TRANSACTIONS

OF THE

NEW ZEALAND INSTITUTE

TRANSACTIONS

AND

PROCEEDINGS

OF THE

NEW ZEALAND INSTITUTE

1890

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BY

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Director

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NEW ZEALAND INSTITUTE.

ESTABLISHED UNDER AN ACT OF THE GENERAL ASSEMBLY OF NEW ZEALAND INTITULED "THE NEW ZEALAND INSTITUTE ACT, 1867."

Board of Governors.

(ex officio.)

His Excellency the Governor.
The Hon. the Colonial Secretary.

(nominated.)

The Hon. W. B. D. Mantell, F.G.S.; W. T. L. Travers, F.L.S.; Sir James Hector, K.C.M.G., M.D., F.R.S.; W. M. Maskell, F.R.M.S.; Thomas Mason; the Hon. Robert Pharazyn, M.L.C., F.R.G.S.

(elected.)

1890.—James McKerrow, F.R.A.S.; S. Percy Smith, F.R.G.S.; A. S. Atkinson.

Manager: Sir James Hector.

Honorary Treasurer: W. T. L. Travers, F.L.S.

Secretary: R. B. Gore.

ABSTRACTS OF RULES AND STATUTES.

Gazetted in the "New Zealand Gazette," 9th March, 1868.

Section I.

Incorporation of Societies.

1. No society shall be incorporated with the Institute under the provisions of "The New Zealand Institute Act, 1867," unless such society shall consist of not less than twenty-five members, subscribing in the aggregate a sum of not less than fifty pounds sterling annually, for the promotion of art, science, or such other branch of knowledge for

which it is associated, to be from time to time certified to the satisfaction of the Board of Governors of the Institute by the Chairman for the time being of the society.

2. Any society incorporated as aforesaid shall cease to be incorporated with the Institute in case the number of the members of the said society shall at any time become less than twenty-five, or the amount of money annually subscribed by such members shall at any time be less than £50.

3. The by-laws of every society to be incorporated as aforesaid shall provide for the expenditure of not less than one-third of the annual revenue in or towards the formation or support of some local public museum or library, or otherwise shall provide for the contribution of not less than one-sixth of its said revenue towards the extension and maintenance of the Museum and library of the New Zealand Institute.

4. Any society incorporated as aforesaid, which shall in any one year fail to expend the proportion of revenue affixed in manner provided by Rule 3 aforesaid, shall from thenceforth cease to be incorporated with the Institute.

5. All papers read before any society for the time being incorporated with the Institute shall be deemed to be communications to the Institute, and may then be published as Proceedings or Transactions of the Institute, subject to the following regulations of the Board of the Institute regarding publications:—

Regulations regarding Publications.

(*a.*) The publications of the Institute shall consist of a current abstract of the proceedings of the societies for the time being incorporated with the Institute, to be intituled "Proceedings of the New Zealand Institute," and of transactions, comprising papers read before the incorporated societies (subject, however, to selection as hereinafter mentioned), to be intituled "Transactions of the New Zealand Institute."

(*b.*) The Institute shall have power to reject any papers read before any of the incorporated societies.

(*c.*) Papers so rejected will be returned to the society in which they were read.

(*d.*) A proportional contribution may be required from each society towards the cost of publishing the Proceedings and Transactions of the Institute.

(*e.*) Each incorporated society will be entitled to receive a *proportional* number of copies of the Proceedings and Transactions of the Institute, to be from time to time fixed by the Board of Governors.

(*f.*) Extra copies will be issued to any of the members of incorporated societies at the cost-price of publication.

6. All property accumulated by or with funds derived from incorporated societies, and placed in charge of the Institute, shall be vested in the Institute, and be used and applied at the discretion of the Board of Governors for public advantage, in like manner with any other of the property of the Institute.

7. Subject to "The New Zealand Institute Act, 1867," and to the foregoing rules, all societies incorporated with the Institute shall be entitled to retain or alter their own form of constitution and the by laws for their own management, and shall conduct their own affairs.

8. Upon application signed by the Chairman and countersigned by the Secretary of any society, accompanied by the certificate required under Rule No. 1, a certificate of incorporation will be granted under the seal of the Institute, and will remain in force as long as the foregoing rules of the Institute are complied with by the society.

Section II.

For the Management of the Property of the Institute.

9. All donations by societies, public departments, or private individuals to the Museum of the Institute shall be acknowledged by a printed form of receipt, and shall be duly entered in the books of the Institute provided for that purpose, and shall then be dealt with as the Board of Governors may direct.

10. Deposits of articles for the Museum may be accepted by the Institute, subject to a fortnight's notice of removal, to be given either by the owner of the articles or by the Manager of the Institute, and such deposits shall be duly entered in a separate catalogue

11. Books relating to natural science may be deposited in the library of the Institute, subject to the following conditions:—

(*a*.) Such books are not to be withdrawn by the owner under six months' notice, if such notice shall be required by the Board of Governors.

(*b*.) Any funds especially expended on binding and preserving such deposited books at the request of the depositor shall be charged against the books, and must be refunded to the Institute before their withdrawal, always subject to special arrangements made with the Board of Governors at the time of deposit.

(*c*.) No books deposited in the library of the Institute shall be removed for temporary use except on the written authority or receipt of the owner, and then only for a period not exceeding seven days at any one time.

12. All books in the library of the Institute shall be duly entered in a catalogue, which shall be accessible to the public.

13. The public shall be admitted to the use of the Museum and library, subject to by-laws to be framed by the Board.

Section III.

The laboratory shall for the time being be and remain under the exclusive management of the Manager of the Institute.

Section IV.

(Of Date 23rd September, 1870.)

Honorary Members.

Whereas the rules of the societies incorporated under the New Zealand Institute Act provide for the election of honorary members of such societies, but inasmuch as such honorary members would not thereby become members of the New Zealand Institute, and whereas it is expedient to make provision for the election of honorary members of the New Zealand Institute, it is hereby declared,—

1. Each incorporated society may, in the month of November next, nominate for election, as honorary members of the New Zealand Institute, three persons, and in the month of November in each succeeding year one person, not residing in the colony.
2. The names, descriptions, and addresses of persons so nominated, together with the grounds on which their election as honorary members is recommended, shall be forthwith forwarded to the Manager of the New Zealand Institute, and shall by him be submitted to the Governors at the next succeeding meeting.
3. From the persons so nominated the Governors may select in the first year not more than nine, and in each succeeding year not more than three, who shall from thenceforth be honorary members of the New Zealand Institute, provided that the total number of honorary members shall not exceed thirty.

LIST OF INCORPORATED SOCIETIES.

NAME OF SOCIETY.	DATE OF INCORPORATION.
Wellington Philosophical Society	10th June, 1868.
Auckland Institute	10th June, 1868.
Philosophical Institute of Canterbury	22nd Oct., 1868.
Otago Institute	18th Oct., 1869.
Westland Institute	21st Dec., 1874.
Hawke's Bay Philosophical Institute	31st Mar., 1875.
Southland Institute	21st July, 1880.
Nelson Philosophical Society	20th Dec., 1883.

OFFICERS OF INCORPORATED SOCIETIES, AND EXTRACTS FROM THE RULES.

WELLINGTON PHILOSOPHICAL SOCIETY.

Office-bearers for 1891. — *President* — E. Tregear, F.R.G.S.; *Vice-presidents* — A. McKay, F.G.S., Hon. R. Pharazyn, M.L.C., F.R.G.S.; *Council* — W. M. Maskell, F.R.M.S., Sir James Hector, K.C.M.G., M.D., F.R.S., A. de B. Brandon, G. V. Hudson, F.E.S., Sir W. Buller, K.C.M.G., F.R.S., W. T. L. Travers, F.L.S., Charles Hulke, F.C.S.; *Secretary and Treasurer*—R. B. Gore; *Auditor*—T. King.

Extracts from the Rules of the Wellington Philosophical Society.

5. Every member shall contribute annually to the funds of the Society the sum of one guinea.

6. The annual subscription shall be due on the first day of January in each year.

7. The sum of ten pounds may be paid at any time as a composition for life of the ordinary annual payment.

14. The time and place of the general meetings of members of the Society shall be fixed by the Council, and duly announced by the Secretary.

AUCKLAND INSTITUTE.

Office-bearers for 1891.—*President*—Professor F. D. Brown; *Vice-presidents*—James Stewart, C.E., J. Martin, F.G.S.; *Council*—Rev. J. Bates, W. Berry, Rev. J. Campbell, C. Cooper, T. Humphries, E. A. Mackechnie, T. Peacock, J. A. Pond, Rev. A. G. Purchas, Professor A. P. W. Thomas, F.L.S., E. Withy; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—J. Reid.

Extracts from the Rules of the Auckland Institute.

1. Any person desiring to become a member of the Institute shall be proposed in writing by two members, and shall be balloted for at the next meeting of the Council.

4. New members on election to pay one guinea entrance-fee in addition to the annual subscription of one guinea, the annual subscription being payable in advance on the first day of April for the then current year.

6. Members may at any time become life-members by one payment of ten pounds ten shillings, in lieu of future annual subscriptions.

10. Annual general meeting of the society on the third Monday of February in each year. Ordinary business meetings are called by the Council from time to time.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

Office-bearers for 1891.—*President*—Professor F. W. Hutton; *Vice-presidents*—J. T. Meeson, B.A., T. W. Naylor-Beckett; *Treasurer*—J. T. Meeson, B.A.; *Secretary*—R. M. Laing, M.A., B.Sc.; *Council*—R. W. Fereday, F.E.S., H. R. Webb, F.R.M.S., Dr. Jennings, Dr. Symes, G. A. Mannering, F. Barkas.

Extracts from the Rules of the Philosophical Institute of Canterbury.

31. The ordinary meetings of the Institute shall be held on the first Thursday of each month during the months from March to November inclusive.

35. Members of the Institute shall pay one guinea annually as a subscription to the funds of the Institute. The subscription shall be due on the first of November in every year.

37. Members may compound for all annual subscriptions of the current and future years by paying ten guineas.

OTAGO INSTITUTE.

Office-bearers for 1891.—*President*—Professor F. B. de Malbisse Gibbons; *Vice-presidents*—Rev. Dr. Belcher and Mr. C. W. Adams; *Council*—Professor T. J. Parker, Dr. Hocken, Dr. De Zouche, Dr. Scott, Messrs. F. R. Chapman, G. M. Thomson, and D. Petrie; *Secretary*—A. Hamilton.

Extracts from the Constitution and Rules of the Otago Institute.

2. Any person desiring to join the society may be elected by ballot, on being proposed in writing at any meeting of the Council or society by two members, and on payment of the annual subscription of one guinea for the year then current.

3. Members may at any time become life-members by one payment of ten pounds and ten shillings in lieu of future annual subscriptions.

5. An annual general meeting of the members of the society shall be held in January in each year, at which meeting not less than ten members must be present, otherwise the meeting shall be adjourned by the members present from time to time until the requisite number of members is present.

11. The session of the Otago Institute shall be during the winter months, from May to October, both inclusive.

WESTLAND INSTITUTE.

Office-bearers for 1891.—*President*—Mr. M. L. Moss; *Vice-president*—Captain G. W. Bignell; *Hon. Treasurer*—Rev. John Blackburne; *Council*—Messrs. Joseph Churches, T. O. W. Croft, Robert Cross, W. C. Fendal, W. L. Fowler, W. G. Johnston, A. H. King, John Nicholson, Robert Ross, M. Scanlan, J. N. Smythe, J. P. Will.

Extracts from the Rules of the Westland Institute.

3. The Institute shall consist (1) of life-members—*i.e.*, persons who have at any one time made a donation to the Institute of ten pounds ten shillings or upwards, or persons who, in reward of special services rendered to the Institute, have been unanimously elected as such by the Committee or at the general half-yearly meeting; (2) of members who pay two pounds two shillings each year; (3) of members paying smaller sums, not less than ten shillings.

5. The Institute shall hold a half-yearly meeting on the third Monday in the months of December and June.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

Office-bearers for 1891.—*President*—Mr. H. Hill; *Vice-president*—Mr. L. Lessong; *Treasurer*—Mr. J. S. Large; *Secretary*—Mr. Geo. White; *Auditor*—Mr. T. K. Newton; *Council*—Drs. Moore and Spencer, Messrs. J. W. Craig, H. H. Pinkney, P. S. McLean, and J. T. Carr.

Extracts from the Rules of the Hawke's Bay Philosophical Institute.

3. The annual subscription for each member shall be one guinea, payable in advance on the first day of January in every year.

4. Members may at any time become life-members by one payment of ten pounds ten shillings in lieu of future annual subscriptions.

(4.) The session of the Hawke's Bay Philosophical Institute shall be during the winter months from May to October, both inclusive; and general meetings shall be held on the second Monday in each of those six months, at 8 p.m.

SOUTHLAND INSTITUTE.

Office-bearers for 1891.—*Trustees*—Ven. Archdeacon Stocker, Rev. John Ferguson, Dr. James Galbraith.

NELSON PHILOSOPHICAL SOCIETY.

Office-bearers for 1891.—*President*—The Bishop of Nelson; *Vice-presidents*—A. S. Atkinson and Dr. Boor; *Hon. Secretary*—Sidney Black; *Hon. Curator*—R. I. Kingsley; *Hon. Treasurer*—Dr. Hudson; *Council*—J. Holloway, Dr. Mackie, Dr. Cressy, Rev. W. Evans, Rev. F. W. Isitt.

Extracts from the Rules of the Nelson Philosophical Society.

4. That members shall be elected by ballot.

6. That the annual subscription shall be one guinea.

7. That the sum of ten guineas may be paid in composition of the annual subscription.

16. That the meetings be held monthly.

23. The papers read before the Society shall be immediately delivered to the Secretary.

TRANSACTIONS.

TRANSACTIONS

OF THE

NEW ZEALAND INSTITUTE, 1890.

I.—ZOOLOGY.

Art. I.—*Further Coccid Notes: with Descriptions of New Species from New Zealand, Australia, and Fiji.*

By W. M. Maskell, F.R.M.S., Corr. Mem. Royal Society of South Australia.

[*Read before the Wellington Philosophical Society, 8th October, 1890.*]

Plates I.–VII.

Of the eighteen or twenty new species and varieties mentioned in the following paper, five are Australian. These have been very kindly furnished to me by Mr. C. French, Government Entomologist of Victoria, who has allowed me to trespass largely upon his good-nature for supplies of specimens. I regret that I have not been able to include in this paper a most remarkable Coccid, of which Mr. French has sent me several examples, and which forms on *Casuarina*, in the neighbourhood of Melbourne, large galls, through which protrude hard and horny cylindro-conical tubes forming the insect's particular domicile. This species belongs, as far as I can make out, to none of the genera at present known of Coccids; but, as I have not yet a sufficiently complete series of all its stages of growth, in view of its very curious features its description must be postponed for the present. I am again indebted to Mr. R. L. Holmes, of Bua, Fiji, who has sent me a Diaspid described in this paper; and the remainder of my new species, with the exception of *Lecanium cassiniæ*, are due to the assiduous industry of Messrs. Raithby and Cavell, of Inangahua, in this country, who have been, as last year, of the greatest assistance to me.

Two of the genera herein given—*Parlatoria* and *Leachia*—are new to the South Seas. Our New Zealand example of the latter is decidedly interesting from the peculiar eyes of the male, probably unique in the family. There is also a special interest in the adult form of *Cœlostoma assimile*, and its curious and not easily explicable mode of burrowing into the wood of its food-plant.

A fire in the Government Printing Office storehouse lately destroyed, as I understand, nearly all the remaining copies of my book on the scale-insects of New Zealand, 1887. I have therefore, in dealing herein with species mentioned in this paper, added a reference to the original descriptions of them in volumes of the New Zealand Transactions.

Group DIASPIDINÆ.

Genus Aspidiotus, Bouché.

Aspidiotus corokiæ, sp. nov. Plate II., figs. 1–4.

Female puparium circular, rather solid, slightly convex, with the pellicles in the centre; colour varying from yellow to (less frequently) white, pellicles yellow; diameter about $\frac{1}{24}$in.

Male puparium rather more elongated than that of the female, not carinated; texture thinner; colour whitish; pellicle yellow, near the middle.

Adult female yellow, of the normal peg-top shape of the genus; length about $\frac{1}{35}$in. Abdomen ending in two conspicuous floriated lobes, with one smaller lobe on each side of them, and another small lobe a little distance along the margin; margin numerously indented; between the terminal lobes, and as far as the single small lobes, are several fine short serrated or forked hairs. Pygidium exhibiting no regular groups of spinnerets, but there are two pairs in the region where the upper laterals usually are, and a considerable number of single spinnerets near the margins. In some individuals traces may be detected of a lattice-work pattern above the anal orifice, which last is placed near the extremity; but this lattice-work is not constant.

Adult male unknown.

Hab. In New Zealand, on *Corokia cotoneaster*, in the Reefton district.

Only a few species of *Aspidiotus* have been reported without groups of spinnerets, and the present does not seem to agree with any of them, as far as I know. A species, *A. phormii*, Brème, is reported by Signoret as living on *Phormium tenax*, and therefore presumably a New Zealand insect; but I have not seen it: moreover, the description of it does not state whether the "groups" are present or not. *A. acaciæ*, Morgan (Ent. Mo. Mag., Aug., 1889), a Tasmanian species, differs from ours in several particulars. *A. camelliæ* has not even the two pairs of orifices noticeable in *A. corokiæ*.

Aspidiotus camelliæ, Signoret. Scale-Ins. of N.Z., p. 41; N.Z. Trans., vol. xi., p. 200.

I think that Mr. Morgan (Ent. Mo. Mag., Aug., 1889) is correct in separating this from *Kermes camelliæ*, Boisduval; or, rather, perhaps, it should be said that Boisduval's description is so vague and uncharacteristic that it is best to assign the species to Signoret, who at least placed it correctly.

I also agree with Mr. Morgan in considering *A. rapax*, Comstock, as identical with *A. camelliæ;* and I believe that the insect which is so common here upon *Euonymus*, and which I have identified as *A. camelliæ*, is the same as Comstock's species.

Euonymus japonicus is much infested by this insect, and is often not worth the trouble of cultivation on this account.

Aspidiotus cladii, sp. nov. Plate I., figs. 1–4.

Female puparium rich dark-brown, the margin orange-red and the pellicles dark-yellow. Form circular, rather convex; pellicles central; diameter about $\frac{1}{10}$in.

Male puparium similar in colour, but narrower and elongated: length about $\frac{1}{20}$in.; not carinated.

Female dark-brown, almost black, the abdominal extremity lighter-coloured. Form of the usual peg-top shape of the genus, shrivelling at gestation. Abdomen acuminate, ending in four small terminal lobes and another pair rather higher up; margin serrated, bearing at each side two rather long hairs. A few hairs also on the cephalic segments. No groups of spinnerets, but a few small single orifices.

Adult male unknown.

Hab. In Australia, on *Cladium*, a species of rush. My specimens were sent to me by Mr. French.

This is a handsome species, the colours of the puparia being unusually bright. I do not think that it is at all like any described species.

Aspidiotus rossi, Crawford MS.

I have very frequently had specimens sent to me from Australia which I believe to be this species. The female puparium is large, intensely black, flat, and usually circular (but I have seen some, on small narrow leaves, elongated). It appears to be very common about Adelaide, Melbourne, and Sydney, on almost every kind of plant. I have not found it yet occurring in New Zealand. Mr. Crawford has not yet published a description of this insect, but I believe it is deposited in the Museum of Adelaide under the name here attached to it.

Genus DIASPIS, Costa.

Diaspis pinnulifera, sp. nov. Plate I., figs. 13–16.

Female puparium circular or sub-circular, reddish-brown, flat; the pellicles sub-central, yellow. Diameter about $\frac{1}{16}$in.

Male puparium elongated, white, distinctly carinated. Length about $\frac{1}{20}$in.

Adult female brown, pegtop-shaped, shrivelling at gestation. Abdomen somewhat acuminate, ending in six terminal lobes, of which the two median are the largest, the outer pair the smallest. Between the lobes are some small scaly hairs. Margin slightly crenulated: two of the crenulations on each side, just beyond the outer pair of lobes, bear longish feather-shaped processes or scales, slender and pointed, one to each crenulation. Four groups of spinnerets, of which the upper laterals have 5–8 orifices, the lower pair 2–4. Several single spinnerets.

Adult male unknown.

Hab. In Fiji. Mr. R. L. Holmes has sent me specimens on some large smooth leaf; but I do not know the plant.

The female puparium of this species resembles somewhat, to the naked eye, that of *Aspidiotus coccineus* (*aurantii*), although close inspection shows that it is less regularly circular. But the carinated male puparium fixes it in *Diaspis*. The two pairs of feathery processes on the margin of the last abdominal segment are quite distinct and characteristic.

Genus MYTILASPIS, Targioni-Tozzetti.

I think it advisable here to enter somewhat into detail as to my plan of including in the genus *Mytilaspis* a number of insects which, in the outward appearance of the female shield, do not present exactly the "mussel" shape of the type, but rather resemble the broad scale of *Chionaspis*. These insects, in my various papers, I have named *M. epiphytidis, M. leptospermi, M. metrosideri, M. pallens, M. phymatodidis*, and *M. pyriformis*, and in this paper *M. intermedia*.

Professor Comstock, in the Second Report of the Department of Entomology, Cornell University Experiment Station, 1883, p. 97, states that the two genera *Chionaspis* and *Mytilaspis* "can in almost all cases be distinguished by the colour of the scale;" and says that he knows of no species of *Mytilaspis* in which the scale of either sex is white. In his "Introduction to Entomology," 1888, p. 149, he, however, only gives as the distinguishing mark of *Mytilaspis* "scale of male similar in form to that of the female." I confess that, to me, colour plays a very unimportant part in the matter. I look on colour as an accident not only of the organisms themselves, but also of the observer's eyes. Men rarely, I think, agree entirely as to shades of colour, and what to one may seem a distinct brown may to another appear dark-grey. Writers on Coccids have not, luckily, plunged as deeply as the lepidopterists into the mysteries of "fuscous-ochreous," "fuscous-blackish," "piceous-fulvous," and so on. We are spared that infliction so far; and undoubtedly I would not argue that most men cannot tell the difference between "brown" and "white." But, if we begin to consider colour as an important distinction, especially for *generic* differentiation, I fear the result will be endless confusion. Moreover, as a fact, colour in Coccids is not a constant character. Not only do the insects themselves change with age, but very frequently their shields vary with the food-plant or other conditions. For example, in my species *Mytilaspis pyriformis*, in many cases, the enclosed female, up to gestation, is light "yellowish-brown or greyish" (Scale-Ins. of N.Z., p. 53); but after gestation I find it frequently a very dark-brown, almost black. Again, the same insect, on a soft and succulent leaf of *Dysoxylon*, has a light-brown shield; on *Rhipogonum* it is often nearly black; on the hard bark of a pine-tree it is frequently a very pale yellow. Again, *Mytilaspis pomorum*, according to Signoret, has a shield "dark-brown;" Professor Comstock (Ag. Rep., 1880) calls it "ash-grey;" I have seen often some quite white mixed with the brown ones. I believe that hares in Scotland are sometimes brown and sometimes white; but we could not separate the two generically.

Professor Comstock's second character—"Scale of male similar in form to that of the female"—is much more reliable; but it does not go quite far enough, and requires the additional words "not carinated," as I shall point out presently.

In the *Entomologist's Monthly Magazine* for July, 1888, Mr. A. Morgan proposes a classification of the Diaspid group based upon what he terms a "tendency" to certain shapes in the puparia. I freely confess that I feel the greatest possible horror of accepting as the basis of anything at all a "tendency;" nor do I sympathize in the least with the prevailing modern fashion of philosophy in this respect. Moreover, in systematic observation it would seem to be extraordinarily difficult, in examining some newly-found insect, to affirm whether it is, or merely "tends to be," something or other: it would be better to take it at once for what it appears to be in fact. But I venture to think also that Mr. Morgan's theory leads him into a want of definiteness and clearness. For example, he separates *Aspidiotus* from *Diaspis* as follows: "*Aspidiotus* female and male circular, male tends to linear form; *Diaspis* female circular, male linear." It would be puzzling to make out a "circular" object "tending to linear form:" why not say "elliptical" at once? Again, his distinctions of *Mytilaspis* and *Chionaspis* are: "*Mytilaspis* female elongated-circular; *Chionaspis* elongate but sometimes much rounded." There is here certainly something wanting.

In point of fact, the outline of the puparium is not a sufficient generic distinction, as between *Mytilaspis* and *Chionaspis*, any more than colour. Instances of variation are innumerable: position on a leaf or twig often alters the shape. In the numerous cases where insects are found in hundreds together, their consequent crowding and pressing on each other, or on the hollows of the plant, often produce most variable contours. For example, in the New Zealand species *Chionaspis dysoxyli*, although the normal female puparium is regularly pyriform, the insects are often so jammed together that specimens occur quite narrow, or mussel-shaped, or irregular. Again, *Mytilaspis pyriformis* on a slender twig becomes often very convex, even nearly globular, and I have seen some very like a *Diaspis*. On the whole, therefore, I have been led to lay little stress on mere outline, and consequently to include in *Mytilaspis* several species much resembling *Chionaspis*.

The distinction upon which I have relied has been the absence or the presence of carinations or grooves in the male shield. I consider all species in which these grooves appear as belonging (*ceteris paribus*) to *Chionaspis*; all species from which the grooves are absent as belonging (*ceteris paribus*) to *Mytilaspis*. In like manner, dealing with the genera having circular or sub-circular female puparia, the presence of carinations in the male puparium points to *Diaspis*, the absence of them to *Aspidiotus*. So, a few months ago, when my friend Mr. E. T. Atkinson sent me from Calcutta for identification an insect attacking the Assam tea-plant, I found the female puparium sub-circular, convex, with the pellicles not central. Had I not seen anything more I should have placed it in *Diaspis*; but, the male shield having no grooves, I unhesitatingly advised Mr. Atkinson to name it *Aspidiotus theæ*. Similarly, as none of the species mentioned at the beginning of this note exhibit carinations, I have placed them all under *Mytilaspis*, disregarding the widened and pyriform shape of the female puparium.

On the other hand, I have also included in the same genus *Mytilaspis cordylinidis*, where both female and male puparia are snowy-white, because they are not only similar, but free from grooves.

