. Archibald, and placed in the Warrnambool Museum. The determination of the age of the rocks is of importance, and Mr. Officer, following the lead of Professor Tate, alleged them to be pleistocene, and suggested that the impressions were made by two individuals sitting close together, and somewhat obliquely to each other. In the discussion which followed, Mr. D. M'Alpine, F.C.S., spoke in complimentary terms of the paper, and referred to the action of carbonate of lime in the preservation of such marks, whilst Mr. F. R. Godfrey, who had seen the slab, bore testimony to the remarkable similarity of the impressions to human footprints. Mr. J. Dennant, F.G.S., however, disputed Mr. Officer's deductions, basing his objections not only on the fact that these dunes were generally formed in a comparatively short time, but also on their position relative to the newer basalt and a fossiliferous bed, both of which are of recent formation. Mr. G. Sweet supported Mr. Dennant, and Messrs. F. G. A. Barnard, C. M. Bridger, and F. Wisewould also joined in the discussion.

(2) "Maori preserved heads of New Zealand," by T. Steel, F.C.S. Reference was made to the custom of the Maoris in the reverence they pay to their deceased ancestors, and corresponding customs amongst the natives of Africa, New Guinea, New Hebrides, Egypt, and Australia. The writer then described the method adopted by the Maoris in preserving the heads of distinguished persons, and exhibited a very good specimen in illustration, the age of which could be traced back for at least 50 years. He concluded by stating the fact that before the head came into his possession it had been neglected, and most of the hair had been destroyed by moths After having kept it some time, he noticed that a thin growth of very fine hair in scattered patches had taken place. In order to gain definite information of future growth the hair has been closely shaved from a marked patch.

The meeting terminated by the usual exhibition of specimens.

Melbourne, October, 12th, 1891.—C. Frost, Esq., in the chair.

New members.—Mrs. C. E. Andrews, Miss Burkett, Miss G. Sweet, Miss F. Thompson, and Messrs. E. T. Carter, J. L. Bowen, D. E. Martin, G. J. Page, W. Strickland, and J. B. Walker.

Paper.—(1) "Some peculiar changes in the colour of the flower of *Swainsonia procumbens*," by J. P. Eckert. When the flower opens the corolla is lilac, and the first change is noticed in the longitudinal venules of the largest petals, which soon after assume a deep crimson. Then, at two different points of the petals a dark blue is noticed, which gradually extends over the whole surface, the peripheral portion being a little paler in colour. In the central portion the colour varies through all the shades of blue till finally it assumes a rosy tint. Frequently the petals will assume their original colour for some days, and afterwards go through all the gradations of colour once more. Mr. Eckert assigns as the cause a meteorological one, that arch scourge—the north wind—being very effective towards its accomplishment. Experiments with the electric current gave almost conclusive testimony in favour of the hypothesis. In speaking upon the subject, Mr. T. Steel, F.C.S., gave some interesting details as to the application of the spectroscope to this particular branch of study.

ROYAL SOCIETY OF VICTORIA.

Melbourne, August 13th, 1891.—Professor Kernot, President, in the chair.

Papers.—(1) "On the mode of reproduction of *Peripatus leuckartii*," by Arthur Dendy, D.Sc.

(2) "Short Descriptions of New Land Planarians," by Arthur Dendy, D.Sc.

(3) Professor Spencer exhibited and remarked upon *Notoryctes typhlops*, the new Australian mammal recently described by Dr. E. C. Stirling of Adelaide.

(4) "Notes on the recent Flood on the Yarra," by Professor W. C. Kernot.

Melbourne, September 10th, 1891.—Professor Kernot, President, in the chair.

Papers.—(1) Adjourned discussion on the paper read by Professor Kernot, on "Notes on the recent Flood on the Yarrow."

(2) "On a new species of Graptolitidæ—*Temnograptus magnificus*," by J. B. Pritchard; read by Dr. Dendy. This new fossil was discovered in Silurian strata near Lancefield.

(3) "On the presence of Ciliated Pits in Australian Land Planarians," by A. Dendy, D.Sc. The author stated that these structures have the form of little pits on the head; they probably acted as olfactory organs, and were supplied with special nerves from the brain.

Melbourne, October 8th, 1891.—E. J. White, Esq., in the chair.