If I am asked what would be the proper course in cases where the female puparia only are observed, I should say, suspend the judgment, or, if required to pronounce, let it be provisionally until examination of the male. But, as a rule, some specimen of the male is pretty sure to accompany a number of the females.

Since the foregoing was written I have received from Mr. French some specimens of *Aspidiotus rossi*, on leaves of *Pittosporum*. These leaves being exceedingly narrow, the usual circular form of the puparia has been changed to oblong, almost rectangular; but I should certainly not consider them as specifically distinct.

Mytilaspis intermedia, sp. nov. Plate II., figs. 5–9.

Female puparium yellowish-brown, the posterior end usually exhibiting a narrow border of white. Being placed transversely on small twigs of the plant, and coiling round them, it frequently appears very convex, the two ends meeting; the proper shape would probably be flat and pyriform. Pellicles small, dark-yellow. The length may be taken as about $\frac{1}{12}$ in.; but this, again, is difficult to determine.

Male puparium of similar colour to that of the female, elongated, without carinations. It also is placed on small twigs, but longitudinally, so that the form is not affected; it is usually found near a bud. Length about [illegible] in.

Adult female before gestation greyish, the pygidium yellow. Form normal of the genus. Abdomen ending in four lobes, of which the two median are large and fimbriated, the other two very small. Five groups of spinnerets, the uppermost three almost forming an arch; upper group 10–15 orifices, upper laterals 12, lower laterals 10–12. In some specimens the arch appears to be complete. Several single spinnerets. Between the lobes, and along nearly all the terminal margin, are several spiny hairs. Length of the insect about [illegible] in.

Adult male unknown.

Hab. In New Zealand, on *Leptospermum scoparium*, as yet only from Beeston. The insect affects the small terminal twigs, and the female is very inconspicuous from its small size and from its mode of coiling transversely round the twig. The male is still more difficult of detection, as it is usually placed amongst the loose bud-scales, which it much resembles in colour and size.

I look on this insect as a link between *M. pyriformis* and *M. leptospermi*; and, indeed, it is possibly rather a variety of this last than really distinct. The female differs slightly from both in the terminal lobes, and the abdominal segments want usually the spiny hairs of *M. pyriformis*. In the character of the puparium, however, as there is no trace of the bark-cells so characteristic of that of *M. leptospermi*, it differs also from that species; at the same time, this may be accounted for by its position on the small, hard, smooth-barked twigs of the plant instead of the loose scaly bark of the trunk, which can be so easily employed as a shield by *M. leptospermi*. On the whole, whilst not entirely satisfied as to its independent status, I shall leave it now as distinct, though much nearer to *M. leptospermi* than anything else, and a probable link between that and *M. pyriformis*.

On account of the bent shape which this insect takes, from curling round very small twigs, it is very difficult to extract it from its puparium without damage.

Mytilaspis gloverii, Packard.

M. gloverii, Packard (Comstock, Ag. Rep. 1880, p. 323).

This insect has been sent to me from Melbourne, on a leaf of orange. I doubt its being really specifically distinct from *M. citricola*, Packard, the only difference apparently being in the narrower form of the female puparium. Professor Comstock, however, so definitely urges the separation of the two that I do not venture here to disturb his arrangement. Mr. Douglas (Ent. Mo. Mag., March, 1886, p. 249) considers *M. citricola* as identical with *M. flavescens*, Targioni.

Genus Chionaspis, Signoret.

Chionaspis dubia, Maskell. Scale-Ins. of N.Z., p. 54; N.Z. Trans., vol. xiv., p. 216.

An insect which I consider to be only a small form of this species occurs at Reefton on leaves of *Leptospermum*, and at Wellington on *Asplenium* and *Cyathodes*. I find nothing except size which can be taken as a clear distinction: the female puparium averages about $\frac{1}{24}$in. in length, and the pellicles are proportionately larger than in the type. The segments of the body are certainly more conspicuously prominent; but there is no character on which I feel justified in considering this form as even a variety.

Chionaspis dysoxyli, Maskell. Scale-Ins. of N.Z., p. 55; N.Z. Trans., vol. xvii., p. 22.

In my paper of 1889 (vol. xxii., p. 135) I mentioned the fact that the males of this species are frequently entirely apterous. I shall presently (*vide post*) have to report the same phenomenon in *Eriococcus hoheriæ*, and an almost similar condition in *Leachia zealandica*. There are thus three of our New Zealand Coccids having males abnormally developed.

I regret that when writing last year I overlooked a paper by Dr. F. Löw (1883) on *Leucaspis pusilla*, in which that species is mentioned, together with *Chionaspis salicis* and *Eriococcus* (*Acanthococcus*) *aceris*, as having apterous males. My only excuse is that I read German with great difficulty. However, I see no harm in recording now a list of the few Coccid species reported as exhibiting this abnormal character. They are less than a dozen out of several hundreds of species known in different parts of the world: and the point is not without some interest. What is the object of these apterous individuals? In most cases it would appear that their organs, excepting the wings, are fully developed: in *Eriococcus hoheriæ* there seems to be something wanting, but its generative organs are apparently perfect. *Leachia zealandica* and *Gossyparia ulmi* exhibit very small rudimentary wings, which must be quite useless for flight. I have included both in the following list, which gives all the apterous males that I know of at present; also *Lecanium hesperidum*, although I have not yet been able to procure the full text of M. Moniez's paper, and have only gathered from a summary of it that the male is never winged.

Species.	References.
A. Sometimes totally apterous:	
Aspidiotus (?) *sabalis*, Comst. ..	Comstock, 2nd Cornell University Report, 1883, p. 67.
Chionaspis salicis, Linn. ..	Bouché, Stett. Ent. Zeit., 1884, p. 294.
	Löw, Wiener Ent. Zeit., II., 1883.
Chionaspis fraxini, Signoret (= *C. salicis ?*)	R. Newstead, in lit.
Chionaspis alni, Sign. ..	R. Newstead, in lit.
Chionaspis dysoxyli, Mask. ..	Maskell, N.Z. Trans., vol. xxii., p. 136
Leucaspis pusilla, Löw ..	Löw, Wiener Ent. Zeit., II., 1883.
Lecanium hesperidum ..	Moniez, Comptes Rendus de l'Acad. des Sciences, Feb., 1887.
Eriococcus (*Acanthococcus*) *aceris*, Sign.	Löw, Wiener Ent. Zeit., II., 1883.
Eriococcus hoheriæ, Mask. ..	The present paper.
B. Sometimes with rudimentary wings:	
Gossyparia ulmi, Geoffroy ..	Signoret, Essai, p. 320.
	Howard, "Insect Life," Aug., 1889.
Leachia zealandica, Mask. ..	The present paper.

As regards the time of the year at which these apterous males emerge, I find that it varies considerably. Mr. Newstead tells me that *C. salicis* and *C. alni* came out in England in July (summer); Mr. Howard states that *G. ulmi* appeared about the 1st May at Washington (spring); here in New Zealand *E. hoheriæ* appeared in May (autumn), *C. dysoxyli* from February to August (autumn and winter), and *L. zealandica* in October (spring). Our winter in this country is, of course, not nearly as severe as that of England or Northern America. But, so far, I have not met with any apterous males in our summer season.

Genus POLIASPIS, Maskell.

Scale-Ins. of N.Z., p. 56; N.Z. Trans., vol. xiv., p. 293.

I venture to put in a few considerations in favour of the retention of *Poliaspis* as a separate genus. Professor Comstock, in his Second Report of the Cornell University Department of

Entomology, 1883, whilst adding to the genus a new species, *P. cycadis*, remarks that he is "far from feeling sure that the genus will prove to be a natural one;" but he gives no reason for this opinion, and, in fact, reverses it by including a species in the genus. Mr. A. Morgan, in the Entom. Monthly Mag. for October, 1888, follows the lead of Professor Comstock (as, indeed, he seems to do all through), and adds two reasons for doubting the generic position of *Poliaspis:* first, that it included only one species when first established, and, secondly, that the chief generic character regarded the abdominal features of the female, and not the shape of the scale or puparium. With reference to his first reason, it is evident that the discovery by Comstock of *P. cycadis* at once destroys it; and the mere fact that originally only one species was known does not in the least prevent the addition hereafter of any number of others. But, besides, it does not seem to me altogether satisfactorily established that, because, in three or four instances quoted by Mr. Morgan, Professor Comstock eliminated genera formed by Signoret, Targioni, &c., which genera only included single species, it must therefore be taken that this must be always agreed to. If it had been said that the formation of a genus, or even of a species, on a single *specimen*, is wrong, I should entirely agree. Moreover, I would advocate simplification as far as it can possibly be carried. But, when a large number of individuals are found occurring plentifully on certain plants, and year after year, and these individuals exhibit some *organic* character (not such trivial things as size, colour, and the like) not found in known genera, I conceive that an entomologist is justified in erecting them into a genus, even of only one species. I have never formed either a species or a genus without very careful examination of as many specimens (sometimes several scores) as I could get hold of; but, having established on single species such genera as *Poliaspis*, *Lecanochiton*, *Inglisia*, *Cœlostoma*, I have had the satisfaction of finding my judgment confirmed by the discovery of other species clearly cognate. Of course, if, after the most careful study, an observer is to be made liable to the overthrow of his work on the ground that somebody else has not seen anything similar to that which he has observed, it will become very difficult to systematize in any branch of science.

Mr. Morgan's second reason is of another class. He says that differences in the abdominal characters of Diaspid females ought not to "subserve generic purposes, as in that case the uniformity of the rule on which the genera of Diaspids have been established becomes imperfect." I am not aware of any "rule" properly so called. Signoret, I observe, remarks that differences in the forms of the puparia may be conveniently employed; and, in common with other students of the *Diaspidæ*, I have adopted his plan in most cases. But I would not agree with Mr. Morgan if he intends to say that the forms of the puparia are to be our only generic guides: and I notice that Signoret himself adds that such characters as the arrangement and numbers of the spinnerets may be usefully taken into account. Indeed, I would not venture to use the term "rule" at all in connection with such a study as that of Coccids, which even yet is scarcely more than grazed, as it were, and certainly not deeply broken into. But, rule or no rule, it would still be a question whether uniformity were a necessity. It is good, doubtless, and that is all. In the present case an exception does no harm; especially as the generic separation of *Poliaspis* has been made to depend upon an organic difference requiring for detection close microscopic observation, and not merely a trivial external character which might very possibly be fallacious.

On the whole, therefore, whilst desiring as much as anybody simplification, and deprecating entirely any hasty and superficial eagerness to extend the list of genera, I venture to maintain the separation of *Poliaspis*.

Genus PARLATORIA, Targioni-Tozzetti.

Female puparia elongated or sub-circular, the pellicles terminal or sub-central. Male puparia elongated. Abdomen of female as if crenulated and largely fringed.

This genus has not hither to been reported from this part of the world. Three species are known in Europe and America.

Parlatoria pittospori, sp. nov. Plate I., figs. 5–9.

Female puparium dull dark greenish-grey, sometimes almost black; pellicles green, sub-central. Form sub-elliptical, flattish. Length about $\frac{1}{25}$in.

Male puparium elongated, not carinated. Pellicle terminal. Length about $\frac{1}{50}$in.

Female dark-brown, segmented, sub-elliptical but shrivelling at gestation to globular. Posterior extremity broadly rounded, ending in six trifoliate lobes not close together, and with equal spaces between them. Margin conspicuously crenulated, and bearing in each crenulation and between the lobes a fringe of broad scaly hairs which are deeply serrated at the ends only. This fringe extends along the margin nearly as high up as the rostral region. The margin is considerably thickened on the last segment, and just within it is a row of curved narrow markings which may be elongated spinnerets. There are four spinneret-groups: the upper laterals have 13–16 orifices, the lower pair 11–13: many single tubular spinnerets on the dorsal surface.

Adult male unknown.

Hab. In Australia, on *Pittosporum undulatum.* Mr. French has furnished me with a large number of specimens.

The females of each species of this genus differ only very slightly indeed in the character of their lobes and fringe. In *P. proteus*, Curtis, the scaly hairs are serrated on the sides and not at the ends. *P. zizyphi*, Lucas, has an oblong, distinctly black puparium, not at all like that of our species. *P. pergandii*, Comstock, seems much nearer; but, apart from the colour of the insect and of its puparium, the numbers of spinnerets in the groups differ; its puparium is also more widely expanded posteriorly, and its pellicles are at one end.

Parlatoria myrtus, sp. nov. Plate I., figs. 10–12.

Female puparium light yellowish-brown, or whitish; pellicles dark-green. Form pyriform, flat, the pellicles terminal. Length about $\frac{1}{20}$in.

Male puparium of similar colour, but smaller and narrower; not carinated.

Adult female brown, more or less elongated, shrivelling at gestation. Abdominal extremity broadly rounded, conspicuously crenulated, ending in six lobes, and bearing the usual fringe of scaly hairs which are serrated at the ends. These scales are broader than those of the last species, especially the anterior ones, which are frequently also serrated at the sides. The fringe extends along the margin not quite as far as the rostral region. Four groups of spinnerets: upper laterals with 12–14 orifices, lower pair 10–12.

Adult male unknown.

Hab. In Australia, on *Myrtus communis* and *Viburnum* sp. Mr. French has sent me several specimens.

The differentiating characters of this species are not much clearer than those of the last, but I think them sufficient. *P. proteus*, Curtis, has the same lateral serrations on the scaly hairs of the abdomen, but the spinneret orifices are less numerous, and the puparium differs considerably. I have satisfied myself by comparison that *P. pergandii* is quite different. Mr. Douglas says of *P. proteus* that the "second exuviæ are long-oval, and conspicuously large." This character might possibly apply to *P. pittospori*, but certainly not to *P. myrtus*.

Group LECANIDINÆ.

Subdivision LECANODIASPIDÆ.

Genus Lecanochiton, Maskell.

Lecanochiton minor, sp. nov. Plate III., figs. 1–14.

Test of adult female brown, hard, horny, and tough; rather thick; nearly circular; upper surface flat; form cylindrical, with sloping sides. Upper surface formed almost entirely of the pellicle of the second stage. Diameter of test at the base about $\frac{1}{18}$in.

Test of male elongated, white or yellow, glassy, convex, divided into segments as in most *Lecanidinæ*, and with a posterior hinged plate for egress of the insect. In some specimens a quantity of white cotton is visible over the test. Length about $\frac{1}{24}$in.

Adult female convex, filling the test, brown; base circular. Antennæ with apparently only four joints, of which the third is very long, the others very short; on the last joint are a few hairs. Feet absent. Some very minute hairs are placed in a circle near the margin. Abdominal cleft conspicuous; lobes adjacent, sub-conical. Anogenital ring with numerous hairs. Mentum short and thick, dimerous.

Female of second stage light-brown, flattish, elliptical, naked, active; length about $\frac{1}{30}$in. Abdominal cleft and lobes present. Antennæ of six joints. Feet present, slender.

Larva flat, elliptical, brown, naked, active. Form normal of *Lecanidinæ*, with conspicuous abdominal cleft and lobes. Antennæ rather long, with six joints, the third the longest; on the last are a few hairs, of which one is a good deal longer than the rest. The anal ring appears to have six hairs. Length of larva about $\frac{1}{40}$in.

Adult male reddish-brown, the wings rather thick. Antennæ with ten joints, the last five of which are not moniliform, but elongated. The abdominal spike is long and curved. Length of the insect, exclusive of the spike, about $\frac{1}{25}$in.

Hab. In New Zealand, on *Metrosideros robusta*, in the Reefton district.

This is much smaller than *Lecanochiton metrosideri*, Mask., and is easily distinguished by its very regular sub-cylindrical female test. Indeed, at first sight the test may be easily mistaken for a pupa of some Aleurodid; but the pellicle of the second stage, as well as the antennæ and lobes of the enclosed insect, at once proves its Lecanid character. The antennæ of the adult are peculiar, and perhaps the long third joint may really be made up of three or four atrophied and confused joints. The male antenna differs from that of *L. metrosideri* in not having the last five joints moniliform.

Genus INGLISIA, Maskell.

Inglisia fagi, sp. nov. Plate III., figs. 15–25.

Test of adult female usually conical, less frequently elongato-convex, open beneath, with a distinct fringe of small segments which are often sharply triangular; main segments large, patched with brownish-green, or often altogether light-green, sometimes white, distinctly striated with air-cells, which are generally largest near the margins of the segments. Length of test often reaching $\frac{1}{5}$in., height from $\frac{1}{10}$in. to $\frac{1}{7}$in. Texture glassy, very thin and brittle.

Test of male elongated, elliptical, only slightly convex; segments large, striated; fringe conspicuous; colour greenish; texture glassy, very thin and brittle: length about $\frac{1}{12}$in.

Adult female greenish or brownish, filling the test previous to gestation, afterwards shrivelling. Margin set rather closely with conical spines. Antennae of six joints, the first two short, the third almost half as long as the whole antenna, the fourth and fifth equal and rather longer than the first, the sixth rather more than half as long as the third. On the sixth joint several hairs, of which one is much longer than the rest. Foot normal: digitules four, the lower pair being rather widely dilated. Anogenital ring with six hairs. Abdominal lobes rather large. On the dorsum are a great number of tubular spinnerets, and also (mostly on the posterior region) groups of large, simple, circular orifices. Mentum dimerous.

Female of second stage light-brown or with a greenish tinge. General form elongate-elliptical, the dorsum raised to a narrow ridge. Abdominal cleft and lobes conspicuous. Spiracular spines rather long, and there are a few other small marginal spines. Length about $\frac{1}{15}$in.

Larva greenish-yellow, elliptical, naked, active; length about $\frac{1}{50}$in. Antennæ of six joints, the first five short and sub-equal, the sixth nearly as long as the rest together. Feet rather thick; tibia rather more than half as long as the tarsus. Abdominal cleft short, with a small brush-like group of hairs from the anal ring; dorsal lobes rather large, with long setæ. Mentum large, dimerous.

Adult male brown, patched with green. Length of body (exclusive of abdominal spike) about $\frac{1}{16}$in. Antennæ of ten joints, the first two very short, the rest long and slender; the fourth, fifth, and sixth are the longest, the tenth fusiform; all the joints bear several hairs, and on the last there are three long hairs bearing knobs at the end. Dorsal eyes, four; ventral eyes, four: ocelli, two. Abdominal spike long, and slightly dilated at three-fourths of its length; the basal tubercle bears four short setæ.

Hab. On *Fagus* var. sp., Reefton district, New Zealand.

This insect exhibits some characters of both *I. leptospermi* and *I. ornata*, chiefly in the varying form of its test. I do not lay much stress on colour, although I have never seen *I. leptospermi* otherwise than pure white or very faint pink, or *I. ornata* otherwise than brown. More reliable differences are in the six-jointed antenna of the female and the much longer abdominal spike of the male. The large green tests of this insect are very handsome, but so brittle that they scarcely bear any handling.

Subdivision LECANIDÆ.

Genus Lecanium, Illiger.

Lecanium cassiniæ, sp. nov. Plate II., figs. 10–19.

Adult female naked, red-brown in colour, semi-globular, hollow beneath, attached to the plant by its edges, which are not recurved outwards; diameter averaging about $\frac{1}{16}$in. Antennæ of eight joints, the third and fourth the longest, the seventh the shortest; a few longish hairs on the last joint. Feet normal; tarsus nearly as long as the tibia; upper digitules fine hairs, lower pair rather thick and dilated. Mentum dimerous. Anogenital ring with numerous hairs; lobes roundly triangular, adjacent. Epidermis marked with great numbers of irregularly-shaped semi-translucent cells. Margin bearing slender spiny hairs. On the dorsum there are several minute spines. At the spiracles are pairs of conical spines with a group of simple circular spinneret-orifices at the base of each; and close to the abdominal cleft a great many similar orifices are visible, but not in groups. On the dorsum, in most specimens, may be made out obscurely one longitudinal and two transverse carinations; but the insect often appears smooth.

Female of second stage naked, active, flattish, elliptical; colour red-brown; length about $\frac{1}{35}$in. Dorsal carinations distinct and usually conspicuous. Antennæ of six joints. Marginal hairs as in the adult; the spiracular spines are rather long.

Larva dull-yellow, of the normal elliptical flattish form, naked, active; length about $\frac{1}{60}$in. Antennæ of six joints. Abdominal cleft and lobes normal.

Hab. In New Zealand, on *Cassinia leptophylla*, Wellington, Wairarapa, Hawke's Bay, and probably elsewhere. As *Cassinia* is in many parts of this country a great nuisance and a useless encumbrance, the occurrence on it of a Lecanid, often in great numbers, may be considered as a satisfactory thing; but, although sometimes the plants over a large area are quite blackened with the fungus induced by the "honeydew" of the insect, I cannot find that any good results have followed from its visitation.

L. cassiniæ is nearly allied to *L. oleæ*, Bernard, and I at one time thought that it might be identical, so that I added *Cassinia* to the list of food-plants of that species in my book on scale-insects in 1887. I believe, however, that it must be separated: it differs from *L. oleæ* not only in colour (which is not of great importance), but considerably in size, and principally in the markings of the skin. These, in *L. oleæ*, are regularly oval, or round; in *L. cassiniæ* they are quite irregular, approaching indeed those of *L. depressum*, Targioni, though they are more translucent than in the latter. In point of fact, there would seem to be much similarity in the markings of several species of Lecanium, and identification is not easy. Comstock (Ag. Report, 1880, p. 336) says that the anogenital ring of *L. oleæ* has only six hairs: this may serve to further distinguish *L. cassiniæ*, where, as in most insects of the genus, these hairs are very numerous.

Lecanium longulum, Douglas.

Lecanium chirimoliæ, mihi, N.Z. Trans., vol. xxii., 1889, p. 137.

In the *Entomologist's Monthly Magazine*, vol. xxiv., 1887, p. 97, Mr. J. W. Douglas describes a species, *L. longulum*, with food-plant (amongst others) *Annona muricata*. I had not seen his description when writing last year on *L. chirimoliæ*, but have since not only read it but had the opportunity of examining two specimens which Mr. Douglas has been good enough to send me. I am compelled to consider the two species as identical, and to abandon mine. The extremities of *L. longulum* are rather more broadly rounded than in my own types, but I do not consider the difference as important. Mr. Douglas is inclined to think that *L. longulum* has antennæ of eight joints, but he is doubtful on the point. In my Fijian species the antenna has certainly seven joints, and I believe this will also be the case with the other. The same genus of plants furnishes a food-plant for both insects. I think that the abdominal cleft and the distance of the antennæ from the cephalic extremity are perhaps a little longer in my specimens than in those of Mr. Douglas. The dorsal "long pale clear oval spot" mentioned in the description of *L. longulum* is not to be detected in the dead dried specimens before me. But, on the whole, I deem it best to identify the two species, and therefore to abandon *L. chirimoliæ* in favour of Mr. Douglas.

Lecanium ribis, Fitch, Trans. of New York Agric. Soc., 1856; Signoret, Essai, p. 462.

Adult female dark-brown in colour, or with a slight reddish tinge. Form semi-globular, attached to the plant by the edges, which are not broadly flattened; becoming hollow at gestation, with eggs and larvæ beneath. Diameter averaging about $\frac{1}{9}$in., but sometimes reaching $\frac{1}{6}$in. Epidermis not carinated, nor exhibiting any oval perforations or tessellated markings; but near the margins there are many fine transverse corrugations or small wrinkles.

Female of second stage yellow or yellowish-brown, flattish, elongated, elliptical. Length about $\frac{1}{18}$in. It is not carinated, but there is often a median very slight dorsal elevation, and the margins are finely corrugated as in the adult.

Hab. On gooseberries, black and red currants, in New Zealand, Europe, and America. My New Zealand specimens were received from Mr. W. W. Smith, of Ashburton, who informs me that the insect is common at that place in gardens. This is to be regretted, as it is likely to spread with rapidity and to do much damage.

This species is closely allied to *L. hemisphæricum*, Targioni, to *L. hibernaculorum*, Boisduval, and to *L. rugosum*, Signoret. It differs from the two first in the absence of markings on the skin, and from the last (which attacks peach-trees) in its general smoothness, and a few other particulars.

Lecanium frenchii, sp. nov. Plate IV., figs. 1–8.

Adult female very dark-brown, or rich glossy black; form sub-circular, very slightly convex; diameter about $\frac{1}{8}$in. Dorsal epidermis covered with numerous minute pits, and divided into irregular tessellations by smooth narrow bands, of which one is median and longitudinal, the others ramifying from it towards the margin. If the insect is macerated in potash the small dorsal pit-like marks appear as oval spots; the median band is not noticeable, but the transverse ones appear like cracks or slits in the body. Margin fringed with numerous very small fan-like processes, attached by a very short stalk, and with a short tubular canal extending from each into the body; this fringe is usually yellow. Antennæ slender, with eight joints. Feet very slender; upper digitules fine knobbed hairs, lower pair slightly dilated; on the trochanter a longish hair, and I think a spine on the tibia. The spiracular spines are very short, placed in small depressions, and not extending beyond the margin; they are somewhat club-shaped and thick. The abdominal cleft is rather deep; the lobes are triangular, small, adjacent. Anogenital ring with numerous hairs. At gestation the body becomes slightly hollow beneath. I think the insect is oviparous: at least, empty egg-shells are to be found beneath the body, and I have not seen any larvæ within the abdomen.

Female of the second stage yellow or light-brown, flat, elongated; length reaching sometimes $\frac{1}{11}$in. On the dorsum, in some specimens, fragments of a white, glassy test may be seen; but there is no fringe, except the small fan-like processes as in the adult, and these are not noticeable until towards the end of this stage. Antennæ of six joints. Feet, spines, and anogenital ring as in the adult.

Larva and male unknown: the male pupa has a white waxy test.

Hab. In Australia, on *Banksia australis*. My specimens are from Melbourne, sent by Mr. French, whose name I am glad to attach to this very handsome species.

The rich black colour and the curious fringe of small fans on the margin very clearly distinguish this insect. Viewed with a low power of the microscope, the tessellations and pitted surface of the dorsum are very curious. It would belong probably to Dr. Signoret's first series of the genus *Lecanium* (Essai, p. 226), though exceptional in its oviparous habit, and nearest, possibly, to *L. tessellatum*, Sign. But no species hitherto reported (as far as I know) exhibits a similar fringe.

Group COCCIDINÆ.

Subdivision ACANTHOCOCCIDÆ.

Genus Solenophora, Maskell.

Solenophora corokiæ, Maskell. N.Z. Trans., vol. xxii., p. 141.
Plate V., figs. 1–7.

I had not last year seen anything but the adult female of this species; I can now add the second stage and the male.

Female of second stage covered with a dirty-yellow or brownish loose test, convex, elliptical, from which protrude usually six or seven whitish, rather thick, cottony processes. The insect is red, elliptical in the cephalic and thoracic regions, tapering to a short, thick, abdominal prolongation terminating in two anal tubercles, each bearing a seta. Anal ring with six hairs. Feet entirely absent. Antennæ atrophied, a single conical joint, bearing a few hairs. Body covered with great number of spinneret-tubes with figure-of-8 orifices, and some circular. Length of insect about $\frac{1}{20}$in.

Male pupa enclosed in a cylindrical, yellow, felted sac, of which the extremity is somewhat flattened; length about $\frac{1}{20}$in.

Adult male red-brown in colour; length about $\frac{1}{40}$in. The thorax is rather large, the abdomen somewhat short and squat. Antennæ of nine joints, the first two very short, the third and fourth the longest, the rest sub-equal; all the joints bear hairs, and on the last are three long hairs knobbed at the end. Dorsal eyes, two; ventral eyes, two: ocelli, two. Abdominal spike short, conical, with the curved appendage noticeable amongst *Acanthococcidæ*.

As the second-stage female in this species is apodous, as in *S. fagi*, the character becomes important enough to be generic, and *Solenophora* is thus, I believe, a quite exceptional genus in the group. *Nidularia*, Targioni, and *Antonina*, Signoret, lose the feet in the adult state, but retain them in the second stage. The male of *S. corokiæ* offers no particular characters.

Genus Rhizococcus, Signoret.

Rhizococcus totaræ, Maskell. N.Z. Trans., vol. xxii., p. 142.

The male sac of this species is snowy-white, very loose in texture, and formed of rather coarse threads; length about $\frac{1}{20}$in.

The adult male is of normal form, orange-red in colour, the abdomen yellow; the two cottony "tails" are rather longer than usual; the spike exhibits a curved appendage. Antennæ of nine joints, of which the last three are moniliform; the ninth is very small. Dorsal eyes, two; ventral eyes, two: ocelli, two.

There is no particularly distinguishing character about this male.

Rhizococcus intermedius, sp. nov. Plate V., figs. 8–11.

Adult female sub-globular, naked; sometimes conspicuously segmented, sometimes nearly smooth; colour yellow, or red, or sometimes greenish. It affects generally the axils, or the terminal buds, of young shoots of the plant. The epidermis has a somewhat rough appearance. Anal tubercles rather large, but not usually visible, owing to the position of the insect on the twig. On the dorsum there are three pairs of small spines, and on the margin a double row of spines not set very close together: from all the spines spring glassy filaments which on the margin are sometimes rather long. The anogenital ring has eight hairs. Mentum dimerous. Antennæ of six joints, of which the fourth and fifth are the shortest. Feet normal; the tibia is rather more than half as long as the tarsus; all the digitules are fine hairs.

Larva reddish-yellow, active, naked, flattish, elliptical, tapering posteriorly, segmented. Length about $\frac{1}{70}$in. Antennæ of six joints. Margin bearing several conical spines. On the dorsum there are five pairs of very large spines, one pair near the cephalic extremity, the other four pairs on the thoracic segments; also a few other smaller single spines.

Male pupa in a dull-white closely-felted sac.

Adult male brown; length about $\frac{1}{24}$in. Thorax rather large; abdomen somewhat thick, the last segment bearing two rather dilated tubercles, each with two longish setæ bearing the usual long cottony "tails." Antennæ of ten joints, the first two very short, the next three very long, the sixth shorter, the last three the shortest and sub-equal; all bearing several hairs. Haltere sub-cylindrical, with one long curved seta. Abdominal spike short.

Hab. In New Zealand, on *Fagus menziesii*, Reefton.

This insect is not far removed from *R. maculatus*, mihi, and when smooth its colour is nearly all that there is to distinguish it to the naked eye, at least in the adult and larval stages; I have not been able to observe the second female stage. But on close examination the arrangement of the dorsal spines is sufficient to separate it. The three pairs on the adult, and the five pairs on the larva, which I have found to be constant in a large number of specimens examined, are good characters. In *R. maculatus* the adult has no dorsal spines, while the larva has twenty. As both of these species affect the same genus of food-plant (though seemingly not the same species), I am unable to look upon the variation of habitat as sufficient to account for the differences observable. At the same time I am not so clear on the point as to positively insist on a specific separation of the two insects.

Genus Eriococcus, Targioni-Tozzetti.

Eriococcus hoheriæ, Maskell. Scale-Ins. of N.Z., p. 93; N.Z. Trans., vol. xii., p. 298.

Two apterous forms of the male of this species emerged in May last from amongst a number of sacs, male and female, sent to me by Mr. Raithby.

This apterous form is deep-red in colour, rather less than $\frac{1}{30}$in. in length, being thus smaller than the winged form. The antennæ have only nine joints, the head is not fully separate from the thorax, and there seem to be only two simple eyes. The abdominal spike is normal, though rather long, and when the insect was alive I could detect the penis; the tubercle at each side of the base of the spike is perhaps more pronounced than in the winged form, and I could see no cottony "tails." The feet appear to be rather thick and swollen. Both specimens observed were very active, and as far as could be seen were sufficiently apt for generation.

I have already discussed (*ante*, under *C. dysoxyli*) the general question of apterous males. There is this difference between the present species and (I believe) all the others: that in *E. hoheriæ* the whole form is, so to speak, intermediate. The junction of the head with the thorax, the nine-jointed antenna, and the two simple eyes, are clearly imperfections; whereas in other apterous species the only organs and characters wanting are the wings. I am unable to add to the present paper a figure of this interesting and peculiar insect; but will endeavour to do so next year if I then publish a paper.

Eriococcus multispinus, Maskell, var. *lævigatus*, var. nov.

Mr. French has sent me an Australian insect which seems to be only a variety of *E. multispinus*, distinguished by having a smooth sac without the processes characterizing the New Zealand species on *Knightia*. I attach it to the above species on account of the short blunt conical form of the very numerous dorsal spines and the short antennæ with six sub-equal joints, characters distinguishing *E. multispinus* from *E. pallidus*, in which the spines are slender and the third antennal joint long, and from *E. raithbyi*, which has no dorsal spines, and seven-jointed antennæ.

Hab. In Australia, on *Acacia armata.*

Eriococcus pallidus, Maskell. Scale-Ins. of N.Z., p. 95; N.Z. Trans., vol. xvii., p. 29.

This species exhibits several variations in the arrangement of the dorsal spines, and slightly in the size and colour of the sac.

On *Elæocarpus dentatus* the type-form occurs, in which the sac is large (about $\frac{1}{8}$in.) and light-coloured, and the dorsal spines are arranged in a single transverse row on each segment. On *Myoporum lætum* the sac is also large and light, the spines being usually as in the type, but frequently almost wanting on the abdominal segments. On *Atherosperma novæ-zealandiæ* and on *Fagus menziesii* the sac is smaller (about $\frac{1}{15}$in.) and dark-coloured; the enclosed insect is also rather dark, and the dorsal spines are more numerous than in the type, each segment exhibiting several scattered spines. On *Fagus menziesii*, again, occurs another variety with a small, dark, rather solid sac; the dorsal spines being less numerous than in the last form, and more approaching to longitudinal rows on the abdomen.

I leave all these as variations of one species chiefly on account of the antenna, which I find similar in all, with six joints, of which five are sub-equal, but the third joint is longer, usually equal to any two of the others. This character, together with the slenderness of the spines, distinguishes *E. pallidus* from *E. multispinus*, irrespective of the variations in the sac, which are not indeed so important.

The varieties here mentioned occur at Wellington and Reefton. Doubtless forms nearly similar may be found elsewhere and on other trees.

Eriococcus danthoniæ, sp. nov. Plate V., figs. 12–17.

Sac of adult female pure-white in colour, very loose in texture; form elliptical; length about $\frac{1}{10}$in.

Sac of male pure-white, similar to that of the female, but smaller; length about $\frac{1}{20}$in.

Larva brownish-yellow; elongated, flattish, active, naked; length about $\frac{1}{40}$in. Antennæ short, thick, of six sub-equal joints; the last joint bears some longish hairs, one a good deal longer than the others. Feet rather thick; all the digitules are fine hairs. Anal tubercles large and prominent.

On the margins a row of strong conical spines, usually bearing tubular cottony filaments. On the dorsum a median longitudinal double row of conical spines, much smaller than those at the margin.

Adult female dull brownish-yellow, or sometimes dull-pink; elongated; segmented; length averaging about $\frac{1}{11}$in., width about $\frac{1}{40}$in., the insect being thus rather unusually long and slender. Antennæ of seven sub-equal joints, the last bearing numerous hairs. The feet, as usual in the genus, have the tarsus longer than the tibia; all the digitules are fine hairs, the lower pair rather long. Anal tubercles conspicuous; anogenital ring with eight hairs. Margins bearing a row of strong conical spines, three on each side, on each segment; from these spring usually cottony filaments. On the dorsum a large number of simple circular spinneret-orifices, and several very slender spines.

Adult male pinkish or light-red, the dorsal part of the thorax yellowish; length of body about $\frac{1}{25}$in. Abdomen rather slender; spike short; terminal segment bearing on each side two longish setæ, from which spring the usual long cottony "tails." Antennæ of ten joints, the third much the longest and somewhat dilated at its tip; all the joints, especially the last three, are hairy. Dorsal eyes, two; ventral eyes, two; ocelli, two. The wings are perhaps rather more solid than usual.

Hab. On *Danthonia cunninghamii*, Reefton district, New Zealand, frequently clustered thickly between the culms and sheathing-leaves of the grass.

The snow-white, loosely-constructed sac and the elongated slender form of the female in this species readily distinguish it. The seven-jointed antenna is abnormal, but I have already, in the case of *E. raithbyi* (Trans., vol. xxii., p. 146), said that I do not consider this point, taken by itself, as sufficient to remove an insect from the genus. There is no species indigenous to this country which can be mistaken for it, and it is not at all likely to have been introduced.

Ericcoccus paradoxus, Maskell. Trans. Roy. Soc. South Australia, 1888, p. 104.

In my description of this insect I mentioned as its food-plant *Pittosporum undulatum*. Mr. French has sent me from Melbourne specimens on *Eucalyptus goniocalyx*: these specimens are larger than those which I received from South Australia.

Eriococcus leptospermi, sp. nov. Plate IV., figs. 9–14.

Sac of female dirty-white, or yellowish, usually accompanied by much black fungus; felted, elliptical; length about $\frac{1}{12}$in.

Sac of male white, smaller than that of the female.

Larva yellow, flattish, naked, active, elliptical; length about $\frac{1}{70}$in. Margin bearing spines set rather closely together; and on the dorsum are two median longitudinal rows of similar spines. Antennæ of six joints. Feet rather thick, normal of the genus. Anal tubercles scarcely prominent, with long setæ.

Female of second stage red or dark-brown, flattish, active, elliptical; length about $\frac{1}{45}$ in. Marginal spines stronger than in the larva, and bearing glassy tubes forming an irregular fringe. Anal tubercles large and conspicuous. Antennæ of six joints.

Adult female red; elliptical in the cephalic and thoracic regions, and tapering posteriorly. Length about $\frac{1}{15}$in. Margins bearing double rows of spines; dorsum with two median longitudinal series of spines. and several others singly. Antennæ of six joints, the third the longest. Feet normal of the genus, the tibia much shorter than the tarsus; all the digitules are fine knobbed hairs. Anal tubercles two, conspicuous, with short setæ. Anogenital ring with eight hairs.

Adult male reddish-brown; length about $\frac{1}{35}$in. It appears to exhibit no special features.

Hab. In Australia, on bark of *Leptospermum lævigatum.* My specimens were sent to me by Mr. French.

This insect, in the general peg-top shape of the adult female, resembles *E. hoheriæ,* Mask., a New Zealand species which also constructs similar sacs on the bark of its food-plant. The Australian form differs in the character of the spines, in having only two anal tubercles, and in not having its feet atrophied in the adult stage. Both species seem to be alike in their tendency to be covered with black fungus, which renders them very inconspicuous on the bark of the tree.

Subdivision DACTYLOPIDÆ.

Genus DACTYLOPIUS, Costa.

Dactylopius poæ, Maskell. Scale-Ins. of N.Z., p. 101; N.Z. Trans., vol. xi., p. 220.

I received some months ago from Mr. Raithby a number of insects which I cannot distinguish from this species, but which inhabited, instead of the roots of grasses underground, the tangled moss and small climbing-plants clothing the roots and stems of various trees in the forests of the Reefton district. Like the insects from grass, as mentioned in my last paper (Trans., vol. xxii., p. 150), these from trees seemed not to excrete a great quantity of cotton in their natural habitation, but on being removed to tubes covered themselves at once with large tufts of cotton.

Genus Ripersia, Signoret.

Female insects of the general form of *Dactylopius*, but having antennæ of six joints: naked, or covered with cotton or meal.

Ripersia fagi, sp. nov. Plate IV., figs. 15–20.

Adult female sub-globular or slightly elongated, naked; generally distinctly segmented, but in specimens which have been parasitised the segments become very indistinct; colour dark-red or brown; length about $\frac{1}{15}$in. It appears to affect chiefly the *upper* surface of the leaves. Anal tubercles two, very inconspicuous, and just above them are two small tubercular lobules; all the four bear setæ and also short hairs, and these bear white cottony excretion, which is sometimes amalgamated in a mass, sometimes in the form of separate pencils: and from the anogenital ring springs another cottony pencil. Anogenital ring with six hairs. Antennæ somewhat slender, with six joints which have the form of those of *Dactylopius*: the first two are short, the third about as long as the first and second together, fourth and fifth equal to the second, sixth rather longer than the third, fusiform, with a few short hairs. Feet rather strong and thick: in the two anterior pairs the tarsus is almost as long as the tibia, but in the posterior pair the tibia is nearly twice as long as the tarsus; the digitules are all fine hairs. Mentum trimerous. There are no dorsal or marginal spines, but a great number of circular simple spinnerets: these are particularly numerous on the anal tubercles and lobules.

Female of the second stage flattish, elongated, slightly segmented; colour varying from yellow to brown, red, or dark-green; length about $\frac{1}{30}$in. The extremities are truncate. Anal tubercles inconspicuous, but a little more prominent than in the adult, and with a pair of lobules anterior to them; all these bear setæ and short hairs. Antennæ of six rather thick joints: the first five are sub-equal, the third being rather the longest; the sixth is about half as long as all the rest together. Feet rather thick; the posterior tarsi are as long as the tibiæ. Anal ring with six hairs.

Larva active, elongated, distinctly segmented, flattish, usually expanded posteriorly; colour yellow; length about $\frac{1}{45}$in. Anal tubercles very inconspicuous, setiferous; the anterior lobules are not noticeable. Antennæ with six rather thick joints, sub-equal, except the last which is nearly as long as the rest together. Feet thick; all the tarsi are about as long as the tibiæ. Anal ring large, with six hairs.

Male unknown.

Hab. In New Zealand, on *Fagus menziesii*, Reefton district.

Only two species of this genus have been hitherto reported —*R. corynephori*, Sign., in Europe, and *R. leptospermi*, Mask., from Australia. The present insect is so evidently a Dactylopid, from the very inconspicuous anal tubercles and the form of the antennæ, that, although in outward appearance it may easily be mistaken for a *Rhizococcus*, it cannot be placed in that genus. Moreover, the tibiæ of the adult, being equal to or longer than the tarsi, remove it from the *Acanthococcidæ;* and, as Signoret established the genus *Ripersia* to include *Dactylopidæ* having six-jointed antennæ, I have no hesitation in ascribing to that genus this insect.

Subdivision MONOPHLEBIDÆ.

Genus LEACHIA, Signoret.

Adult females naked, or producing not much cotton; antennæ of eleven joints, each of which is more or less cylindrical, the base not being smaller than the tip.

Adult males presenting no lateral tassels on the abdominal segments, but at the extremity tubercular lobes bearing bunches of setæ.

Signoret distinguishes this genus from *Guerinia*, Targioni, by the form of the joints in the female antenna, which in *Leachia* are cylindrical, and in *Guerinia* narrowed at the base. Seeing that he also makes this character the *only* one separating *Guerinia* from *Monophlebus*, and considering that it seemed by no means to be of great importance, I united the genus *Guerinia* to *Monophlebus* in the synopsis of genera given in my "Scale-Insects of New Zealand," p. 90, and I made *Leachia* separate from both these genera on the more important character of the absence of lateral tassels in the male. Whatever may be the right view as regards *Guerinia*, I have no hesitation in maintaining the distinction between *Leachia* and *Monophlebus*, especially since I have now had opportunities of studying both genera in the insect about to be described and in *Monophlebus crawfordi*, mihi, from Australia. This last insect exhibits, in the male, undoubted abdominal tassels; the insect herein given has none.

There is a point given by Signoret (Essai, p. 393) as a character of *Leachia*: "Eyes facetted, surrounding a large portion of the head, or almost pedunculated." It will be seen that our New Zealand insect differs from this in the peculiar form of the eye, divided into eight simple segments, and the pair forming a ring. But in this it differs also from all other Coccids hitherto described, as far as I know; and I do not feel inclined to propose a new genus for it based only on this character, until at least another species is found possessing it.

Yet another character is ascribed to *Leachia* by Signoret, "Male presenting at the extremity of the abdomen tubercular lobes;" and in his descriptions of *L. braziliensis* and *L. fuscipennis* he mentions these lobes as bearing "bundles of hairs." It will be seen that our insect presents also this character, and thus all the more clearly belongs to this genus.

Leachia zealandica, sp. nov. Plate VI., figs. 1–17.

Adult female red or reddish-brown in colour, excreting white meal and cotton, and also some longish, curling, rather coarse, yellow threads. At the abdominal extremity usually there are two pencils of white cotton, and somewhat thicker quantity of meal; also often on the last segments short white cottony lateral tassels, as in some *Dactylopidæ*. Body elongated, distinctly segmented, elliptical, convex above; length varying—some specimens reach $\frac{1}{3}$in., but most are smaller. Rostrum and mentum very large and long: mentum trimerous, with several hairs at the tip. Antennæ of moderate length, not conical, with eleven cylindrical joints, of which nine are sub-equal, the fourth and fifth being a good deal shorter than the rest; the last joint is fusiform. All the joints bear several hairs, and at the tip of the last there are two strong spiny hairs curving inwards towards each other. Feet rather strong; tibia not quite as long as the tarsus; all the joints are hairy, the hairs on the inner margins stronger than the rest; on the trochanter is a long seta, and on the end of the tibia a strong spine. The claw has a minute tooth on the inner edge; there are no tarsal digitules; at the base of the claw is a sub-conical process with a single rather long digitule with dilated end. The anogenital ring is large, and (unusual in the group) bears elongate pores and several hairs, of which six are much larger than the rest: these hairs bear the pencils of cotton noticed above. Around the ring is a patch containing numbers of circular spinneret-orifices. Epidermis covered with numerous hairs, some pretty long, some small and spiny, interspersed with circular spinnerets: the longer hairs frequently form tufts.

Larva yellowish-red, covered with white meal; active, elongated, segmented; length about $\frac{1}{25}$in. Two thick pencils of cotton at the abdominal extremity, and on the last three or four segments are lateral tassels of cotton as in *Dactylopius*. Antennæ of seven joints—the first and second equal, the third and fourth very short, the fifth and sixth longer but less than the two first, the last large, fusiform, pointed, and half as long as all the rest together; all the joints hairy, and on the last are two curved spines as in the adult. Feet rather thick; tibia shorter than the tarsus; claw toothed, and with a process and digitule as in the adult. Rostrum and mentum large;

setæ very long. Anal ring and terminal hairs as in the adult.

Adult male red or reddish-yellow, rather large; length of body about $\frac{1}{12}$in.; covered with much white meal, which, with the numerous hairs, renders it difficult to examine dead specimens, especially the eyes. No lateral abdominal tassels, but the last segment is somewhat dilated and tubercular, bearing on each side a bundle of from four to six strong and rather long setæ, bearing two very long and very thick white cottony "tails." Wings large, thick, and strong; the nervures brown, strong, and conspicuous; colour of wings darkish-grey, powdered with much white meal. Haltere very large, flat, fusiform, bearing two hooked setæ, not at the extremity, but on the anterior margin. Head slightly produced in front: eyes divided, each formed of eight tubercular segments, almost encircling the head, but not quite meeting dorsally and ventrally; each small tubercle in the ring may possibly be very obscurely facetted. Colour of eyes dark-brown. A small simple ocellus is placed behind the middle of each half-ring. Antennæ almost as long as the body, with ten joints—the first two smooth; the rest, except the last, compressed in the middle, and bearing each two rings of long hairs; the last fusiform, hairy, with two curved spines as in the female. Feet very long and slender, hairy; claw bearing a minute tooth on the inner margin; a single process and digitule, as in the female.

Amongst a large number of winged males received alive from Reefton early in October there were several specimens almost apterous, exhibiting very small, useless, rudimentary wings. With the exception of this character, however, I see nothing to distinguish them from the others: they are similar in the eyes, feet, and antennæ; the head is separate from the thorax; and they are as active as their winged brethren.

Hab. In New Zealand, on several trees—*Podocarpus totara*, *Fagus* var. sp., *Cupressus dacrydioides*, &c.—in the forests of the Reefton district. Mr. Raithby has kindly furnished me with many specimens of both males and females.

As remarked above, the absence of lateral abdominal tassels in the male, with its tubercular extremity bearing more than two setæ, and the eleven-jointed cylindrical antenna of the female, seem to me to bring this insect fairly within the genus *Leachia*. The very peculiar eyes of the male have not their counterpart in any other Coccid with which I am yet acquainted. With regard to the anogenital ring of the female, this is certainly rather abnormal, as the ring in the *Monophlebidæ* is normally a simple orifice, without hairs or pores; but I find Signoret, although in his generic characters he includes a simple ring, stating that in *L. braziliensis* the anus is "surrounded by a large number of spinnerets and long hairs," and that in *L. fuscipennis* the ring is "hidden by a good deal of pubescence." The character is therefore one which ought perhaps to be considered generic; but in the absence of information as to such genera as *Porphyrophora*, *Ortonia*, and others, in which I can find no definite statements as to the anogenital ring, I have hesitated to include it above as generic.

In outward appearance, to the naked eye, a live female of *L. zealandica* might be easily taken for a *Cœlostoma;* but the presence of the rostrum and mentum at once distinguishes it from that genus. The winged form of the male, both in colour and size, resembles somewhat that of *Icerya purchasi;* but the character of the eyes is a clear distinction. Another somewhat distinctive character is the claw, with its single digitule, in both sexes.

Genus Monophlebus, Leach.

Monophlebus crawfordi, Maskell. Trans. of Roy. Soc. South Australia, 1887–88, p. 108.

Mr. A. Koebele, in the account of his "Trip to Australia to investigate the Natural Enemies of the Fluted Scale," published by the United States Department of Agriculture, 1890, mentions that he found at Melbourne many specimens of *M. crawfordi*, and procured from them a number of parasitic flies. He gives a figure of the Coccid, with an enlarged figure of the antenna, in which I notice only eight joints (surely an error?). He states also (p. 20) that the insects were under loose bark of various Eucalypti, "embedded in cottony matter, and the single (often 2in.) long, white, setous, anal hairs sticking out." In a footnote to the same page he observes that these long hairs are not mentioned in the description of the insect which I originally published. Of course, as I have not had the opportunity of observing these insects in their natural home, Australia, I may have missed seeing this particular character: it is possible that these anal setæ may have been broken off from my specimens. Yet in all the number (perhaps forty or fifty) which I examined (both alive and dead) there was not the least indication of anything of the sort. And Mr. Crawford, of Adelaide, tells me that, in some two hundred observed by him, he has seen no long anal setæ. Moreover, I received about April last, from Mr. A. S. Olliff, of Sydney, a very fine specimen, alive, of *M. crawfordi*. This I placed in a glass-covered box, where it has remained ever since, and it is even yet (30th September) not dead, though so long confined. It has excreted a few long, very thin, cottony threads from various parts, and seems as if it would cover itself with cotton. But I have seen no trace of a long anal seta.

Taken in conjunction with the eight-jointed antenna figured by Mr. Koebele, and also the absence from his figure of the longitudinal dark stripes of the adult *M. crawfordi*, his statement about the anal setæ raises the question whether the insects he saw may not have been immature.

Genus Cœlostoma, Maskell.

Cœlostoma pilosum, sp. nov. Plate VII., figs. 1–10.

Adult female dark-red in colour. At first naked; then with a thin covering of white meal, which gradually becomes thicker and more solid, until it assumes the appearance of a hard, granular shell, looking like a coating of lime: at gestation this increases to a snow-white mass of closely-felted cotton covering the insect and the eggs. Length of insect variable, some specimens attaining a length of ½in., shrivelling at gestation. Form elliptical, convex, distinctly segmented. Antennæ of eleven sub-equal joints, each joint except the last very slightly dilated towards the tip, the last joint ovate; all the joints bear hairs, and on the last are two stronger than the rest. Feet strong and thick; on the trochanter a long seta; all the joints bear several hairs, but there seems to be no distinct comb of spines on the inner edge of the tibia and tarsus; the claw has a minute tooth. Upper digitules absent; lower pair fine hairs. Epidermis thickly covered with longish hairs interspersed with small, simple, circular spinneret-orifices. Anogenital ring simple: at the extremity of the abdomen are two very small tubercles, with a shortish seta on each. Rostrum and mentum entirely absent, being replaced by a small orifice between the first pair of feet.

Female of second stage dark-red in colour, covered partially or wholly with a hard, white coating, like lime, which frequently at last exhibits marginal tuberosities forming a kind of thick fringe. Length variable, reaching sometimes ⅛in. when extracted from the shell. Form elliptical, slightly convex, segmented. Antennæ atrophied: they may have six or eight joints, but these are so confused that it is difficult to determine the number; at the tip are several spiny hairs. Feet also atrophied, the joints apparently reduced to two, with a very small hook-like claw at the end. Rostrum and mentum very large: mentum conical, triarticulate. Epidermis very thickly clothed with longish rather thick hairs, interspersed with small, simple, circular spinneret-orifices. Anal extremity not exhibiting a brown patch; the anal ring simple, with the tubular internal organ usual in the genus, and frequently a long, slender, white, waxy filament.