Papers.—(1) "Notes on the Distribution of Victorian Frogs, with Description of two new species," by A. H. S. Lucas, M.A., B.Sc. These species were found at Narree Warren, Gippsland, and at Gisborne and Macedon respectively.

(2) E. F. J. Love, M.A., communicated a letter from Sir George Stokes, President of the Royal Society of London, concerning the Gravity Survey of Australia, written in reply to one from himself. The letter contained a number of suggestions, the most important being a new method, based on the principle of dynamical similarity, for the determination of the errors introduced into results of observations by variations of temperature and atmospheric pressure.

(3) "Notes on the Magnetic Shoal near Bezout Island, North-West Australia," by R. L. J. Ellery, F.R.S., C.M.G. This paper gave details of the results of observations made by Captain Moore, the commander of the "Penguin," under instructions from the Admiralty. According to these there was a magnetic shoal near the islands. It was about four miles long by two miles broad, and was at a depth of eight or nine fathoms. In a wooden ship, or composite vessel like the "Penguin," the compasses would act as usual after leaving the shoal. Whether or not induction would take place in an iron vessel was a matter yet to be ascertained. At present there was no evidence of danger to navigation, except that a vessel steering by compass across the shoal would be set out of her course, more or less, according as to whether she cut the shoal at the narrowest part of it or obliquely. The locus of the shoal was 20 deg. 32 min. 35 sec. S., 117 deg. 13 min. 2 sec. E. From it Bedout Island summit was distant 2·17 miles, and bore S. 78 deg. 49 min. W.

ROYAL SOCIETY OF TASMANIA.

Hobart, September 8th, 1891.—His Excellency Sir R. G. C. Hamilton, K.C.B., President, in the chair.

His Excellency referred to the paper read on behalf of Mr. A. J. Ogilvy at last meeting on the best means of collecting scientific information, and suggested that the matter should be brought under the notice of the approaching meeting of the Australasian Association for the Advancement of Science. He considered that valuable information would be obtained if, as suggested, there was a representative of the Society in every district to keep his eyes and ears open, and let them know of anything of scientific interest.

Mr. A. J. Ogilvy said he regarded it as very important that in every district the Society should have some one to represent it, and pointed out that if at any time it wanted any special local knowledge there would be somebody to whom application could be made. He thought that the Fellows should consider as to the best means of carrying out the suggestion made, and deal with the subject at a future meeting.

Paper.— (1) "Electric Traction," by Montague Jones, C.E.

It is with considerable regret that I have to announce to the subscribers of the The New Zealand Journal of Science that the second attempt to keep a periodical of the kind going in this colony has proved unsuccessful. With the present number this issue comes to a close. There can be no doubt of one fact in regard to such a periodical, namely, that if it were sufficiently supported by all the scientific societies of Australasia even as a record of their proceedings, it would prove most valuable. Speaking for myself,—and my want must be that of numbers of others interested in, and attempting to carry on scientific work,—I have often wanted to know what was being done in other colonies and in other parts of this colony in certain lines of research. A journal in which all the societies could record their doings would therefore be most useful, and this the present publication has attempted to do. Unfortunately secretaries of societies are not always alive to the importance of keeping their members in touch with other and similar organisations, and any imperfections in this direction are attributable to this cause. So convinced am I of the good which would result from a joint publication of their proceedings by the various scientific societies in Australasia, that I would urge upon those members who meet in conference at Hobart next January, to try to come to some arrangement in this direction.

The history of private enterprise in connection with scientific periodicals in Australia and New Zealand has been one of failure. Most of the societies in existence receive just so much Government aid as enables them to publish their papers, and in this way to kill private effort.

The previous and present issues of this Journal, the Southern Science Record, and, within the last twelve months, the issue of the Spectrum in Sydney, all testify to the fact. At the same time many of the scientific societies, and notably the N.Z. Institute are so long in the publication of their papers, that an author may wait twelve months after reading a paper before he sees it in print. This certainly wants remedying. Meanwhile the publication of an abstract in a widely-spread periodical would obviate many of the objections.

In conclusion I would express the hope that the suggestion thrown out here may be acted upon, and that a mild form of federation in the department of scientific work may precede that political federation of Australasia of which we have heard so much of late years.

GEO. M. THOMSON.

Dunedin, November 14th 1891.

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