Larva red, active, naked or with thin white cotton; elliptical, flattish, segmented; length about $\frac{1}{40}$in. Antennæ of six joints—the third, fourth, and fifth the shortest, the sixth very large, ovate, with a small projection at the tip. Feet rather thick; digitules four, all fine hairs. Mentum large, conical, triarticulate; setæ very long. Abdominal extremity bearing two small tubercles, each with a long seta, and two or three spines; between the tubercles protrude two rather thick pencils of white cotton. Epidermis not thickly clothed with hairs, but on each segment is a single transverse row of small spiny hairs with some small simple circular spinnerets.

Male unknown.

Hab. On various trees in forests, Reefton district, New Zealand. The second stage mostly on *Podocarpus totara* or various species of *Fagus*.

This insect is easily distinguished from *C. zealandicum* by the snow-white shelly covering both in the adult and the second stage, and by the thick coating of hairs on the epidermis. The larva is much smaller than that of *C. zealandicum*, and, curiously, it differs also in being much less hairy, quite the contrary of the second stage. I do not think that this can be the female form of *C. wairoense*, because the peculiar brush of digitules which distinguishes the male of that species has no counterpart in *C. pilosum;* and as far as my experience goes such a character would in all likelihood be shared by both sexes. The female of *C. wairoense* and the male of *C. pilosum* may both be discovered some day.

Cœlostoma assimile, Maskell. N.Z. Trans., vol. xxii., p. 153. Plate VII., figs. 11–17.

In my paper of last year I gave a brief description of the second female stage of this insect; I am able now to complete it, and to add also the adult female and the larva.

Adult female reddish-brown, occupying a deep pit in the twig it lives on (mostly in the axils), the mouth of the pit being covered with the mass of thick yellow wax, of irregularly globular shape, already formed by the second-stage female. The cavity burrowed out is frequently quite deep in the bark, and even seems sometimes to extend into the wood. The dimensions vary: some of the waxy coverings are only about $\frac{1}{15}$in. across; others observed reach $\frac{1}{8}$in. The wax is very hard. The adult female at first, after discarding the pupal skin, occupies the whole space, and is globular, with a diameter of about $\frac{1}{16}$in., obscurely segmented; but at gestation it shrivels up into an extremely small shapeless mass, filling the cavity with red oval eggs, and becoming at last so shrivelled that it is extremely difficult to find her. Antennæ short, thick, atrophied; the joints apparently only five, but the fifth may be made up of several, so that the normal antenna would have eleven joints, as usual in the genus: the third and fourth joints are very short; the fifth long, sub-conical, with three or four spiny hairs at the tip: as the third and fourth joints are the thickest, the antenna is somewhat elliptical. Feet absent. Rostrum and mentum entirely wanting. Epidermis covered with very slender hairs, which are sparse on the cephalic and thoracic regions but very numerous on the abdomen, and also with many small, simple, circular spinneret-orifices. Spiracles sixteen, four of which, on the cephalic region, are very large. Anogenital ring simple, with a tubular organ leading to it, as usual in the genus; at each side of the ring is a sub-circular scar or orifice of the same dimensions.

Female of the second stage as described in my last paper (vol. xxii., p. 153). I omitted, however, then to state that from the anogenital ring and tubular organ there springs a long, white, slender filament. This filament is sometimes more than an inch long: it protrudes through the waxy covering, and at the extremity there is often seen a minute bubble of honey-dew. The filament is excessively brittle, and pieces broken off are frequently observed on the adjacent twig. At the metamorphosis the exuviæ of this second stage remain in the cavity, and become flattened and disc-like: on breaking open the waxy test in late autumn, when the eggs have been laid, this pupal skin is usually the first object visible, covering the eggs, and, as the adult female (as stated above) has shrivelled up, the skin may be at first mistaken for the adult, but the presence of the very large rostrum and mentum at once shows the real state of the case. The filament already mentioned frequently remains protruding, and is found to be attached to this pupal skin.

Larvæ red, elongated, sub-elliptical, tapering somewhat posteriorly, active, sparsely covered with thin white cotton; length about $\frac{1}{35}$in. Antennæ of six joints—the first five cylindrical, sub-equal; the sixth very large, ovate. Feet with rather thick femora and tibiæ; tibia shorter than tarsus; claw slender, with a tooth on the inner margin; no tarsal digitules, the lower pair long, fine, with a slightly-dilated tip. Mentum large, conical, triarticulate, with a few hairs at the tip. Epidermis bearing many simple circular spinneret-orifices, which are most numerous in a circular patch at the abdominal extremity, with the usual tubular organ bearing three rings of glands; at the extremity are two very small anal tubercles, each bearing a long seta, and from the tubular organ there protrudes between the tubercles a thickish pencil of white cotton.

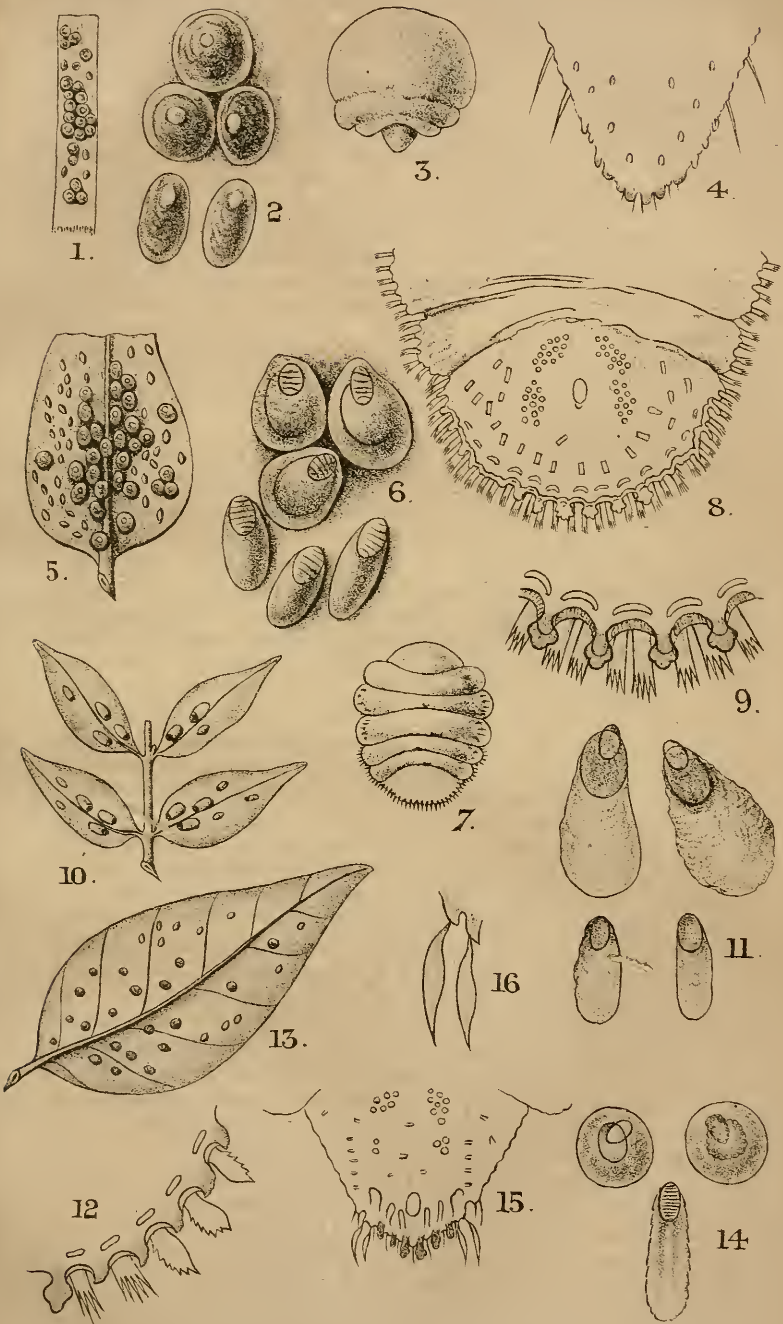
Male unknown.

Hab. On *Fagus menziesii*, *Phyllocladus trichomanoides*, and *Fagus fusca*, Reefton district. It appears to be not uncommon in that region. The waxy tests are very small and inconspicuous.

The finding of the adult female enclosed in the waxy mass formed by the female of the second stage was a surprise to me, being a distinct departure from the normal condition of things, especially in the group *Monophlebidæ*. It affords a good instance of the necessity, as I take it, of thorough examination of all stages before any absolute certainty can be arrived at, even as to the generic position of an insect. Whatever may be the rule amongst other orders and families of insects, Coccids present this difficulty to students: that one must be prepared at any time to find very distinct departures from generic, or even group, types, and to consider any character whatsoever as elastic and variable. Thus, for example, in the *Dactylopidæ*, the insect described in my last paper under the name *D. obtectus* departs entirely from the generic type in employing a portion of the plant it lives on as a shelter or "scale" for the adult female. So, again, in the *Monophlebidæ*, no genus or species has been reported hitherto in which the adult female is not, at least before gestation, free and active, or only covered with loose cotton. *Cœlostoma assimile* departs altogether from the types of the group and the genus in remaining under the thick waxy test in its adult state; and the variation is emphasized, so to speak, by the absence of the feet. The characters, however, of the larva and of the second stage being so clearly those of the genus *Cœlostoma*, and the rostrum and mentum of the adult being entirely absent, I have no hesitation in retaining the insect in that genus despite the form of the antenna; and, indeed, this may be looked on as merely atrophied.

The deep cavity made by this species in the wood of its tree, and its usual position in the axils of the twigs, make it resemble *Xylococcus filiferus*, Löw (Verh. der zool.-bot. Gesellschaft, Wien, 1882), which insect also has a small covering of wax, and a very long slender filament protruding from the abdominal extremity. But the presence in *Xylococcus* of a very distinct rostrum (which, indeed, seems to be the only member preserved by the adult female) clearly distinguishes that genus from *Cœlostoma*; and, indeed, the forms of the larva and of the second stage are also quite different.

The late Dr. Löw, whose death a few months ago deprived entomology of one of its brightest ornaments, devoted some remarks in his description of *Xylococcus filiferus* to the question of the manner in which that Coccid managed to produce a deep cavity in the wood of its food-plant, *Tilia europæa*. He was, however, unable to give any other explanation than that it proceeded "by a most peculiar kind of suction, and besides by a certain influence which these insects exercise on



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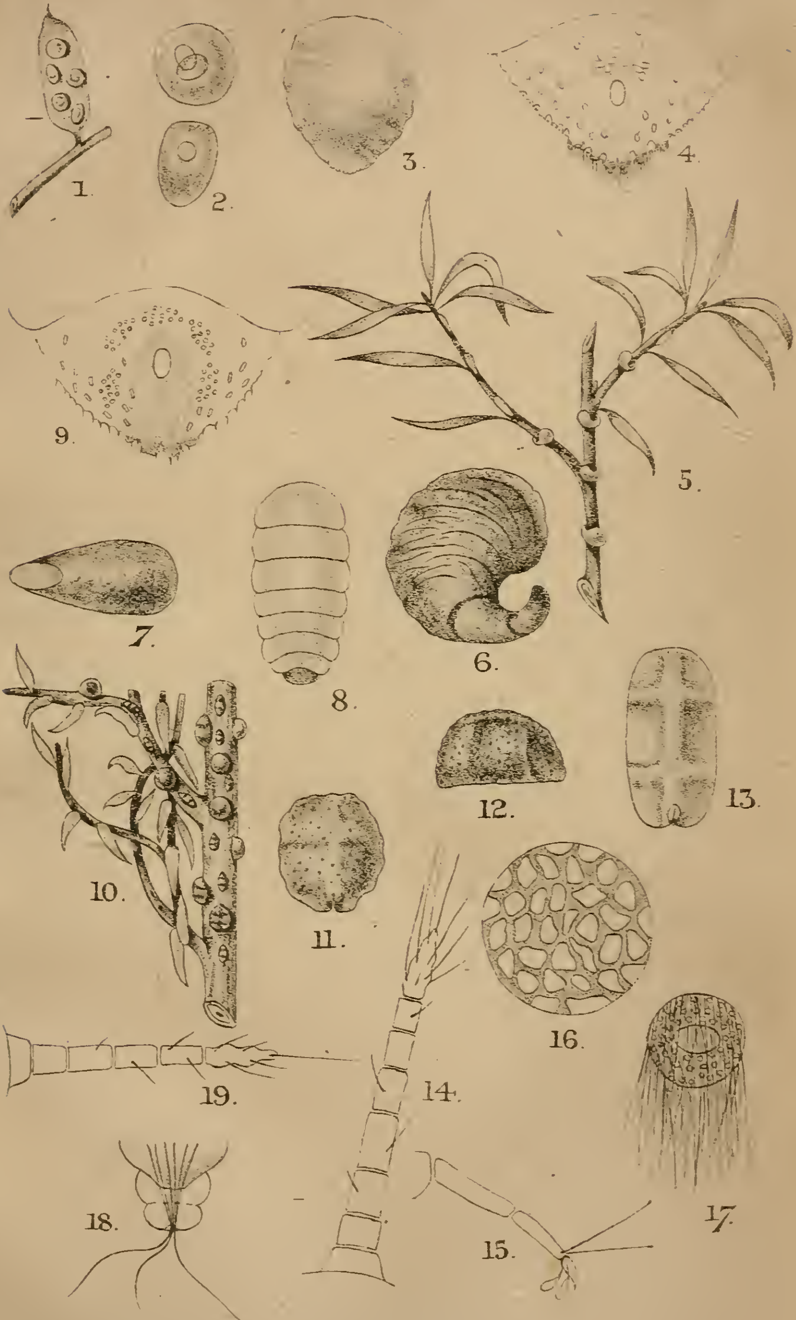

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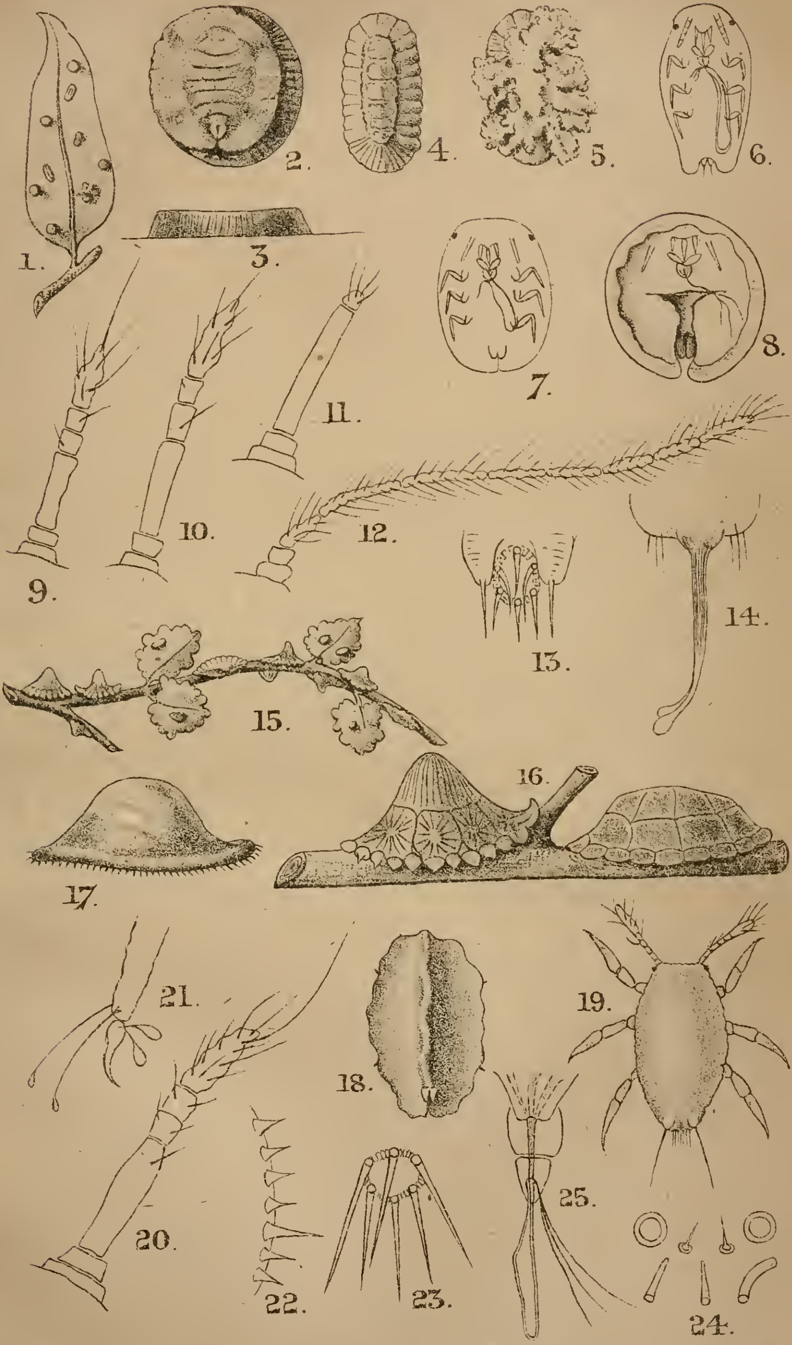

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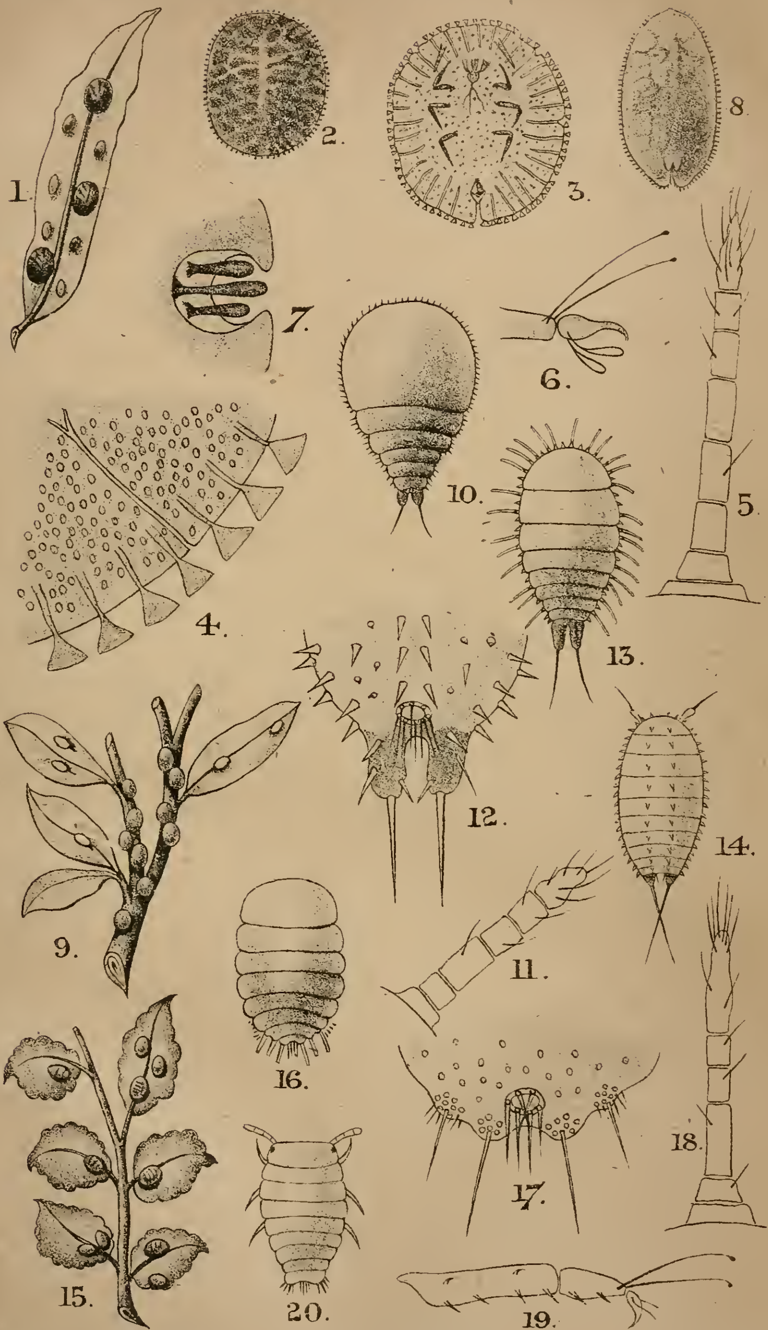

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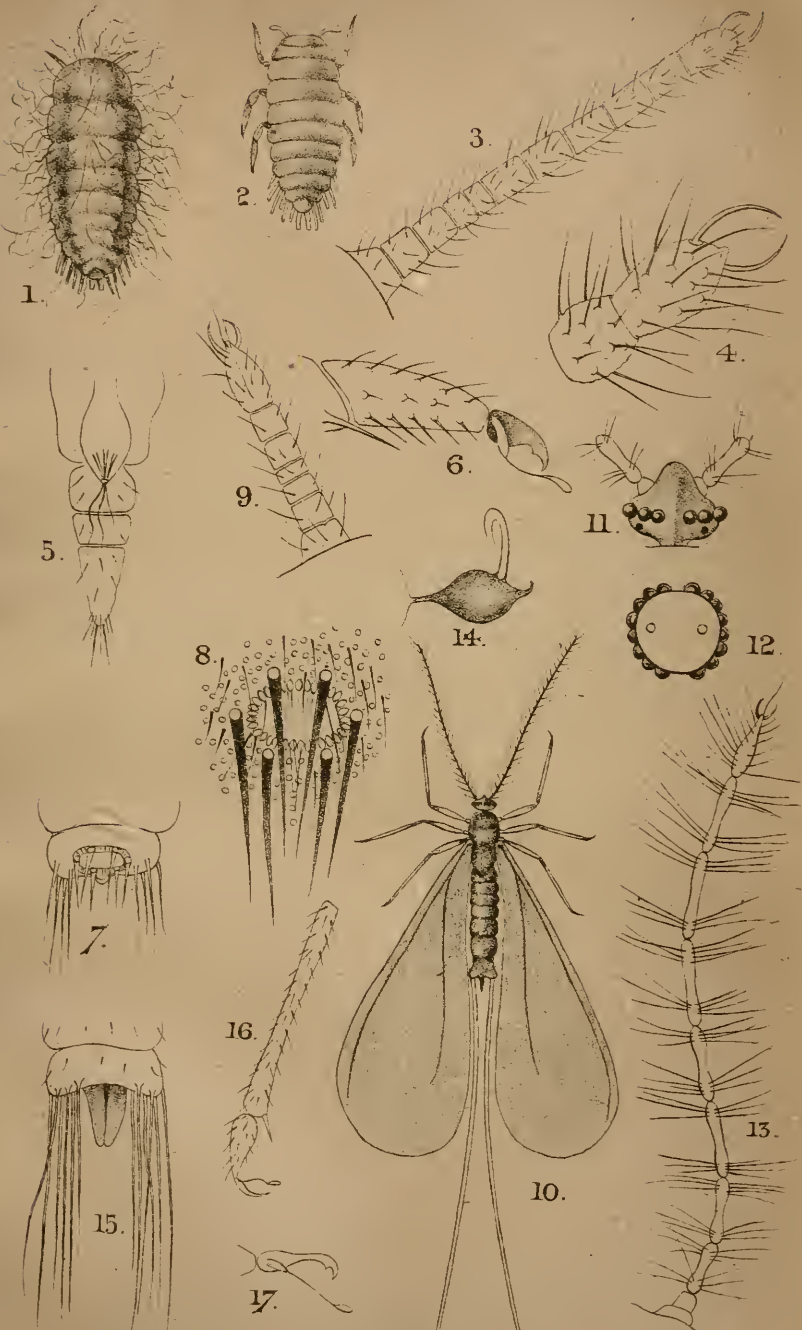

W.M.M. del. ad nat. COCCIDÆ. C.H.P. lith.

W.M.M. delt ad nat.

COCCIDÆ.

C.H.P. Lith.

the plant-growth." In fact, when it is considered how entirely devoid Coccids of all genera are of any organs for piercing or cutting, except the rostral suckers, it is difficult to understand how they manage to burrow into plants. Here in New Zealand we have such species as *Ctenochiton viridis*, which does not indeed form a deep cavity, but produces a decided and conspicuous depression beneath its body in the leaf it lives on. *Rhizococcus fossor* forms a peculiarly deep pit in its leaf, pressing out the opposite surface in a distinct swelling, and at last almost disappears sometimes in the pit. *Cœlostoma assimile* burrows a deep hole through the bark of the tree, and even into the wood, fashioning for itself a complete little cavern. How is all this done? In the case of *Ctenochiton* and *Rhizococcus*, living as they do on soft leaves, one might imagine that they use their feet and claws to press out the plant-cells and make the cavities; but *Cœlostoma assimile* loses its feet almost in its infancy, and the explanation would therefore not suffice in this case. I do not think, moreover, that any mechanical action would altogether account for the phenomenon; for in specimens of leaves and (as far as I could) of wood examined I do not see any traces of such pressure on the cells as would render them misshapen. Whatever may be the real action of the Coccid, it seems to me that it must be at the same time mechanical and chemical. There must be some chemical reason why certain species form on plants large galls, which are exactly the opposite of cavities; and in the same way some chemical action must, I think, be exerted to produce the cavities and depressions. But I can offer no plausible explanation myself; and I do not forget that, as far as is known at present, Coccids do not exude any acrid or acid fluid likely to exert active influence on plant-cells.

It may be observed that purely "passive" pressure would not sufficiently account for the phenomenon—that is, I do not think that the cavities can be produced merely by the insect lying motionless on the bark or leaf, and permitting the plant-cells to grow round and over it. Such a proceeding would necessarily, I take it, induce some kind of distortion; but I see no signs of this in the cases referred to. Moreover, in the case of *C. assimile* and *R. fossor*, passive obstruction (as it might be called) is not at all sufficient to produce in so short a time the deep pits observed. Further, such insects as *Lecanium hesperidum*, *Mytilaspis pomorum*, and scores of others, are just as closely attached to plants as any others, and yet produce no cavities in either leaves or bark, or even in the very soft substance of fruit.

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ART. II.—*An Exhibition of New and Interesting Forms of New Zealand Birds, with Remarks thereon.*

By Sir WALTER L. BULLER, K.C.M.G., F.R.S.

[*Read before the Wellington Philosophical Society, 29th October, 1890.*]

PROBABLY no section of New Zealand zoology has received such careful attention or been so thoroughly worked 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 requirements and caprices of man, all tend to make the study of our birds more attractive than that of any other branch of natural history. So much has already been written on this subject that it might reasonably be looked upon as a well-nigh exhausted field. So far, however, from this being the case, new forms and characters of bird-life, and new facts in the history of even our commonest species, are being continually brought to light; and it seems to me that, after the manner of the Zoological Society of London, which has been so eminently successful, the best mode of bringing observations of the kind before such a society as this is to exhibit the specimens, wherever practicable, and to make brief remarks thereon by way of explanation or suggestion.

Adopting this plan, I shall this evening place before you some very interesting birds which have recently come into my possession; and I propose to continue doing this from time to time, as fresh material is forthcoming. By this means facts and observations of a valuable kind may often be elicited during the customary discussion that follows the reading of a paper at these meetings.

Miro traversi, Buller.

I exhibit, first, a pair of the so-called Chatham Island Robin, obtained at the Snares, where it is said to be comparatively numerous. Now, it is a very curious circumstance that this bird is not found on the Auckland Islands, nor on Antipodes Island, nor on Campbell Island, nor on the Bounty Islands. It occurs on the Chatham Islands, and on Pitt's Island, adjacent thereto; but it has never been met with in New Zealand. The set of the sea-current is from the Snares to the Chatham Islands, as we have lately been reminded by the loss of the barque "Assaye," which is supposed to have been driven upon the Snares, whilst a portion of her wreckage has been washed up, two months later, on the Chathams. This bird possesses very indifferent powers of flight, and its distribution between places so far apart must have been accomplished by the accidental floatage of a great mass of timber-growth or island *débris* of some sort.

Sphenœacus fulvus, Gray.

The pair now exhibited was obtained on the Snares, where, according to the observations of Mr. Reischek, this bird inhabits trees, instead of swamp-vegetation or fern-beds, as *S. punctatus* does in New Zealand. It is very like the last-named species in appearance; but on comparing them it will be seen that *S. fulvus*, apart from its browner or less spotted character, has the tail-feathers full and webbed instead of being narrow, with disunited barbs, as in *S. punctatus*.

Exactly similar specimens have been obtained in the South Island, and writing of these I have said (Birds of N.Z., ii., p. 61): "Whilst, however, keeping the form distinct for the present, I am far from being satisfied that it can be separated from *S. punctatus*. I am more inclined to regard it as a somewhat larger local race, with a corresponding modification of plumage. But for the fact that the latter species is as common in the South Island as in the North, this might be treated as the representative form."

Prosthemadera novæ-zealandiæ, Gmelin.

One of the most remarkable features in the ornithology of New Zealand is the frequency of albinism. Of no less than thirty-three species, albinoes of greater or less purity have been recorded. In the case of our common Tui (*Prosthemadera novæ-zealandiæ*) four examples are mentioned in my "Birds of New Zealand" (vol. i., p. 95). I have now to add the singular specimen which I exhibit this evening, and which, as I am informed, was obtained at Table Hill, about twelve miles from Milton, in March, 1887. The general plumage is white with a creamy tinge, the quills and tail-feathers being pure-white. The fore part of the head is dull steel-black, which colour fades away into greyish-brown on the neck and upper part of the breast, and then gradually blends with the white. The bill and feet are of the normal colour; but the claws are pale-brown. This is the best albino I have seen. The one that comes nearest to it is the specimen obtained by me at Wanganui (and now in the Colonial Museum), a full description of which will be found in "The Birds of New Zealand," 1st ed., p. 88.

Platycercus novæ-zealandiæ, Sparrm.

One of the most variable of our species is the Red-fronted Parrakeet (*Platycercus novæ-zealandiæ*). No less than seven varieties of this species, from different islands, have been described and named by naturalists as distinct species. That from the Auckland Islands is distinguished by its diminutive size, being scarcely larger than my *Platycercus rowleyi*, from the South Island. Curiously enough, the form which comes from Antipodes Island (of which I exhibit two specimens, ♂ and ♀, this evening) is even larger than ordinary-sized examples of this species in New Zealand. It differs, too, from the latter in the general hue of the plumage, which has a larger admixture of yellow, and in having the frontal spot, which is deep-crimson in the New Zealand bird, much reduced in extent, and more or less varied with yellow. It is very singular, also, that this species should be found inhabiting a small area like Antipodes Island, which forms the restricted habitat of the perfectly distinct *Platycercus unicolor*.

Gallinago aucklandica, Gray.

It will be seen from the four examples of this rare bird which are now exhibited (two males and two females) that the sexes are exactly alike in plumage. It will be noticed, also, that the general coloration is much darker in one pair than in the other. The lighter-plumaged birds were obtained at the Auckland Islands, and of these the female has a bill fully 0·25in. longer than in the male. The darker-coloured birds (which, again, are precisely alike in plumage) came from the Snares, and ought perhaps to be referred to *Gallinago pusilla*.

Tringa canutus, Linn.

The specimen of this cosmopolitan species now on the table was obtained in Pelorus Sound. It is prettily marked, and indicates the commencement of a change from winter to summer plumage, birds in the latter garb being extremely rare in this country.

Larus novæ-hollandiæ, Stephens.

The specimen now exhibited exactly accords with Mr. Howard Saunders's description of this species, and the bill, which is appreciably larger than in *Larus scopulinus*, is of the same arterial-red colour. I exhibit, at the same time, an adult specimen of the latter for comparison.

But here is another Gull, recently received from Otago, and coming nearer to *Larus bulleri* (Hutton) than any of the others, which appears to be a distinct species. It will be seen that it has the same narrow bill as the latter. Instead of being entirely black, as in ordinary specimens, the bill is reddish-brown at the base, with black tips, which may be due to the season of the year in which it was killed. The legs, however, which are blackish-brown in *Larus bulleri* all the year round, appear, as far as one can judge from the dried specimen, to have been pale- or pinky-red. It seems to be an adult bird, notwithstanding the subterminal patches of black on the outer webs of the secondaries, and we therefore examine with interest the markings on the primaries, which are now recognised as being the safest criterion for separating these closely-allied forms. These we find to be very different from those in the other species of the group. The first primary has a long oar-shaped mark of white extending almost its entire length, and spreading out again at the base; the second primary has a smaller and more spatulate mark of white; the third primary has an irregular longitudinal bar of white occupying both sides of the shaft and extending to within 2in. of the tip; in the succeeding quills the same character is continued, but the white mark assumes a more symmetrical and rounded appearance.

Ocydromus earli, Gray.

I have much pleasure in exhibiting a specimen of the true *Ocydromus earli*, lately received from the Marlborough Province; also, for comparison, an example of the common North

Island Wood-hen, which I have named *Ocydromus greyi*, in compliment to Sir George Grey.

As fully explained in "The Birds of New Zealand" (vol. ii., pp. 106, 107), when I came to examine the type of *Ocydromus earli* (described as far back as 1862) in the British Museum, I found that this was not the North Island species, as every writer on the subject had treated it, but a closely-allied form, with pale-red legs, from the South Island. Of the latter bird Mr. Reischek obtained five specimens in 1884, and two of these I purchased and took to England with me. This led to my hunting up the type of *O. earli*, with the result I have stated. By this discovery the common North Island bird was left without a distinctive name. Finding, when I 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, I thought I could not do better than dedicate this species to him.

Nycticorax caledonicus, Gmelin.

I have also to exhibit another New-Zealand-killed example of the Nankeen Heron, differing from those already recorded in being furnished with the beautiful occipital white plumes, rolled in the form of a pointed queue, 7in. long. This was shot at the mouth of the Catlin River, about a mile from the sea, about August or September, 1888. As already recorded (Birds of N.Z., ii., pp. 139, 140), Sir George Grey, when Governor of the colony, in 1852, introduced some of these birds from Australia, and liberated them at Wellington. But as early as 1845 the Rev. Mr. Colenso met with one in the Waikato district (*l.c.*, p. 140); and, as the bird is only met with rarely, singly, and at long intervals, it is most reasonable to suppose that these are stray visitants from Australia rather than the descendants of the imported stock. The example described in my first edition, and now in the Colonial Museum, was shot in the neighbourhood of Wellington in 1856, and may have been one of the introduced birds.

Diomedea fuliginosa, Latham.

I exhibit a younger nestling of this Albatros than the one described in "The Birds of New Zealand." The whole body is covered with thick woolly down of a slaty-grey colour, except on the forehead, face, and throat, where the down is very short and thickset, having the appearance of pile-velvet. This stumpy growth is black; but a patch of white encircles the eyes, fills the lores, and sweeps over the base of the bill, having the appearance of blinkers. Bill and feet black.

Œstrelata mollis, Gould.

Among the specimens exhibited to-night is a full-plumaged example of *Œstrelata mollis*, a species only rarely met with off the New Zealand coast. This one was sent to me by Mr. T. F. Cheeseman, who obtained it on Sunday Island during his semi-official visit to the Kermadec Group in August, 1887. It was known to the settlers there as the "mutton-bird," and Mr. Cheeseman treated it as an undetermined species of *Majaqueus*. I have another example in my collection, from Otago; and if, as I believe, my birds are male and female, the sexes present no difference in plumage.

This species was originally described by Mr. Gould in the "Annals and Magazine of Natural History" (vol. xiii., p. 363); and in his account of it in "The Birds of Australia" he records a very remarkable circumstance. "It is a species," he says, "that will ever live in my memory, from its being the first large Petrel I saw after crossing the Line, and from a somewhat curious incident that then occurred. The weather being too boisterous to admit of a boat being lowered, I endeavoured to capture the bird with a hook and line; and, the ordinary sea-hooks being too large for the purpose, I was in the act of selecting one from my stock of salmon-flies, when a sudden gust of wind blew my hooks, and a piece of parchment 10in. long by 6in. wide, between which they were placed, overboard into the sea, and I was obliged to give up the attempt for that day. On the next I succeeded in capturing the bird with a hook I had still left, and the reader may judge of my surprise when, on opening the stomach, I there found the piece of parchment, softened by the action of the salt water and the animal juices to which it had been subjected, but so completely uninjured that it was dried and again restored to its original use when a further supply of flies could be procured."

Œstrelata affinis, Buller.

I exhibit a pair of these birds lately brought from the Auckland Islands. There is no appreciable difference in the plumage of the two sexes; but in the male bird the speckled markings on the forehead are more conspicuous, whilst there is a richer tinge of brown on the arm of the forewing. Another, which I obtained, in June last, from the east coast of Otago, has gone to England, where hitherto my type-specimen has been unique. The characters by which I distinguished the species are constant in all these examples. Dr. Otto Finsch, without seeing the bird, proposed to unite it to *Œstrelata mollis*; but Mr. Osbert Salvin, our great authority on Petrels, on comparing my bird with the large series of the latter species in the British Museum, unhesitatingly agreed with me that it was quite distinct. On comparing the two examples now on the table with the bird from Sunday Island, the following external differences are at once manifest: The species is somewhat smaller than *Œ. mollis*; the upper surface is slaty-grey instead of blackish-brown; the lower part of breast and abdomen are dark-cinerous, with barred markings on the sides of the body, instead of this surface being almost entirely white; the tail-coverts are white in their whole extent, instead of being slaty-grey; there is a broad blackish band along the edge of the wing, within which the entire lining is pure-white, instead of being grey and white intermixed, as in *Œ. mollis*, and the inner vanes of the primaries are pure-white, except at the tips; the legs, instead of being distinctly "sandalled," as in the other species, are dull-yellow, with brown toes and interdigital webs.

Puffinus gavia, Forster.

The specimen exhibited was obtained at Circle Hill, about twelve miles from Milton, in the Provincial District of Otago, in July last. Although at certain seasons of the year very numerous off our coasts, extremely few specimens are to be met with in our local museums and other collections. The single example which I took to England with me was quite unique, as no specimen of this bird then existed in Mr. Salvin's splendid collection of petrels, nor even in the British Museum, the type of Forster's original description having somehow disappeared.

The attention of collectors should be directed to these smaller petrels. The seas surrounding New Zealand and extending to Australia form, so to speak, a great nursery for this family, of which no less than thirty-nine species, belonging to fifteen genera, are already on our list; and, as comparatively trivial characters often distinguish them, it is not unreasonable to look for the discovery of new species from time to time.

Puffinus bulleri, Salvin.

The petrel described by Mr. Sandager under the name of *Puffinus zealandicus* (Trans. N.Z. Inst., vol. xxii., p. 291) is now deposited in the Otago Museum. It is undoubtedly the same species as that described by Mr. Salvin under the above name. It would seem to be a somewhat rare form in these seas, for, up to the present time, only three examples are known, one of which is in the cabinet collection in the British Museum. In "The Birds of New Zealand" (2nd ed.) this petrel and the preceding one are figured together on the same plate, and, with the rock background, form a very effective picture. My original specimen was a storm-tossed one on the Waikanae Beach, in October, 1884; Mr. Sandager's bird flew against the lantern of a lighthouse; and the British Museum specimen was purchased by Mr. Salvin from a dealer who said it had been obtained on the New Zealand coast.

Eudyptes, sp.

The coasts of New Zealand are rich in penguins as well as petrels. Twelve well-defined species, belonging to four genera, are already on our list, and I have now to submit to you another absolutely distinct species, of which I have received two specimens from the West Coast sounds. I have not yet been able to identify it with any described form of *Eudyptes*. and I have little doubt that it will prove to be new to science.

Among the species referred to above is one so rare that only a single example of it has yet been recorded. I refer, of course, to the Black Penguin (*Eudyptes atratus*). The type was kindly forwarded to London by Professor Parker for the purpose of being figured in the second edition of "The Birds of New Zealand," and I regret to say that this unique specimen has been lost, with my own collections, in the barque "Assaye." I have, however, given Mr. Keulemans's drawing of it to Captain Fairchild, and have asked him to keep a sharp look-out for this penguin at the Snares, its only known habitat.

ART. III.—*The Habits and Life-history of the New Zealand Glowworm.*

By G. V. HUDSON, F.E.S.

[*Read before the Wellington Philosophical Society, 8th October, 1890.*]

Plate VIII.

MY former paper on this insect (Trans. N.Z. Inst., vol. xix., p. 62) was written considerably over four years ago, and is, I regret to say, very incomplete in its details, as well as being in some places absolutely misleading. I will therefore, with the permission of the Society, completely recast my account of the natural history of the glowworm, the present paper thus entirely superseding my previous one. I trust that this course may be allowed, as the insect is one of unusual interest, and also excessively difficult to observe. It is therefore desirable that a complete account of its habits and life-history should be carefully recorded.

My first attempt to discover the nature of the New Zealand glowworm was in January, 1885, when I captured several specimens and recorded them as dipterous larvæ, but, through pressure of other work, did not figure or carefully examine them.

Exactly a year later I had the insect again brought under my notice during a conversation with Mr. E. Meyrick, who told me that he had written a short note on the animal, which is quoted in full in my previous paper (Trans., vol. xix., p. 62). He stated as his opinion that the larva was referable to one of the Staphylinidæ (Coleoptera), and carnivorous. The light he considered attracted, and the web entangled, minute insects on which he supposed the larva to feed. It will be seen that his supposition as to the nature of the insect is entirely contradicted by subsequent investigation, whilst the latter conjecture has not in any way been corroborated, as we are still entirely in the dark as to the use of either the web or the light to the larva.

During February and March, 1886, I instituted very careful observations on the larvæ, keeping several specimens in captivity. From these I ascertained that the light was not exhibited at all regularly, sometimes being brightest at night, and sometimes in the early morning hours. I have since noticed that, in the natural state, the larvæ shine most brilliantly on dark damp nights with a light north-west wind.

The web referred to above is suspended in a rocky or earthy niche in the banks of streams in the densest parts of the forest. It consists of a thick glutinous thread stretched across the niche, and supported by several smaller threads running right and left, and attached to the sides and end of the cavity. On this the larva invariably rests, but when disturbed immediately glides back along the main thread, and retreats into a hole which he has provided at the end of it. From the lower side of this central thread numerous smaller threads hang down, and are always covered with little globules of water, resembling a number of minute silver-beaded necklaces, constituting a conspicuous, though apparently unimportant, portion of the insect's web. I should mention that all these threads are constructed by the larva from a sticky mucus exuded from the mouth.

The organ which emits the light can easily be seen by a reference to Pl. VIII., fig. 1. It is situated at the posterior extremity of the larva, and is a gelatinous and semi-transparent structure, capable of a great diversity of form. It can be withdrawn or extended at the will of the larva, which, however, can immediately cease to shine without withdrawing it. This action is most likely effected by shutting off the air from the tracheæ ramifying through the "light-organ," which, being, no doubt, largely composed of phosphorus, only becomes luminous when in contact with the oxygen in the air-tubes. Larvæ cease to shine on very cold nights, in the day-time, and in a room which is artificially lighted.

During my observations in 1886 one of the larvæ disappeared, and I naturally assumed that it had buried itself in the earth, and was undergoing its transformation into the pupa state. This was apparently confirmed by the emergence, in about a month's time, of a fly which was afterwards identified by Baron Osten-Sacken as *Trimicra pilipes*, whose larva is well known, and has nothing to do with the present insect. It is most unfortunate that a larva of this *Trimicra* should have got into the breeding-cage without my knowing it, and thus deceived me.

Further investigations were instituted at the end of 1886, when I discovered a luminous pupa suspended in one of the webs in the manner represented at fig. 2, which I have since several times reared from the glowworm, and which is consequently the real pupa. It is a curious animal, furnished with a large process on the back of the thorax, which is attached to the web, and holds the pupa suspended in the middle of the niche previously inhabited by the larva. The light is emitted from the posterior segment of the pupa, but is much fainter than in the larva, and a distinct organ is not apparent. It is frequently altogether suppressed for days together. This pupa died in a few days, and all the larvæ then under observation also died.

Larvæ were again procured in August, 1888, but this time I did not succeed in getting any of them as far as the pupa stage. I should mention that the larvæ are only to be obtained by walking up the bed of the stream in the big gully of the Botanical Gardens at night, with a bull's-eye lantern. A piece of thin stick is rapidly introduced behind the larva as soon as it is detected, which always adheres to it, and is thus taken away, web and all, and carried home in a tin box with damp moss, &c.

On the 1st September, 1888, I obtained another supply of larvæ, placing them this time in a large bell-glass with stones and ferns, the bottom of the glass having about 1in. of water in it. This I conceived would closely resemble their natural habitat. During all my expeditions I always examined a great number of the webs, and could never find any remains of insects entangled. I also noticed that the largest larvæ were always concealed in the deepest niches in the bank, and frequently behind large cobwebs, where they would stand a poor chance of capturing insects. I also think that there must be a very great mortality among the larvæ, judging from the number of minute ones always observed, in natural conditions, compared with large ones. On the 21st December I found that two of the larvæ had changed into pupæ resembling the one I found two years before. These unfortunately became mouldy and died, and it was not until the following April that I succeeded in rearing the true fly, which I discovered on the morning of the 4th standing beside its old pupa-skin. Two enlarged drawings were then made, and forwarded to Mr. Skuse, of Sydney, and Baron Osten-Sacken, of Heidelberg, Germany. Both these gentlemen had been previously furnished with specimens of the larvæ in alcohol. They then expressed their opinion that the fly of which I sent a drawing probably did *not* result from the luminous larva, and that it would be desirable to postpone publication until another specimen had been reared. Convinced though I was of the accuracy of the observation of the 4th April, I determined to verify it, and again procured larvæ, which all died. On the 10th July, 1890, I got about twenty large larvæ, spending upwards of three hours in the bed of the stream. Two of these changed during August into pupæ, one of which died, but the other gave rise to another fly exactly resembling the one reared on the 4th April, 1889. The circumstances connected with the emergence of this fly are so entirely conclusive that it may perhaps be well to relate them in detail. On examining the pupa at 8 a.m. on the 14th, I observed that it had become much paler in colour. At 2 p.m. I noticed the fly perched on it, with its head down towards the tail of the pupa, and *the extremity of the abdomen of the fly still within the pupa-skin*. In this position it remained until the following day at 5 p.m., when I transferred the fly into a large glass-topped pill-box, which I placed on the table in my sitting-room. On returning to the room at 7 p.m. without a lamp, I was astonished to see the inside of the box brilliantly lit up, the extremity of the fly's abdomen giving out a strong light about half as bright as that emitted by a full-grown larva. The whole of the phenomena relating to the emergence of this fly from the pupa, and its subsequent luminosity, were also observed by my brother, who was present at the time, and can fully corroborate these statements if necessary. As this was a female fly, I decided to take her up into the big gully in the Gardens, where the larvæ are abundant, and see if she would attract males. As soon as I arrived I put the box down in the bed of the stream, and the fly immediately lit up so as to again strongly illuminate the inside of the box. There were lots of larvæ all round, so that I considered it likely there were also flies. After thirty-five minutes I visited the box, but found nothing had arrived. I then left her for ten minutes more, and returned, with the same result. During this expedition I again carefully examined many webs of the larvæ, and took a quantity of the mucus from them home and examined it with the microscope. I could, however, find no trace of insects entangled on their remains. I am quite at a loss to explain either the light, the web, or the food of the larva. I must leave these points for future investigation.

I should mention that the flies reared on the 4th April, 1889, and the 14th September, 1890, were both females, as it is conceivable that this may have an important bearing on future inquiry as to the use of the light.

I attach a scientific description of the fly, which has been kindly drawn up by Mr. Skuse, of Sydney, for the present paper.

Fam. MYCETOPHILIDÆ.

Sect. BOLITOPHILINÆ.

Genus Bolitophila, Hoffm.

Bolitophila, Hoffm., Meigen, Syst. Beschr., i., p. 220, pl. 8, figs. 1–4, 1818; Macquart, S. à B. Dipt., i., p. 126, 1834: *Messala*, Curtis, Brit. Entom., xiii., p. 581, figs. 1–3, 1836: *Bolitophila*, Walker, Ins. Brit. Dipt., iii., p. 71, pl. xxiii., fig. 7, 1856; Winnertz, V. z.-b. G., Wien, xiii., p. 672, pl. xix., fig. 5, 1863.

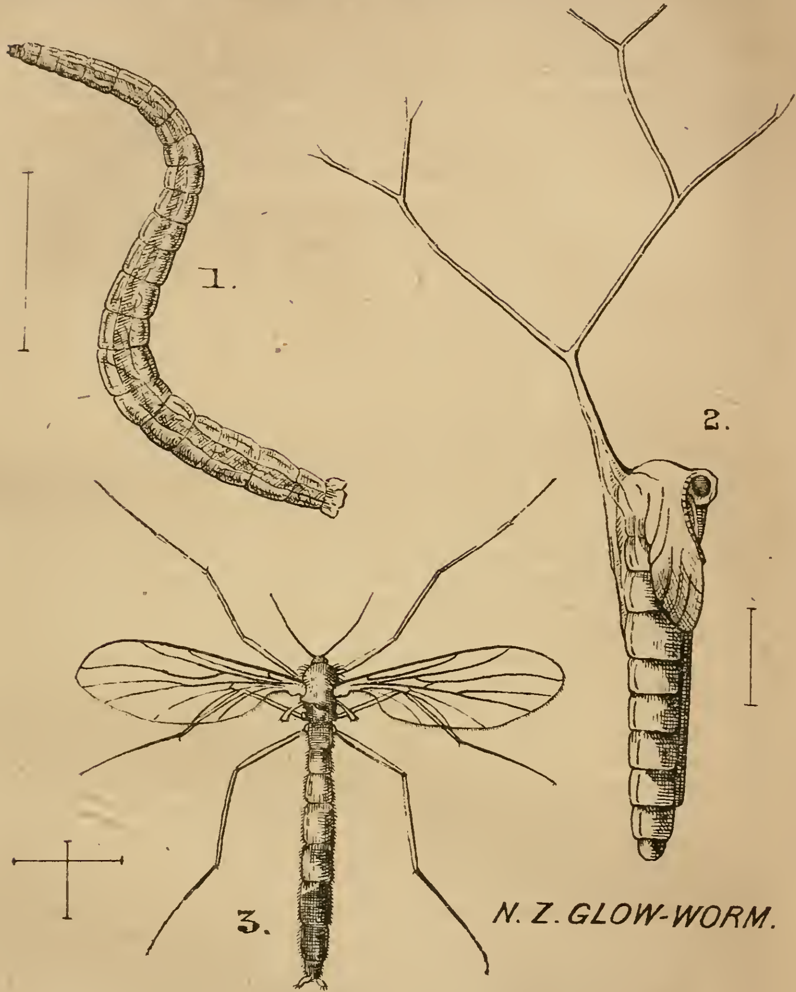
Head small, roundish, fore part flattened. Eyes broadly oval, a little emarginate on the inner side above. Ocelli three, arranged in a somewhat bent line on the front. Palpi prominent, incurved, cylindrical, four-jointed; first joint very small, the following of almost equal length, the fourth the longest. Antennæ setaceous, pubescent, in the ♂ as long as, in the ♀ shorter than the body, 2- + 15-jointed; the joints of the scapus cyathiform; the flagellar joints cylindrical, the terminal one very small, almost gemmiform. Thorax small, oval, highly arched; scutellum small, roundish; metathorax acclivous. Halteres large. Abdomen very long and slender; in the ♂ linear, sub-cylindrical, 8-segmented, without the anal joint; in the ♀ laterally compressed, 9-segmented, the last segment small. Legs long and slender; tibiæ with very short, weak spurs; the fore tibiæ with a single range of spines on the inner side, and the hind pair with one range on the inner and two ranges of shorter and weaker spines on the outer side. Wings large, microscopically pubescent, as long as or somewhat longer than the abdomen, with obtusely-cuneiformly narrowed base; incumbent in repose. Costal vein uniting with the tip of the third longitudinal vein at or somewhat beyond the apex of the wing; auxiliary vein complete, joining the costa, united to the first longitudinal vein by the sub-costal cross-vein; third longitudinal vein with an anterior branch (which is sometimes wanting), the branch short, almost vertical, ending in the tip of the first longitudinal vein or in the costa; small cross-vein short, situated about midway between the origin of the third longitudinal vein and the inner end of the second posterior cell; fourth longitudinal vein starting from the base of the fifth longitudinal vein; fork of the fifth longitudinal vein united at its base to the fourth longitudinal vein by a short cross-vein; sixth longitudinal vein perfect.

Bolitophila luminosa, sp. n.

♀. Length of antennæ, 0·090in. (2·27mm.); expanse of wings, 0·250in. × 0·070in. (6·34mm. × 1·77mm.); size of body, 0·380in. × 0·040in. (9·64mm. × 1·01mm.).

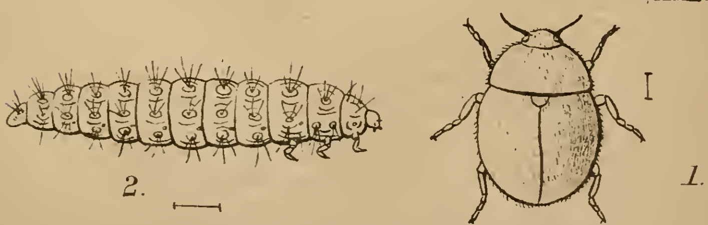
Antennæ very slender, as long as the head and thorax combined; joints of the scapus yellow, tinged with brownish; flagellar joints elongate, progressively diminishing in thickness, brown. Hypostoma brown. Palpi yellow. Front and vertex black. Thorax black or very deep brown, levigate, with a median yellow line, the humeri and lateral borders pale-yellow or whitish; two convergent rows of short black hairs from humeri to scutellum; some black bristly hairs above the origin of the wings; pleuræ deep-brown, tinged with pale-yellow; scutellum black; metanotum brown, bordered laterally with yellow. Halteres pallid, the club black. Abdomen slender, sub-cylindrical, five times the length of the thorax, dusky-brown, the segments indistinctly, especially the hindermost ones, tinged with yellowish anteriorly; densely clothed with very short black or dark-brown hairs; extremity and lamellæ of the ovipositor yellow. Legs long and very slender. Coxæ pale-yellow or whitish, the fore and intermediate pairs with the extreme apex, and the hind pair with almost the apical half, dusky-brown; trochanters dusky-brown; femora pale-yellow or whitish, the hind pair black at the apex; tibiæ and tarsi black. Tibial spurs black. In the forelegs the tibiæ and metatarsi of about equal length; the tarsi twice the length of the tibiæ. Wings shorter than the abdomen, pellucid, with a delicate yellowish tint, and almost the apical half infuscated with grey. Costal vein uniting with the tip of the third longitudinal vein somewhat beyond the apex of the wing; auxiliary vein terminating in the costa opposite or somewhat beyond the inner end of the second posterior cell, the sub-costal cross-vein situated near its base; first longitudinal vein running straight into the costa opposite a point before the tip of the posterior branch of the fourth longitudinal vein; third longitudinal vein gently arcuated at its base, strongly arcuated towards its tip; posterior branch of the fifth longitudinal vein abruptly reaching the margin.—F. A. A. Skuse.

Hab. Wellington, New Zealand (G. V. Hudson). *Type-specimen in the Australian Museum, Sydney, N.S.W.*



N. Z. GLOW-WORM.

Pl. VIIIA.



G. V. H. del. ? RHYZOBIUS. C. H. P. lith.

Obs. In this species, as in the European *Bolitophila tenella*, Winn., the anterior branch of the third longitudinal vein is wanting.—F. A. A. S.

EXPLANATION OF PLATE VIII.

Fig. 1. New Zealand Glowworm. (Larva of *Bolitophila luminosa.*)
Fig. 2. Pupa of same.
Fig. 3. Perfect insect.

ART. IV.—*On the New Zealand* Cicadæ.

By G. V. HUDSON, F.E.S.

[*Read before the Wellington Philosophical Society, 23rd July, 1890.*]

Plate IX.

PROBABLY few groups of insects are so well known and yet so little understood as the *Cicadæ*. These creatures are generally called "singers," and are familiar to nearly every New Zealand child, but at present entomologists appear to have somewhat neglected them. They are also frequently spoken of as "locusts," which is an extremely misleading name, and should be at once dropped. Professor Westwood has long ago pointed out that the term "locust" should only be applied to that group of the saltatorial *Orthoptera* having short erect antennæ, of which the migratory locust (*Locusta migratoria*) may be fairly taken as a type; but, unfortunately, this excellent definition has not been adhered to, even by professed naturalists.

The *Cicadæ* belong to the order *Hemiptera*, group *Homoptera*, and may be easily recognised by the following characters:—

The head is short, broad, and transverse, with large prominent eyes; the ocelli, three in number, are placed on the back of the head in a triangle; the face has a large, nearly circular, swollen, and transversely-striated piece, close to which, at the upper angles, and between the eyes, the antennæ are inserted; these are apparently composed of seven joints, the basal joint being thick and the others slender, and gradually attenuated to the tip. The rostrum, promuscis, or, more strictly speaking, the labium, is greatly elongated and three-jointed; the basal joint being very short, and the terminal joint very long and slender; the mandibles and maxillæ are represented by four fine setæ passing through the promuscis, and the palpi are entirely wanting. The prothorax is short and transverse, the mesothorax very large, the metathorax scarcely visible above, except at the sides; beneath, these segments are nearly equal. The abdomen is short and somewhat triangular; the legs are short, the anterior femora thickened and toothed beneath; the posterior tibiæ slightly spined, without terminal spurs. The tarsi are three-jointed. The forewings are large and rather narrow, deflexed at the sides of the body, and of a uniform consistence, with comparatively few and very distinct veins.

It may perhaps be of some interest to mention here that only a single and very rare species of *Cicada* (*C. anglica*, Curt.) is found in the British Islands, but as we go southwards on the European Continent *Cicadæ* of various species become common, showing that they are essentially insects of a sunny and warm climate like our own.

Of the New Zealand species of *Cicada* at present known to me, two are already described and four are new; but, as my observations have been practically limited to the shores of Cook Strait, it is highly probable that several other species will be discovered in the future. I will begin by describing *Cicada cingulata*, Fabr., which is the commonest and most conspicuous species, and will then briefly point out the characters by which the others may be recognised.

Cicada cingulata, Fabr.

Head and thorax dull-green, with black markings. There are two ill-defined black streaks in the neighbourhood of the ocelli, which last are brilliant crimson, like rubies set in the forehead of the insect. Prothorax with two black stripes in the centre, enclosing a space which appears as a broad central band; depressions black; margin green. Mesothorax with two central and two lateral conical black markings, the bases of the cones being directed towards the hind margin of the prothorax. Abdomen black, with the margins of the segments dull-red. Fore-legs green, with two black stripes and dots on the femora; tip of tibia and tarsus black. Middle- and hind-legs pale-green, basal joints of tarsi and tips of tibiæ black. Underneath the insect is dull ochreous-brown, with much fine silvery hair, which is also occasionally present on the upper sides of the abdomen. The female differs in being redder in colour on the abdomen, which is also ornamented with two broad black stripes on each side of the last segment. The penultimate segment is entirely free from all markings, and usually paler in colour than the rest. Wings with the basal space green, the costa and primary veins being brown, and the others black. There is a black dot at the anal angle of the hindwing, and two black dots on the costa of the forewing near the tip.

The females of all the species of *Cicadæ* may be at once known by the presence of a short ovipositor (Pl. IX., fig. 3, *c*), which is used for drilling into the stems of plants when they deposit their eggs; and the males by the existence of two peculiar drum-like organs, attached to the metasternum and covering two large chambers situated in the basal segment of the abdomen. These cavities contain two stretched membranes acted upon by powerful muscles, and instrumental in producing the noise for which these insects are so justly celebrated. (See figs. 2 and 3, which represent the under-surface of the body in ♂ and ♀ *Cicadæ*.) This insect (*C. cingulata*) varies considerably in size and colour, some specimens being quite ochreous in place of green; but it can always be easily distinguished by its large size. Length of the body, 11 to 12 lines; expanse of wings, 32 to 37 lines.

The song of this *Cicada* is very loud, and rather harsh. It is capable of considerable modulation, and each rhythm consists of three or four notes. The insect usually, however, gives three chirps, then a pause, and three more, keeping this up for five or ten minutes at a time, and perpetually varying the rate of the music.

a. var. *obscura.*—I know of only one distinct variety of this species, which is remarkable for its smaller size, dull colour, and very loud chattering song. It is found among the boulders in the river-beds near the Inland Kaikoura Mountains; but I do not think it is anything more than a variety.

Cicada cingulata first appears about December, and gradually increases in numbers till the middle or end of February, when in certain localities its singing is almost deafening. Occasionally trees may be seen swarming with these insects, which delight to rest on the branches in the hottest sunshine. A sharp hand is needed to effect a capture, even with a net, as the insects lose no time in making off when once they stop singing. This occurs on the approach of any enemy, and is no doubt taken as a danger-signal by the other *Cicadæ*. The ordinary house-sparrow destroys enormous numbers of this fine insect, and I do not think it will long remain abundant in the neighbourhood of our larger towns. In fact, even during the last seven years the species has become decidedly scarcer in the Wellington gardens.

Cicada muta, Fabr.

This species differs from *Cicada cingulata* in the following respects: The body is slightly more attenuated. *There is always a distinct silvery stripe down the centre of the abdomen, and an ochreous stripe margined with black down the centre of the prothorax.* No general description is possible, owing to the remarkable variations to which the insect is subject, but the following is a table of the varieties that have at present come under my notice.

α. var. *sub-alpina*.—Dark-green, with black markings consisting of two broad stripes on the inner margins of the eyes; two stripes in the depressions on the prothorax; two small central, and two elongate lateral, cone-shaped markings on the mesothorax; a broad band on each side of the central silvery stripe on the abdomen, and two small stripes on each side of the posterior segment in the female. Wings tinged with green, veins green, costa red, legs green, with black tips to all the joints. This variety frequents forest-clad hills, and is taken abundantly as far up as 4,000ft., when it is replaced by *C. cassiope*, presently to be noticed. It is undoubtedly one of the most abundant varieties of *C. muta*.

β. var. *rufescens*.—Reddish-ochreous, with black markings as in var. *α*, except that the *sides* of the abdomen are frequently much suffused with black. Wings clear, with reddish veins. Many of the females of this variety are very pale in colour, becoming, in fact, quite ochreous. Common in the Maitai Valley, Nelson.

γ. var. *flavescens*.—Of this form I have but one specimen, which was taken on the lower slopes (3,500ft.) of Mount Tapuaewaeonuku, and is quite a bright-yellow colour. It is a female, and must be regarded more as an extreme form of *rufescens* than as a distinct variety.

δ. var. *cinerescens*.—In this form the black markings are much suffused on a dull brownish-yellow ground. The central stripe is, however, present throughout the whole of the insect, and is consequently very conspicuous; veins dull-brown. This variety is very common in the Wairarapa and Wellington districts.

ε. var. *minor*.—Distinguished by its small size, shrill song, red basal portions to the wings, black suffusion of mesothorax, and silvery pubescence. Common among the coarse native grasses growing on sandy ground just above high-water mark, Wellington, and in similar situations on the banks of the Manawatu River, near Palmerston North. Of this variety I have at present only taken male specimens.

Cicada muta varies in length of body from 7 to 11 lines; expanse of wings, 16 to 25 lines.

Cicada tristis, n.s.

This species is at once recognised by its elongate wings and parallel-sided body, the head being the broadest part of the insect. In colour it is bronzy-green, covered with fine silvery hair, and occasionally a central silvery stripe on the abdomen. The markings are dull brick-red, margined with black, and consist of an irregular blotch covering the whole of the top of the head; two broad bands on each side of the prothorax, leaving the margins and a central stripe green; and a broad red stripe on the posterior margin of each of the segments of the abdomen. Wings tinged with brown, veins brown, costa reddish, a blackish suffusion in the anal angle. Length of body, 8 to 9 lines; expanse of wings, 22 to 24 lines. This curious and interesting species occurs on the forest-clad hills around Wellington during February, March, and April. It may be known by its sad and exceedingly feeble song, which may be often heard on a cold autumn afternoon long after all other signs of insect-life have vanished.

Cicada aprilina, n.s.

This is certainly the most beautiful of the New Zealand *Cicadæ*. Its colour is a uniform bright-green, of a most striking intensity when alive. It has no markings on the prothorax; but there is a very obscure blackish line round the ocelli, and two fine longitudinal black lines near the centre of the mesothorax. The abdomen has a central silvery stripe, occasionally margined with black, but otherwise the insect is entirely destitute of any markings. Legs and wing-veins bright-green, except tarsi and inner marginal vein of forewings, which are crimson. Length of body, 8½ lines; expanse of wings, 22 to 24 lines.

This species first appears about the middle of February; but is most abundant in April. Its song is very quick and shrill, and is instantly hushed on the approach of an enemy. This *Cicada* is, in fact, extremely wary, flying off for a great distance when disturbed. Its green colouring is also highly protective, and renders the insect excessively hard to see amongst foliage. These peculiarities probably result from the circumstance that the insect appears late in the year, when few other species are about, and thus it has been much sought after by insectivorous birds, protective coloration and extreme caution being naturally the result of the "survival of the fittest." I have not noticed this species anywhere but in the Botanical Gardens; but there it is tolerably common, although very hard to obtain—in fact, it is only to be captured by approaching very quietly and slowly, and then suddenly striking with the net as soon as the insect is detected.

Cicada iolanthe, n.s.

This is the smallest species of *Cicada* with which I am at present acquainted. In colour it is dark greenish-black, with the edges of the segments reddish-brown, but the female is often much suffused with brown. There are no distinct markings in either sex. The wings are very broad and short in proportion to the body, which is more stoutly built than in any of the species we have previously considered. Length of the body, 6 to 6½ lines; expanse of wings, 12 to 14 lines. This *Cicada* first appears about November, but is somewhat rare. It may be at once known by its extremely shrill song, which is not so rapid in its rhythms as that of *Cicada aprilina.*

Cicada cassiope, n.s.

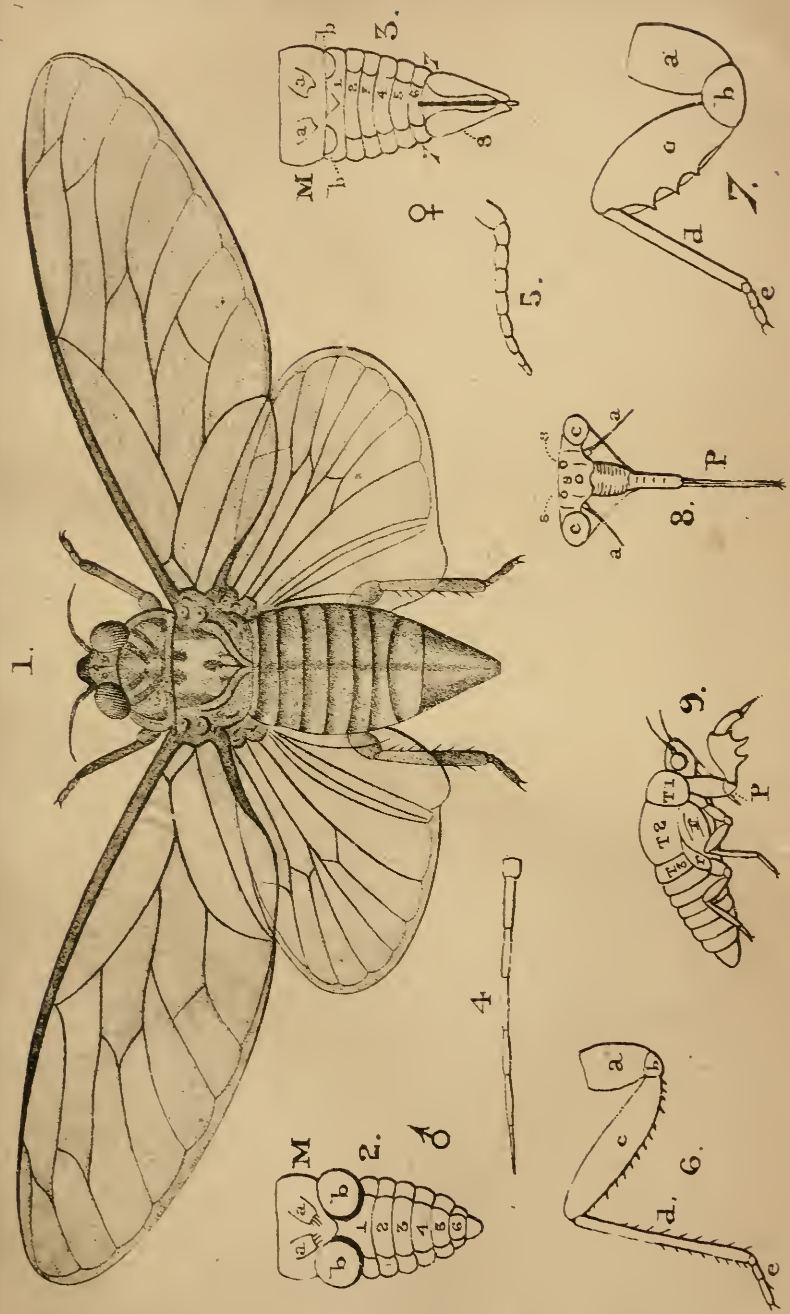
This is the alpine *Cicada* of New Zealand, and has occurred on the mountains in the Nelson and Marlborough Provinces at elevations ranging from 3,000ft. to 5,000ft. In colour the male is nearly black, with the thoracic markings faintly indicated. The veins of the wings are also black. The female differs in being densely covered with dull-whitish hair. The wing-ribs are often pale-brown, but occasionally black, as in the male. Length of body, 9 to 10 lines; expanse of wings, 19 to 22 lines. This species delights to bask in the hot sun shine amongst the rocks and shingle on the mountain-tops. Its note is very weak and shrill, resembling in its slow monotonous character that of *C. tristis*. It is fairly abundant where found, but, like all the other *Cicadæ*, it is not by any means an easy victim to the net.

These two species (*Cicada iolanthe* and *C. cassiope*) are evidently very closely allied, but I think they are sufficiently distinct to be regarded as species in the ordinary sense of the word.

Respecting the life-histories of these beautiful insects, I can at present supply very little information.

The larvæ are occasionally found in the earth during the spring and winter months. They are generally supposed to feed on the roots of plants, but, judging from the fore-legs, which appear to be raptorial as well as fossorial in their structure, it would seem quite possible that they are carnivorous, feeding, perhaps, on the juices of other insects, which they might readily imbibe through their long cylindrical proboscis.

The pupæ (fig. 9) differ chiefly in having rudimentary wings (P P), the legs, &c., being of course more perfectly developed than in the larvæ. When mature, this pupa works its way to the surface of the ground, ascending the stem of a tree, and firmly clinging on by its tarsal claws. The skin on the back of the thorax now splits open, allowing the enclosed *Cicada* to escape. Here the insect rests for a time, until the wings are sufficiently hardened, when it flies away. Numbers of these empty pupa-shells, or exuviæ, are constantly to be seen attached to the stems of trees in the forest, where they always remain until dislodged by some accident.



G.V.H. del. N.Z. CICADÆ. C.H.P. lith.

The alleged occurrence of the well-known Mole-cricket (*Gryllotalpa vulgaris*) in various parts of New Zealand has in some instances been probably due to the observation of a *Cicada* pupa, which, when alive and partially covered with earth, might readily be mistaken for the larva of that insect, although, of course, in reality it has no manner of affinity with it.

In conclusion, I will give a brief summary of the leading characters of the New Zealand *Cicadæ* :—

A. *Cicadæ* with a median band.

1. On prothorax only.
   C. cingulata, Fabr.

2. On thorax and abdomen, very strongly pronounced. Very variable—green, black, red, and yellow, with black markings.
   C. muta, Fabr.

3. With median band faintly indicated both on thorax and abdomen, bronzy-green, with reddish-brown markings. Constant.
   C. tristis, n.s.

4. Entirely green, with median band on abdomen only, and two minute black markings on thorax. Constant.
   C. aprilina, n.s.

B. *Cicadæ* without median band.

5. Small, with no distinct markings. Constant.
   C. iolanthe, n.s.

6. Larger, with thoracic markings faintly indicated. ♀ covered with greyish down. Constant.
   C. cassiope, n.s.

EXPLANATION OF PLATE IX.

Fig. 1. *Cicada cingulata*, considerably enlarged, showing typical markings, general structure, and neuration, which last is *absolutely* identical in all the six species.

Fig. 2. Under-side of abdomen of ♂ *Cicada*, showing the vocal drums, or opercula (*b b*) : *a a*, coxæ of posterior legs ; M, metathorax ; 1 to 6, segments of abdomen. (Enlarged.)

Fig. 3. Ditto in the ♀ : *b b*, rudiments of the opercula of ♂ ; *c*, the ovipositor ; the rest as in fig. 2. (Enlarged.)

Fig. 4. Antennæ of mature *Cicada*. (Much magnified.)

Fig. 5. Antennæ of pupa. (Much magnified.)

Fig. 7. Fore- and (6.) hind- or intermediate leg of *Cicada* : *a*, coxa ; *b*, trochanter ; *c*, femur ; *d*, tibia ; *e*, the 3-jointed tarsus. (Enlarged.)

Fig. 8. Head of *Cicada* seen from the front : *s s s*, the ocelli ; *c c*, the compound eyes ; *a a*, the antennæ ; *p*, the promuscis, or rostrum. (Enlarged.)

Fig. 9. Pupa of *C. cingulata* : *p*, the promuscis ; T1, prothorax ; T2, mesothorax ; T3, metathorax ; P P, the wing-cases. (Slightly enlarged.)

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other ways. An investigation of this kind, to be of any real service in economic matters, requires to be carried out on such a large and exhaustive scale that it is quite beyond the power of any one situated as I am to do it without assistance.

[Since writing the above, Mr. Hobbs, M.H.R., has kindly furnished me with specimens of *Carpocapsa pomonella* in all stages of existence from Auckland, so that material is now available for figuring the complete life-history of this species. From this circumstance it also appears probable that the ravages observed in the Auckland District are due to *Carpocapsa pomonella*, and not to the indigenous *Cacoecia excessana*.]

Art. VI.—*Notes on the New Zealand* Squillidæ.

By Chas. Chilton, M.A., B.Sc.

[*Read before the Otago Institute, 13th October, 1890.*]

Plate X.

During the early part of this year I obtained from Mr. W. M. Innes, of Port Chalmers, some very fine specimens of a *Squilla*, and, in endeavouring to identify them with the forms already described from New Zealand, I have been led to make the following notes, which are perhaps worthy of publication:—

In Miers's "Catalogue of the Stalk- and Sessile-eyed Crustacea of New Zealand," published in 1876, two species of *Squillidæ* are given, both on the authority of Heller. These are *Squilla nepa*, Latr., and *Gonodactylus trispinosus*, White. It is doubtful, however, whether either of these really belongs to New Zealand. In a paper on the Stalk-eyed Crustacea of New Zealand, in the *New Zealand Journal of Science*, vol. i., p. 263, Professor Hutton gives *Squilla nepa* in a list of species which he considers as "very doubtful," but which he was not yet prepared to dismiss from the New Zealand Catalogue. *Gonodactylus spinosus*, he says, may possibly belong to the colony, but was not represented, so far as he knew, in any collection in the colony.

So far as I know, neither of these species is yet represented in any New Zealand collection, but there I fear the matter must be allowed to rest for the present, as it is desirable to hesitate long before removing any species from the list.

Squilla nepa is, according to Miers,* widely distributed in the Indo-Pacific region, and has also been recorded from Sydney and from Chili. *Gonodactylus trispinosus* is known from Western Australia, Fiji, &c.

Since the publication of Miers's New Zealand Catalogue, the additions to our knowledge of the New Zealand *Squillidæ* have been as follows: In 1878 Mr. T. W. Kirk described as a new species *Squilla indefensa*, from Chatham Islands and Kapiti, and also recorded the occurrence of *Squilla armata*, M.-Edw., in Wellington Harbour. In the same year Professor Hutton described as a new species *Squilla lævis*, from the Auckland Islands. In 1880 Mr. E. J. Miers identified *Squilla indefensa*, Kirk, with *Coronis spinosa*, Wood-Mason, under the name *Lysiosquilla spinosa*; but at the time of writing his paper "On the *Squillidæ*" had evidently not seen Professor Hutton's description of *Squilla lævis*. In 1881 Mr. G. M. Thomson described as a new species *Squilla tridentata*, from Stewart Island. Brooks's "Report on the 'Challenger' *Stomatopoda*," published in 1886, added greatly to our general knowledge of the group, and especially of the larval forms, and in this respect largely completed the working-out of the larval history that had been commenced by Claus in his "Die Metamorphose der Squilliden," which appeared in 1871. The number of adult forms in the "Challenger" collections was, however, small, and none of them were from New Zealand. It is to be noted, however, that Brooks places *Gonodactylus trispinosus*, White, in a new genus, *Protosquilla*, formed to include some new species and some previously put down to *Gonodactylus*.

I am not acquainted with any other papers bearing on the New Zealand *Squillidæ*.

During this year I received two very fine specimens of a *Squilla* from Mr. W. M. Innes, of Port Chalmers, and, in working these out and comparing them with the descriptions of the different species described from New Zealand, I became convinced that *Squilla indefensa*, Kirk, *S. lævis*, Hutton, and *S. tridentata*, Thomson, represent but one species, and that my specimens also belong to this species; and it is chiefly with the object of establishing this fact that I am writing the present paper, as in any consideration bearing on the New Zealand fauna the apparent existence of three species of *Squilla* (instead of one, as is really the case) might easily lead to wrong conclusions.

Our list of New Zealand *Squillidæ* will therefore be as follows:—

* "On the *Squillidæ*," Ann. and Mag. N.H., ser. 5, vol. v., p. 1.

Squilla nepa, Latreille.

Squilla nepa.

Miers, "On the *Squillidæ*," Annals and Mag. Nat. Hist., ser. 5, vol. v., p. 25 (1880).

Brooks, "Report on the 'Challenger' *Stomatopoda*," p. 25 (1886).

The further synonymy is given by Miers in the paper quoted.

Hab. Indo-Pacific region. Recorded from New Zealand by Heller, but *New Zealand habitat doubtful.*

Squilla armata, Milne-Edwards.

Squilla armata.

Miers, *l.c.*, p. 26 (1880).

Kirk, Trans. N.Z. Inst., xi., p. 401 (1878).

As no description of this species has as yet appeared in any New Zealand publication, I transcribe the following from Miers's paper "On the *Squillidæ* :"—

"The carapace is narrowed anteriorly, with the cervical suture very faintly defined in its posterior portion, and the lateral longitudinal carinæ obliterated, except on the postero-lateral lobes; the spine at the antero-lateral angles is small but distinct. The rostral plate is somewhat elongated and narrowed distally, with a very slight median elevation. The lateral spines of the antennulary segment are prominent and curved forward; and in front of these are two smaller spines on the ocular segment. The lateral processes of the first exposed thoracic segment are narrow, straight, and acute; those of the two following segments are broader and rounded laterally, with a spinule at their postero-lateral angles. There is a small median carinule or tubercle on the 3rd to 5th post-abdominal segments; on the 4th and 5th segments the lateral carinæ, and on the 6th segment all the carinæ, end in spinules; the terminal segment is armed with a few tubercles near its base, with a longitudinal median carina, on either side of which is a lateral longitudinal series of very small tubercles; there is a rather deep median fissure between the submedian marginal spines, but no denticles; between these and the first lateral marginal spines there are on each side ten or eleven very small denticles or spinules. The distal prolongation of the base of the uropoda ends in two very unequal spines, the inner of which bears a small tooth on its outer margin. Length of the larger individual $5\frac{1}{6}$in."—[Miers.]

Hab. Chili; Auckland Islands (Miers). Recorded from Wellington by Mr. T. W. Kirk. There is a specimen (much damaged) in the Dunedin Museum labelled "Dunedin." Mr.

Kirk informs me that the "Mantis shrimps," dredged in Wellington Harbour, and exhibited by Mr. McIntyre at the meeting of the Wellington Philosophical Society on 2nd July, 1890,* also belong to this species.

Mr. Kirk very kindly lent me a fine spirit specimen (female) and two dried specimens (males) for examination. The female is 4½in. in length; the males are smaller. The "small median carinule or tubercle on the 3rd to 5th post-abdominal segments" is but slightly represented on the large female specimen, and is barely distinguishable in the smaller male specimens, and the "lateral longitudinal series of very small tubercles" on the sides of the median carina of the telson are also absent in all specimens; but in all other respects the specimens agree very closely with Miers's description. As the male specimens are dried, I have not been able to examine the structure of the terminal joint of the 1st abdominal appendage in this species.

Protosquilla trispinosa, White.

Gonodactylus trispinosus.
Miers, *l.c.*, p. 121, pl. iii., fig. 10 (1880).

Protosquilla trispinosa.
Brooks, *l.c.*, p. 71 (1886).

Further synonymy is given by both Miers and Brooks.

Hab. West Australia, Fiji, Ceylon, &c. Recorded from New Zealand by Heller, *but New Zealand habitat doubtful.*

Lysiosquilla spinosa, Wood-Mason.

Coronis spinosa.
Wood-Mason, Proc. Asiatic Soc. Bengal, p. 232 (1875).

Squilla indefensa.
Kirk, Ann. and Mag. Nat. Hist., ser. 5, ii., p. 466 (1878).
Kirk, Trans. N.Z. Inst., xi., p. 394 and p. 401 (1879).

Squilla lævis.
Hutton, Trans. N.Z. Inst., xi., p. 340 (1879) (*not* Hess).

Squilla tridentata.
G. M. Thomson, Trans. N.Z. Inst., xiv., p. 230 (1882).

Lysiosquilla spinosa.
Miers, "On the *Squillidæ*," Ann. and Mag. Nat. Hist., ser. 5, v., p. 12, pl. i., figs. 10–12, and p. 125 (1880).

Of this species I have been able to examine Professor Hutton's type-specimen of *Squilla lævis*, and another specimen labelled "*Squilla indefensa*, Kirk," in the Dunedin Museum; Mr.

* *Monthly Review*, ii., p. 427.

G. M. Thomson has kindly lent me his type of *Squilla tridentata* and a specimen obtained at Waipapa Point by J. F. Erecson; and Mr. T. W. Kirk has been good enough to send me specimens of his *Squilla indefensa.* I am thus able to give the synonyms mentioned above with perfect confidence: indeed, this might almost have been done from the descriptions alone, as there is little difference between them, except with regard to the number of teeth on the dactylos of the raptorial limbs; and this is evidently subject to some variation, as Miers has already pointed out in some other species. One of my specimens, a male 3·68in. in length, has twelve teeth (without the terminal spine) on the left side and thirteen on the right; the other specimen, a female, has lost the raptorial limbs. *Squilla lævis*, Hutton (type-specimen), has twelve teeth (exclusive of the extremity); *Squilla indefensa*, Kirk (type-specimen), has *nine* (exclusive of the extremity); *Coronis spinosa*, Wood-Mason, is described as "ten-toothed," while Miers describes *Coronis tricarinata*, Gray, which I have no doubt belongs to this species, as having *nine* teeth *including* the terminal spine. Thomson's type-specimen of *Squilla tridentata* has only *three* teeth (*four* if we include the terminal spine); but it is very small—only 0·75in. long—and is evidently a young form: in the structure of the telson and in all other points it agrees closely with the other specimens.

Squilla lævis, Hutton, has, of course, no connection with *Squilla lævis*, Hess., Archiv. f. Naturg., p. 170, pl. vii., fig. 22 (1865), which Miers puts down as a doubtful synonym of *Squilla nepa*, Latreille.

I have no doubt that the "*Lysiosquilla tricarinata* (*Coronis tricarinata*, Gray, ined. White List, Cr. Brit. Mus., p. 85, 1847)" mentioned by Miers* is identical with the species now under consideration. Miers compared it with Kirk's description of *Squilla indefensa*, and says it is "very probable that it belongs to the same species;" and, from the further description of the unique specimen that he gives, I have no doubt this identification is correct. The specimen was collected in the Antarctic expedition under Captain Sir J. C. Ross, but the locality has not been preserved. I am not able to find out whether White gave a description of it or not, and whether his name, therefore, has precedence over Wood-Mason's or not.

The species we are considering, though described by most of its authors under *Squilla*, was placed by Miers under the genus *Lysiosquilla*, Dana, the species of which differ from the more typical species of *Squilla* chiefly in the absence of the longitudinal ridges or keels on the carapace and abdomen. As no description of this genus has as yet been given in

* Loc. cit., p. 12.

works on New Zealand Crustacea, I give here Brooks's diagnosis of it.

LYSIOSQUILLA, Dana.

Generic Description.—"*Stomatopoda* with the 6th abdominal somite separated from the telson by a movable joint; the hind body depressed, loosely articulated and wide; the dactyli of the raptorial claw without a basal enlargement, but with more than 6 marginal spines; no more than 4 secondary spines, and often only 1 between the intermediate and submedian spines of the telson, which is usually wider than long, and the outer spine of the ventral prolongation from the basal joint of the uropod usually longer than the inner. The larva is an *Erichthus* or *Squillerichthus* with the ocular and antennulary somites covered by the carapace; the lateral edges of the deep carapace folded inwards over the ventral surface; the bases of the postero-lateral spines distant from the dorsal middle line; the hind body flat and wide; the telson wider than long, with a few spines, or only 1, between the intermediate and submedian spines, and the dactylus of the raptorial claw with numerous marginal spines."—[BROOKS.]

To this he afterwards adds: "The terminal joint of the exopodite of the 1st abdominal appendage of the adult male is subtriangular, with its large outer lobe separated by a suture from the very small inner lobe, and the fixed limb of the petasma very small and not ending in a hook."

Lysiosquilla spinosa, Wood-Mason.

Specific Diagnosis.—Whole dorsal surface quite smooth. Carapace with rostrum making up slightly more than one-fifth of the total length from tip of rostrum to the end of the telson. Eyes nearly cylindrical, corneæ somewhat expanded and wider than the peduncles. Rostrum triangular, sides slightly arched, acute in front. Raptorial claw usually with 12 spines on dactylos; inner edge of the propodos narrow and finely pectinated, with 3 stout movable spines and a few fine hairs near the base. Second thoracic segment produced on each side into a thin rounded projection compressed longitudinally so that when viewed from above it looks like a sharp spine; 3rd, 4th, and 5th thoracic segments rounded at the sides. Appendages of the pereiopods ovate, that of the 4th the largest, that of the 5th narrower than the others. Abdomen widening slightly posteriorly, 6th segment having the postero-lateral angles produced into sharp spines. Telson with the posterior margin semicircular, upper surface with a median and two submedian ridges ending posteriorly in sharp spines just above the level of the marginal spines; lateral portion of telson flat, expanded, ending posteriorly in the lateral spines; usually 1 secondary spine between the lateral and intermediate, and 2 or 3 between the intermediate and submedian spines; in the centre, between the submedian spines, the margin is notched, the portion on each side of the median notch being convex, and bearing 8–9 small secondary spines. Sixth abdominal appendages (uropods) large, the basal portion produced into a long flat spine, ridged below along the inner margin, and reaching nearly as far backwards as the endopodite; inside this spine the basal portion bears 2 small spines on posterior margin; on the upper surface it also bears a spine at the postero-distal angle. The endopodite is small and oval; the exopodite has the first joint nearly as large as the terminal joint, and bears 5–6 spines on the distal portion of the outer margin, the last two being long and curving outwards; terminal joint oval, with a ridge running along the centre of the upper surface.

Colour, male greyish, female with abdomen reddish. (For fuller details see below.)

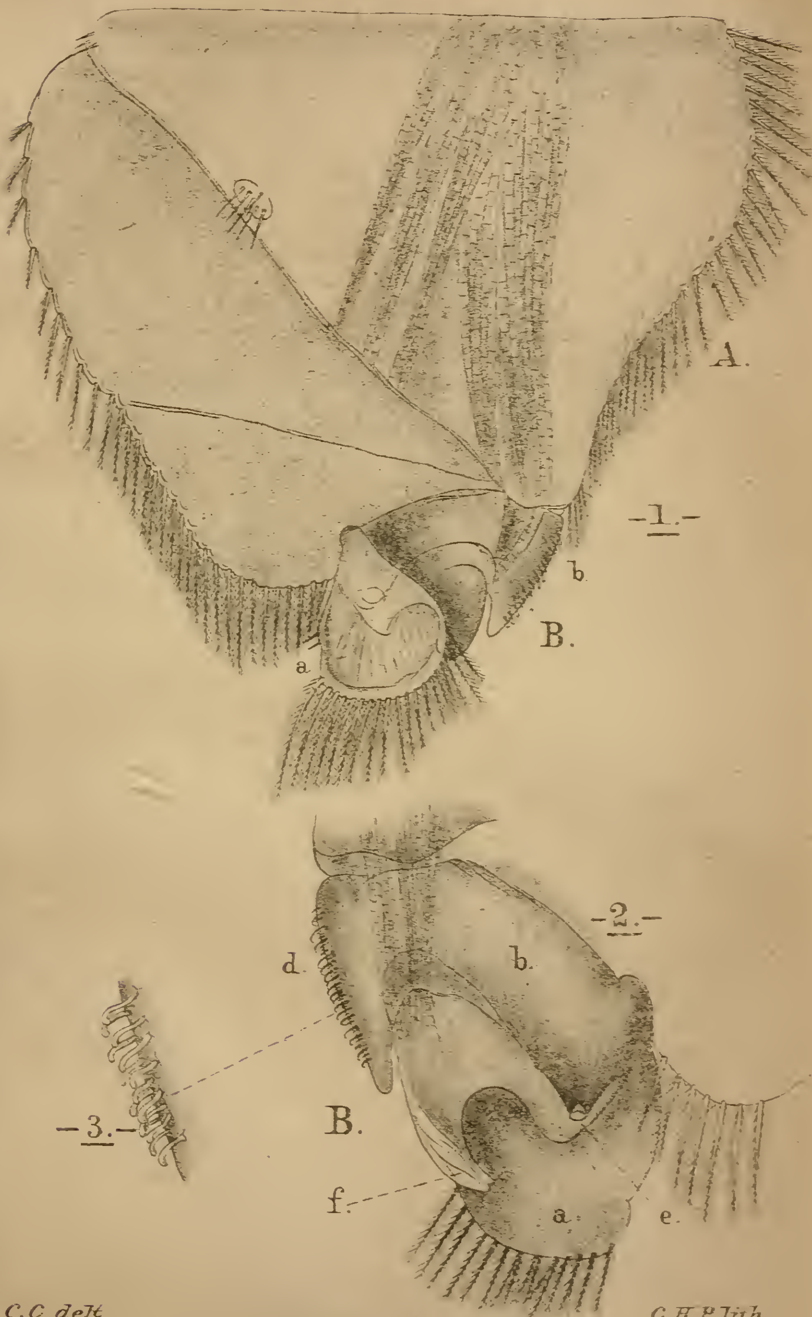
Length of largest specimen examined, 3·68in.

Hab. New Zealand and neighbouring islands. Also recorded from the Andamans (Wood-Mason). In New Zealand this species is evidently widely distributed: Kirk records it from the Chatham Islands, Kapiti, and Waikanae; Hutton's type-specimen was obtained at the Auckland Islands; Thomson's was from Port Pegasus, in Stewart Island, and in his collection there is also a specimen from Waipapa Point; I have specimens from Port Chalmers, and there is also a specimen in Dunedin Museum from Otago Harbour. At the meeting of the Hawke's Bay Philosophical Institute on 13th May, 1889, Mr. Hamilton exhibited specimens of this species* from the Napier district.

In his report on the "Challenger" *Stomatopoda*, Brooks has called special attention to the complicated structure on the endopodite of the 1st abdominal appendage of the male, and says that "if each description of a new species contained a figure of this structure, the tracing-out of the generic relation between the species would be greatly simplified" (p. 13). I therefore give a description and also figures of this appendage in *Lysiosquilla spinosa*. From these it will be seen that in most respects it pretty closely resembles the corresponding appendages of *Lysiosquilla maculata* and *L. excavatrix*, as described and figured by Brooks, though his figures—especially that of the former—are too small to allow of satisfactory comparison in detail.

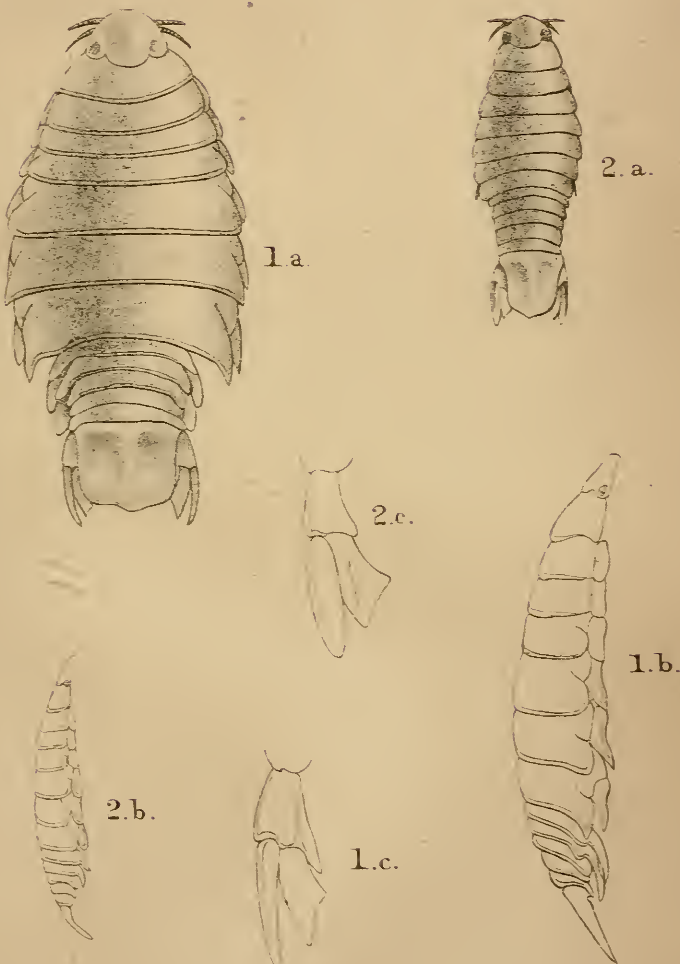
In *Lysiosquilla spinosa* the endopodite of the 1st abdominal appendage of the male (see Pl. X., fig. 1) has the basal joint sub-

* Trans. N.Z. Inst., vol. xxii., p. 551.



C.C delt. C.H.P. lith.

LYSIOSQUILLA SPINOSA.



C.C. del. NEROCILA MACLEAYII. C.H.P. lith.

triangular; the inner edge is sinuous, being convex in proximal half, and afterwards slightly concave, the whole of it being densely fringed with long, very finely plumose setæ; these become somewhat smaller towards the distal end, but there is a tuft of longer ones again at extremity of the joint; the outer edge is curved, and fringed with setæ similar to those on the inner margin; towards the base these setæ are short, more spiniform, and not so numerous. This basal joint is divided into two parts by an oblique suture running from the outer corner of the base across the joint to the inner distal angle. It would appear that the outer distal portion thus separated off is to some extent movable, as three narrow muscular bands arising from the same muscle that supplies the movable limb of the forceps extend as far as the suture. There is a small tuft of 5–6 simple setæ on the surface of the joint on the proximal side of the suture. The terminal joint, B, of the appendage is divided from the basal joint by a nearly transverse suture; it consists of the inner lobe, *b*, and the outer lobe, *a*. The latter is considerably longer than the former, from which it is completely separated, and is very different from it in shape, but is not larger; it is subtriangular, articulating to the basal joint by a very narrow base; it expands distally, and has the end regularly rounded; the outer edge is smooth, but the end and inner margin are densely fringed with long plumose setæ, the outer ones being the longest. The inner joint is partially overlapped by the outer, and is irregularly circular in outline. The retinaculum is distinctly marked, it ends acutely, and has nearly the whole of the inner margin densely covered with the characteristic curved setæ. The movable limb of the forceps, *f*, is long, curved outwards, and ending acutely in two points; the fixed limb, *e*, is small, rounded at the end, and apparently curving outwards from the joint, but not hooked.

Secondary sexual differences between the sexes appear to be rare among the *Stomatopoda*, though Brooks records slight differences in *Lysiosquilla maculata*. Differences in colour are more common. Brooks states that the male of *Pseudosquilla ciliata* is said to be more brilliantly coloured than the female, and that the female of *Lysiosquilla excavatrix* is larger and darker than the male. Of *Lysiosquilla spinosa* I have seen one female only, all the rest being males; but, as the males were all closely alike in colour, and differed markedly from the female, I am inclined to think that the difference is normal: and it is worthy of note that in this species, unlike *Pseudosquilla ciliata*, it is the female that is more brilliantly coloured. In this specimen the thorax and abdomen are also slightly broader in proportion than in the male (see measurements below); but whether this is accidental or normal I cannot say. The raptorial claws were missing in my single female specimen, but Mr. Hamilton tells me that those of the female differed to some extent from those of the male in his Napier specimens. The males are greyish in colour, the general surface of the body being of a semi-transparent white, and varyingly covered with dark spots, so as to give a grey appearance. There is generally a well-marked line of these along the posterior margin of the segments of the thorax and abdomen, and a much broader but lighter band along the anterior margin. The carapace, raptorial limbs, and uropods are more sparingly marked with dots; the telson is much darker, but has white stripes along the median and submedian ridges, and the margins are also white. In most of these respects the female is similar-coloured, but the carapace is darker, and the grey colour is more distinct on the sides of the thorax and abdomen, and does not extend across the centres of the segments so much as in the male; the grey portions, which are rather darker than in the male, have also a slight greenish tint; and, in addition to this, the whole of the central part of the segments of the abdomen is coloured a bright red. This description of the colours of the animals was taken originally from fresh specimens, but very little change has as yet taken place in the spirit specimens, the bright red of the female in particular being just as brilliant as in the fresh specimen.

Nothing is known as yet of the habits of this species. Although widely distributed, it is, probably owing to its habits, not very often taken, and most of the specimens known have been taken from the stomachs of fish. Both my specimens, one of Mr. Thomson's, and Professor Hutton's, were obtained in this way, Professor Hutton's being from the stomach of *Notothenia microlepidota*. Most species of the group are burrowing animals; and *Lysiosquilla excavatrix*, the habits of which have been fully described by Brooks, lies in wait for prey in its burrow, and seldom ventures far from the burrow.

Much interest attaches to the larval forms of the *Squillidæ*. These are transparent pelagic animals, very different in appearance and in habits from the adults; but nothing special is as yet known of the larval forms of *Lysiosquilla spinosa*.

For convenience of comparison I have appended a table of measurements of both male and female, similar to those given by Brooks for *Lysiosquilla excavatrix*. I have made these measurements as carefully as possible; but it must be borne in mind that some of the parts are not easy to measure accurately, and that they may vary to a considerable extent even on the two sides of the one specimen: thus, in the male specimen measured, the scale of the 2nd antenna was 0·28in. long on one side, but only 0·20in. on the other.

LYSIOSQUILLA SPINOSA, Wood-Mason.

Measurements.	In Hundredths of an Inch.		In Thousandths of Total Length.	
	♂	♀	♂	♀
Total length on middle line	3·68	3·21	1·000	1·000
Rostrum	0·18	0·14	0·049	0·044
Carapace	0·62	0·56	0·169	0·174
Total length of rostrum and carapace ..	0·80	0·70	0·218	0·218
From posterior edge of carapace to that of 2nd thoracic segment	0·12	0·12	0·032	0·037
From posterior edge of 2nd thoracic segment to that of 3rd	0·20	0·14	0·054	0·044
From posterior edge of 3rd thoracic segment to that of 4th	0·22	0·20	0·059	0·062
From posterior edge of 4th thoracic segment to that of 5th	0·22	0·20	0·059	0·062
Length of 1st abdominal segment	0·30	0·25	0·082	0·078
„ 2nd „	0·30	0·26	0·082	0·081
„ 3rd „	0·30	0·26	0·082	0·081
„ 4th „	0·30	0·26	0·082	0·081
„ 5th „	0·38	0·32	0·103	0·097
„ 6th „	0·22	0·22	0·059	0·069
„ telson	0·32	0·28	0·087	0·087
Total length of hind body	2·88	2·51	0·782	0·780
Width of carapace at anterior end ..	0·50	0·40	0·136	0·125
Greatest width of carapace	0·80	0·70	0·218	0·218
Width of 2nd thoracic segment	0·35	0·36	0·095	0·112
„ 3rd „	0·55	0·50	0·150	0·156
„ 4th „	0·60	0·56	0·163	0·174
„ 5th „	0·60	0·58	0·163	0·181
Width of 1st abdominal segment	0·68	0·65	0·185	0·202
„ 2nd „	0·70	0·66	0·190	0·206
„ 3rd „	0·72	0·67	0·196	0·208
„ 4th „	0·73	0·67	0·198	0·208
„ 5th „	0·74	0·68	0·201	0·212
„ 6th „	0·65	0·62	0·176	0·193
Greatest width of telson	0·60	0·56	0·163	0·174
Length of 1st antenna, from tip of rostrum to tip of longest flagellum	0·62	0·48	0·168	0·149
Length of appendage of 2nd antenna ..	0·63	0·58	0·171	0·181
Length of scale	0·28	0·25	0·076	0·078
Length of eye	0·18	0·16	0·049	0·050
Total length of swimmeret	0·62	0·52	0·168	0·162

DESCRIPTION OF PLATE X.

Fig. 1. *Lysiosquilla spinosa.* Endopodite of first abdominal appendage of male, posterior side: A, basal joint; B, terminal joint, with outer lobe *a*, and inner lobe *b*. (Enlarged.)

Fig. 2. Terminal joint, B, of same, anterior side: *d*, retinaculum; *e*, fixed limb of forceps; *f*, movable limb of forceps. Other letters as in fig. 1. (Enlarged.)

Fig. 3. Portion of the retinaculum, highly magnified, showing the curved setæ.

Art. VII.—*On the Changes in Form of a Parasitic Isopod* (Nerocila).

By Chas. Chilton, M.A., B.Sc.

[*Read before the Otago Institute, 13th October, 1890.*]

Plate XI.

Nerocila macleayii.

Cilonera macleayii, Leach, MS.; White, in Dieffenb. Voy. N.Z., vol. ii., p. 268. [See Miers, Zool. H.M.S. "Alert," p. 301.]

Nerocila imbricata, List Crust. Brit. Mus., p. 108, *sine descr.* Miers, Cat. N.Z. Crust., p. 107.

Nerocila novæ-zelandiæ, Schiödte & Meinert, Naturhistorisk Tidsskrifft, ser. iii., vol. xiii., p. 70, pl. v., figs. 10, 11.

Nerocila macleayii, Thomson and Chilton, Trans. N.Z. Inst., vol. xviii., p. 155.

Nerocila maclcayii, Thomson, Trans. N.Z. Inst., vol. xxi., p. 263.

This species was given, under the name *Nerocila imbricata*, in Miers's "Catalogue of the New Zealand Crustacea" (1876), as being represented in the collections of the British Museum by specimens from New Zealand. Up to the time of publishing our "Critical List of the Crustacea Malacostraca of New Zealand" in 1885 neither Mr. Thomson nor myself had met with any specimens, and consequently the note, "We do not know this species," was added in the list after the name of the species. Very soon, however, after the publication of this list both of us got specimens, and it appears that the species is not an uncommon parasite on several fish, especially on the west coast of New Zealand.

Young forms on which the incubatory pouch has not yet been developed differ very much from the adult female in the proportions of the body, the prominence of the epimera, &c., so that I did not recognise them as belonging to the same species until I got from the Dunedin Museum a bottle containing four specimens, of which one was an undeveloped female, and another a fully-developed female with large incubatory pouch, and the other two also females with pouches developed, but in other respects intermediate stages between the first and second. It is the first form that has been described by Schiödte and Meinert as *Nerocila novæ-zelandiæ*, and is by them spoken of as "virgo." Their detailed description applies very closely to specimens of this stage, so that I have no hesitation in giving their name as a synonym. These authors have given the differences between the "virgo" and the adult female in other species of *Nerocila*, but the material at their command evidently did not enable them to do this for this particular species; and, as their work is not easily accessible to students in New Zealand,* I propose to give here a description of the "virgo," and afterwards to compare it with the fully-developed female.

The body is narrow-oval, about three times as long as broad. The head is large, suborbicular, broader than long, slightly immersed in the first segment of the thorax, front rounded or with very slight indication of an angle in the centre. The eyes are of fair size and quite distinct, subpentagonal or subhexagonal in shape. The 1st pair of antennæ are somewhat compressed; those of the 2nd pair much more slender, terete, 11-jointed. The posterior angles of the first five thoracic segments are not produced, and are rounded or obtuse; those of the 6th and 7th segments are obtuse and very slightly produced backwards. The first three pairs of epimera are rectangular, overlapping, rounded posteriorly; the last three are somewhat acute posteriorly; the 5th more produced than the 4th, and the 6th equally more so than the 5th. Last pair of thoracic legs a little longer and more slender than the others, and with a few spines on the meros, carpus, and propodos. Abdomen exposed—that is, not covered by the thorax; much longer than broad; 1st segment shorter than the others; 2nd, 3rd, and 4th subequal; 5th a little longer: pleural portions of the 1st and 2nd segments only slightly produced. Telson cordate, as long as the other segments of the abdomen together, about as broad as long, somewhat sharply rounded at the extremity. Uropoda with the basal joint expanded distally, and slightly produced at the inner distal angle; inner branch broad and flat, widening a little distally, obliquely truncate, a very small tooth at the inner angle, the truncate extremity slightly sinuate, outer angle reaching a little beyond the extremity of the abdomen; outer branch much narrower and somewhat longer, widest about the middle, flat, extremity subacute.

* I am indebted to Mr. Thomson for the loan of his copy.

Colour indistinct, yellowish or olivaceous, sometimes with an indistinct darker line down the middle, and one much more indistinct down each side.

Length, 0·78in.; breadth, 0·28in.

There are no marks indicative of sex on the immature form I have described and figured (see Pl. XI., fig. 2); but it appears to be a slightly younger form than the "virgo" described by Schiödte and Meinert under the name *Nerocila novæ-zelandiæ.*

The adult female (see Pl. XI., fig. 1, *a*, *b*, *c*) is much broader in proportion, being only about twice as long as broad; the eyes are very indistinct; the 6th and 7th thoracic segments have the postero-lateral angles acute and much more produced, and the last three pairs of epimera are acutely produced backward, but not beyond the posterior margin of the segments to which they belong. The pleural portions of the first two segments of the abdomen are largely developed and flat; that of the 2nd extends backwards as far as the base of the uropoda. The uropoda are more slender than in the immature forms, and have the basal joint acutely produced rather more than half-way along the inner edge of the inner branch, which is obliquely truncate, and has the outer angle very acute; the outer branch is narrower and rounder than in the immature forms, does not widen at all in the middle, but gradually narrows from the base to the extremity, which is acute.

The colour is olivaceous, and is usually darker and more uniform than in the immature forms.

Length, 1·3in.; greatest breadth, 0·65in.

From the Otago University Museum I obtained four specimens, of which the first was an immature form closely resembling the one I have already described, the length being 0·9in., and the breadth 0·3in. The second specimen was a female with eggs in the brood-pouch, but evidently not so fully grown as the mature form described above; the length was 1·05in., and the greatest breadth was 0·45in., so that the body is narrower than in the fully-developed female; and the epimera, posterior angles of the thoracic segments, and pleural portions of the first two segments of the abdomen were also less developed. The third specimen was also a female bearing eggs, and was larger and more developed in all the respects mentioned than the second specimen, being 1·15in. long, and 0·5in. in its greatest breadth. The fourth specimen was a fully-developed female precisely similar to the form described above, but was slightly larger, being 1·4in. long and 0·7in. broad.

This species seems to be widely distributed in New Zealand, and to be found on several kinds of fish, though, unfortunately, I am not able to give any precise information as to its hosts. I have seen specimens from Lyttelton, Dunedin, and Greymouth, those from the latter locality being forwarded to me by Mr. R. Helms. Mr. Thomson also records the species from the west coast of the South Island. Schiödte and Meinert had specimens from Melbourne also.

It is hazardous to venture opinions on the affinities of different species from descriptions alone; but, so far as I can tell from those of the species described by Schiödte and Meinert, the one that comes nearest to our species is *N. fluviatilis* from the Rio Plata—a species which is perhaps the same as one found at the Falkland Islands.

DESCRIPTION OF PLATE XI.

Fig. 1. *Nerocila macleayii*, mature female: *a*, dorsal view; *b*, side view, limbs omitted; *c*, uropoda.

Fig. 2. *Nerocila macleayii*, immature form: *a*, dorsal view; *b*, side view, limbs omitted; *c*, uropoda.

Note.—Figs. 1, *a*, and 1, *b*, and 2, *a*, and 2, *b*, are twice the natural size; figs. 1, *c*, and 2, *c*, are more enlarged.

Art. VIII.—*On the Anatomy of the Red Cod* (Lotella bacchus).

By James M. Beattie, M.A., from the Biological Laboratory of the University of Otago.

Communicated by Professor Parker.

[*Read before the Otago Institute, 9th September, 1890.*]

Plates XII.–XV.

In this paper I propose dealing with the most important features in the general anatomy of our New Zealand Red Cod (*Lotella bacchus*). The original paper, which was written last year as a thesis for the honours examination of the New Zealand University, contains a quantity of matter which it has been deemed advisable to omit. This matter was simply a restatement and verification of the facts, in the anatomy of other Teleosteans, so well stated in our usual text-books, and therefore superfluous in a paper such as the present.

Lotella bacchus.

External Characters.—Form of lateral-line scales. Variation in fin formula.

Skeleton.—Articulation of dermal-fin rays with interspinous bones. Symmetrical tail. Cartilaginous parts of cranium.

Enteric Canal.—Liver, spleen, gall-bladder. Relative position of chief organs. Peritoneum. Frozen sections.

Gills.—Pseudobranch.

Air-bladder.—Ridge from fontanelle to tip of cornu. Conveying sound-waves.

Urino-genital Organs.—Histology of lymphatic glands.

Circulatory Organs.—Third and fourth efferent branchial arteries unite.

Brain.

Auditory Organ.—Position of otolith, &c.

Parasites.—*Tænia* sp.(?). *Nematoda* (*Filaria* sp.?). *Chondrocanthus lotella. Lernea lotella.*

External Characters.—The lateral-line scales, besides differing from those covering the other parts of the body, also differ among themselves. They are generally of an oval form. Some, however, have an indentation at their posterior border. Others have a prolongation from their posterior ends, and are thus somewhat racket-shaped in appearance.

In regard to the number of dermal-fin rays and branchiostegal rays there is considerable variation. I append the statements given, without any qualification, by Professor Hutton and by Dr. Günther, and some of the results obtained by myself:—

Hutton: D., 10/41; A., 41; V., 6; B., 7.
Günther: D., 10/42; A., 40; V., 6; B., 7.
Beattie: D., 10–12/39–45; A., 43–50; V., 5; B., 7.

From this table it will be noticed that, while both Hutton and Günther make out 6 rays in the pelvic (ventral) fin, I have been able to make out only 5 in the twenty-five to thirty specimens which I examined. Again, in not a single specimen have I got less than 43 rays in the ventral (anal) fin, while the numbers of Hutton and Günther are 41 and 40 respectively. In fact, in only four specimens did I make out 43. In all the others the numbers ranged from 44 up as high as 50, 45 and 46 being the predominating numbers. The numbers in the dorsal fin also show considerable differences. In the anterior part 10 seems to be the usual number, but in two specimens I counted 11 and in seven specimens I made out 12. In the posterior part I make 43 and 44 the most usual numbers. In only one specimen, and that a very young and small one, did I find 41, the number given by Professor Hutton; two had 42, one 39, and two 45.

Skeleton.—This agrees in the main points with the typical Teleostean skeleton. There are, however, certain modifications. The most noticeable and perhaps the most interesting of these is the mode of articulation of the dermal-fin rays with the interspinous bones (fig. 10). Each interspinous bone is intercalated between two adjoining dermal-fin rays, its hatchet-shaped dorsal portion seeming to abut against or articulate with, on the one hand, the posterior edge of the base of a fin-ray, and, on the other hand, with the anterior edge of the base of the fin-ray immediately behind. Closer examination of a freshly-prepared skeleton, however, shows that the interspinous bone articulates not with two adjoining dermal-fin rays, but with two adjoining nodules of cartilage (*a.c.*, fig. 10). These nodules are perfectly distinct, and lie in the hollow of the saddle-shaped base of the dermal-fin rays. Each is pear-shaped, and is in length about one-twentieth of that of the dermal-fin ray, and in breadth about one-third of that of the base of the dermal-fin ray. This cartilage seems to me to correspond with that found in the Ribbon Fish (*Regalecus argenteus*) by Professor T. J. Parker, and to which he refers as follows: ". . . . an ovoidal cartilage on which is perched . . . a dermal-fin ray. I have not met with cartilages of this kind in any fish which has come under my notice, and can find no account of any such in the works at my disposal. I regard them as representing a second or distal series of radials or pterygiophores, the interspinous bones forming the proximal series."

Following the last undoubted caudal vertebra is a fan-shaped bone—the hypural. This bone, together with four others (two dorsal and two ventral), give the symmetrical appearance to the Teleostean tail. These bones, at first sight, appear to be flattened neural and hæmal spines ; but they are attached, three to the last undoubted caudal vertebra and one to the hypural, by ligament only.

A very obvious cartilaginous nodule against which the posterior ends of the præmaxilla and maxilla abut is found in *Lotella*, and is identical with that found in *Gadus*. Curiously enough, as Professor Parker has pointed out, no mention is made of this in the leading authorities.

There is at the posterior part of the cranium on each side of the basioccipital a rather large aperture partly closed by a very thin lamina of bone. This aperture is bounded dorsally by the exoccipital, laterally and internally by the basioccipital, laterally and externally by the opisthotic, and ventrally by the basioccipital and opisthotic. This aperture opens into the auditory capsule, and will be referred to in the description of the air-bladder and auditory organ as the auditory fontanelle.

The cartilaginous parts of the cranium are situated in the ethmoid and auditory regions.

In the ethmoid region there is a median cartilage lying below the mesethmoid and above the vomer throughout the full length of the latter bone. This cartilage sends off processes into vacuities in the mesethmoid. About its centre it sends up an hourglass-shaped process which lies immediately behind the thick part of the mesethmoid, and extends up to the anterior face of the frontals. It also sends off side-processes into the parethmoids, these processes projecting outside at the articular facet for the palatine. The remaining cartilaginous parts of the cranium are contained in the auditory capsules. These extend to the outside by prominent processes, which issue at the facet on the cranium for the articulation of the hyomandibular.

The Enteric Canal.—From the mouth-cavity the gullet leads to the stomach, which occupies a considerable portion of the abdominal cavity, extending from its front wall backwards and downwards to the region of the anus. From the dorsal part of the stomach goes off the intestine, which is continued backwards for some distance. It then bends on itself and passes forward to the region of the stomach, thus forming the looped duodenum. It again bends on itself and passes backwards, forming the ileum and rectum, and finally ends at the anus (Pl. XII., fig. 1).

About $\frac{1}{2}$in. posterior to the junction of the stomach and intestine are given off from the intestine, in the form of a circle, a few blind tubes. These are the pyloric cœca (*py. c.*, figs. 1 and 10). From the examination of a number of specimens I conclude that the normal number of these pyloric cœca is six. However, that number is not constant. In one specimen the dorsalmost of these cœca at about 1in. from its blind end gave off a branch which ran almost parallel with, but not quite to the bottom of, the parent cœcum. Length of cœca, $2\frac{1}{2}$in. Length of branch, $\frac{5}{8}$in. In another specimen I found seven distinct cœca; while in still another I found eight, two of which were, however, much smaller than the others.

The mucous membrane lining the inside of the gullet varies from a whitish to a pinkish tint, and is thrown into a large number of longitudinal folds: that of the stomach is of a light-yellow colour, and is folded in all directions except a small area, just in front of the entrance to the intestine, which is absolutely devoid of folds.

At the entrance of the intestine there is a small flap which represents the pyloric valve (fig. 1).

Immediately posterior to this valve are the openings of the pyloric cœca. Each opens into the intestine by a separate aperture. From the posterior end of the ileum there passes into the rectum a very prominent valvular flap, the ileo-rectal valve (fig. 1).

The interior of each pyloric cœcum is lined by glandular mucous membrane of a rather brownish colour. The inside walls of the intestine are also lined with this glandular mucous membrane.

The Liver: In the natural position of parts the liver covers almost the whole of the alimentary organs. It is attached at the anterior end of the abdomen, and terminates freely at the posterior end. It is a large yellowish-brown-coloured organ (fig. 3), consisting of a long left lobe (*l.l.*), a right lobe (*r.l.*) much shorter than the left, and a short middle lobe (*m.l.*). While agreeing with *Gadus morrhua* in these points, it differs in the fact that all three lobes are distinctly divided into lobules. Consequently the edges of the lobes have an irregular outline.

In the left lobe there are two rather large lobules, the anterior one (*lob. 2*) overlapping the posterior one (*lob. 1*). Each of these is again divided into a number of less marked and much smaller lobules.

The central lobe is divided into four very distinct lobules (*lob. 1–4*), while the right has two well-marked ones (*lob. 1* and *2*).

The spleen is a smooth dark-red body of elongated form lying dorsad of the stomach. The gall-bladder (fig. 2) is an ovoidal sac filled with bright-green bile, situated about the middle of the abdominal cavity towards the right side. From it there passes forwards the cystic duct, which almost at its anterior end dilates, forming a sac-shaped body (*d.c.*). At this point it is joined by the hepatic ducts from the liver.

There are nine of these hepatic ducts. The 8th and 7th and the 6th and 5th unite, forming each a common branch before opening into the cystic duct. The duct formed by the union of the cystic and hepatic ducts—the common bile-duct—opens into the intestine just beyond the pylorus.

The walls of the cystic duct are unequally thickened. I draw this conclusion from the fact that when the bile is forced through the duct the walls become covered with well-marked dilatations, giving them a regular tuberculated appearance.

The Relative Position of the Chief Organs: Through the kindness of Professor Parker I was permitted to avail myself of his privilege and have some specimens frozen at the Burnside Refrigerating Works. They were kept in the chamber three days; the freezing operations at Burnside having been stopped the day I took my specimens. However, at the end of that time they were found to be sufficiently hardened. Sections were made with a small saw, each section wrapped in calico, and transferred to weak spirits for a few days before being mounted. From these sections, and by means of dissection, I have made out the topography of the chief organs as follows: The gullet passes from the mouth-cavity back into the stomach, which lies immediately below the air-bladder, and immediately above the ventral body-wall (fig. 10).

The stomach extends nearly to the posterior end of the abdominal cavity. At about its middle it is separated from the air-bladder by a rather thin spleen. This, though dorsad of the stomach, lies somewhat to the right side (fig. 13). From the stomach passes off the coiled intestine, opening into which are the pyloric cœca. These cœca and the separate coils of the intestine are numbered and named in the drawings of the sections (figs. 10 to 15) in correspondence with the numbers and names in the figure of the enteric canal (fig. 1). The cardiac division of the stomach gives off (fig. 12) towards its ventral right side the pyloric division. This branch passes dorsalwards and then to the posterior end; coils on itself and forms the duodenum. This, again, turns and passes backwards, ending in the anus (fig. 14). From fig. 10 we see that the duodenum passes to the posterior end of the abdominal cavity. Both coils of the intestine lie on the right side, and the pyloric cœca lie on the right and ventral walls of the stomach. The disposition of the pyloric cœca is shown in figs. 12 and 13: 1 and 2 lie on the right side of the stomach; the remaining four lie ventrad of the stomach: 3, 4, and 5 are shown in fig. 12 opening into the pyloric division of the stomach.

The gall-bladder and the spleen are both dorsal to the coils of the intestine. The gall-bladder is posterior, and the spleen anterior. The cystic duct passes over the right side of the spleen, joins the hepatic ducts in the anterior region of the cavity, and then passes into the intestine immediately in front of the junction of the pyloric cœca.

The right lobe of the liver extends backwards about 1in. posterior to the hindermost end of the stomach, lies on the right side of it, and in the natural position of parts covers the gall-bladder, spleen, and part of the folds of the intestine. The left lobe is opposite to this, and extends to the posterior end of the abdominal cavity. In its natural position it covers the whole of the alimentary organs. The middle lobe lies immediately ventral to the stomach.

The liver, with its three lobes, completely surrounds the gullet. The middle lobe however is short, and in the region of the stomach the viscera are bounded laterally but not ventrally by the liver.

The organs of reproduction lie in the posterior part of the abdominal cavity, rather towards the left side (figs. 10 and 14). They lie below the air-bladder, and pass forwards to the dorsal region of the stomach.

The heart, in its pericardial cavity, is at the ventral anterior part of the body, and separated from the abdominal cavity by a vertical partition.

The *sinus venosus* occupies the posterior and ventral region of the organ. The auricle occupies the dorsal part, and the ventricle the ventral part.

The air-bladder extends throughout the whole length of the abdominal cavity, and lies below the vertebral column, from which it is separated throughout the greater part of its length by the middle kidney. At its posterior end it lies just below the rather thicker posterior kidney, and at its anterior end it is bounded above by the lymphatic glands. At its anterior end the air-bladder gives off two cornua, which, passing outwards and slightly upwards, end in a blunt extremity just posterior to the opercular bone.

Peritoneum: This consists of the usual parietal layer lining the body-cavity, and visceral layer reflected over the viscera. In the anterior two-thirds of the abdominal cavity, the peritoneum, which there lies on the outer side of the liver, is extremely delicate, and is closely attached to the liver, while in the posterior third, especially on the right side (the right lobe of the liver not extending to the posterior end of the abdominal cavity), it is quite free, and consequently can be easily made out. On the ventral face of the air-bladder in the middle line the two layers pass into one another, and from this point pass ventrally the various mesenteric attachments of the viscera, which are in strict agreement with those given for *Gadus morrhua* in Professor Parker's "Zootomy." There are various invaginations of the visceral layer, which form peritoneal pouches for the various organs. One on each side passes between the liver and the stomach and intestine. On the right side the stomach and some of the folds of the intestine and gall-bladder are separated by a second pouch, and each gonad is enclosed in a separate pouch.

The Air-bladder.—The air-bladder covers the whole of the dorsal wall of the abdomen, the peritoneal lining of which is reflected over its ventral surface. The dorsal wall of this bladder is, especially in the middle and anterior regions, much thinner than the lateral and ventral walls.

The air-bladder passes from the posterior part of the abdominal cavity forwards right to the anterior part as a regular oval body. It then diverges dorsad, and to the right and left, forming a right and a left cornu.

These cornua pass outwards and forwards until they reach almost the exterior (being separated from the outside merely by a thin layer of skin), just below the operculum in front of the dorsal end of the shoulder-girdle. They end blindly, and their anterior walls lie close against the posterior part of the cranium. The anterior face of the bladder, or, more strictly, of its cornua, towards the middle line is much thickened. This is especially the case at two points where a thick button-like body is seen. These button-like bodies are found to fit against the skull at the apertures of the auditory capsules (fontanelles) already referred to, to come into close contact with the lamina of each fontanelle and thus to completely close them. To quote from Professor Parker's paper in the "Transactions of the New Zealand Institute, 1882:" "Each cornu fits closely against the three facets of the skull, and is strongly attached by fibrous tissue. . . . . The arrangements described must form a fairly-efficient transmitting apparatus for the organ of hearing. Sonorous vibrations, meeting the thin subopercular skin, will be transmitted to the air in the air-bladder and thence to the auditory fontanelle, the vibration of which will act immediately on the perilymph. The subopercular skin will thus act as an imperfect tympanic membrane, the air-bladder as a tympanic cavity, and the auditory fontanelle as a *fenestra ovalis*." On the removal of the dorsal wall of the air-bladder, *in sitû*, there is noticeable a sort of cave, bounded anteriorly by the button-like body already referred to. This cave thus lies immediately posterior to the auditory fontanelle, and is especially noticeable, because between the two caves (*i.e.*, at the median anterior part of the bladder), the dorsal, the anterior, and the ventral walls of the bladder are united and thickened, forming a solid bar-like body. From that portion of this thickened bar which lies mesiad of the two fontanelles there passes backwards and outwards to the posterior and extreme ends of each cornu a ridge formed as a thickening of the dorsal wall of the cornu. The inner end of this ridge forms the right or left—as the case may be—boundary of the cave referred to.

By this arrangement there is an imperfect partition between the main body of the air-bladder and its cornua, and I would suggest that the air-bladder is thus rendered a more perfect tympanic cavity than it would otherwise be. At any rate, it seems pretty certain that the ridge will, at least, have the effect of conducting the sound-waves to the auditory fontanelle.

Given off from the ventro-lateral walls of the air-bladder are a number of diverticula, which serve as means of attachment.

The *rete mirabile* extends forwards from about the middle of the bladder. At its anterior end it passes outwards and forwards in its own cornu. In a young specimen each *rete mirabile* is a distinct band, and the anterior end—that contained in the cornu—is separate from the posterior. In older specimens the two bands have grown together in the middle line, and the break at the anterior end is almost obliterated.

Urino-genital Organs.—The kidneys lie on the dorsal surface of the abdomen above the air-bladder, one kidney lying on each side of the vertebral column. They consist of two irregular longitudinal bands—the right one being the narrower—which pass at the anterior end into two brownish-red bodies, which lie dorsal and also partly anterior to the anterior end of the air-bladder. These improperly-called head-kidneys, to which I will refer again, come in contact with the posterior end of the skull, and also lie to some extent on its dorsal surface under the muscles. These bodies are the remains of the original pronephros. The remaining part of the kidney is mesonephros. At the posterior end the longitudinal bands—the middle kidney—unite and form a median mass lying posterior to the air-bladder, and enclosed in the first hæmal arch. This posterior kidney bends forwards and passes forwards and downwards for about 1½in. or 2in. From this part of the kidney goes off the ureter. Narrow at its posterior end, it widens to form two pouch-like diverticula — the urinary bladder,—and again gradually narrows to its opening behind the anus. The great difference between the kidney of *Lotella* and that of *Gadus* as figured by Smith and Norwell, in their "Illustrations of Zoology," is seen in one of the middle kidneys of *Lotella* being narrower than the other, and also in the presence of the great posterior kidney which extends into the abdominal cavity below the air-bladder. This part seems to be entirely absent in *Gadus*. A microscopic examination shows that the middle and posterior parts of the kidney have the usual structure; but that the so-called head-kidney is absolutely devoid of kidney structure. The whole is composed of an aggregated mass of rounded very small cells, which, unlike the corpuscles seen in the blood-vessels, do not fit closely into one another. The structure is that of a simple lymphatic gland. Balfour, in the "Quarterly Journal of Microscopic Science," vol. xxii., 1882, has described the same structure in several other fishes, with the exception that he found kidney tissue mingled with his lymphatic tissue.

Ovaries: These are two conical bodies uniting with one another posteriorly, and lying one on each side in the posterior part of the abdominal cavity. The ovaries send off from their posterior ends a common duct, which runs parallel with the ureter, and is separated from it by a very thin wall. The oviduct opens to the outside between the anus and the urinary aperture. The cavity of the ovary is filled with plate-like bodies, which are prolongations of its walls, and from the epithelium of which the ova are formed.

Of the male organs I can say nothing, for in working up this paper I never came across a male. This was no doubt due to the fact of the great preponderance of female fishes over males—a fact vouched for by Dr. T. W. Fulton in Geddes and Thomson's "The Evolution of Sex."

Circulatory Organs.—Here we have the purely typical Teleostean type. The only peculiarity and difference between *Lotella* and *Gadus* that I have been able to make out is that in *Lotella* the 3rd and 4th efferent branchial arteries unite and form a common trunk before opening into the left epibranchial artery.

Organs of Respiration.—The gills are four in number, and conform to the Teleostean type.

There is, however, also a rudimentary gill. This pseudobranchia is seen as a small red patch covered with membrane and lying just under the operculum. Thus it is a little anterior to the dorsal end of the first branchial arch. On removing the membrane we see a rather irregular red body, usually with marked indications of a filamentous structure (fig. 4). But in some specimens examined absolutely no trace of filaments could be made out. In all cases, however, the blood-vessels to the pseudobranchs could be made out.

Brain.—Again we have a structure almost identical with that of *Gadus morrhua*.

I have noticed in all the specimens I examined a very thin cord of nervous matter passing, on each side, along the brain-membranes, and slightly dorsal to the brain. This cord unites the tenth nerve with the cutaneous branch of the fifth.

The so-called prosencephala have no trace of a cavity, and it seems perfectly justifiable, as stated by Rabl-Rückarat, to consider them as merely elevations on the floor of the prosencephala, the roof of which is formed by pia, and which is consequently very easily torn away, and is so in usual dissections of the brain. The microscopic anatomy seems to me to put all doubt out of the question. The brains were hardened *in sitû*, the bone decalcified, and sections made. In these sections (figs. 16 and 20) the pallium or roof of the prosencephala was well shown.

Auditory Organ (figs. 5 to 9).—The auditory organ consists of an ovoidal vestibule (*v.*) and three semicircular canals—two vertical and one horizontal. The vertical canals are anterior and posterior. Each canal starts from the top of the ovoidal vestibule with a swollen part—the ampulla—and passes upwards to the dorsal region of the auditory capsule. They then pass backwards and forwards respectively, and finally meet. Their adjacent limbs are thus confluent. The common limb then passes directly downwards, and opens into a swelling at the top of the vestibule. The horizontal canal (*h.s.c.*) lies entirely on the outer side of the vestibule, and opens into it by two separate openings. The ampullæ of the canals are situated at their extreme ends, those of the anterior and horizontal canals being anterior, and that of the

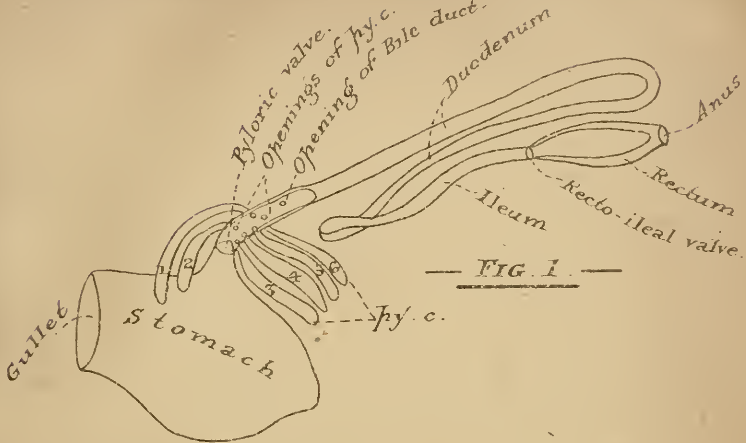


FIG. 1.

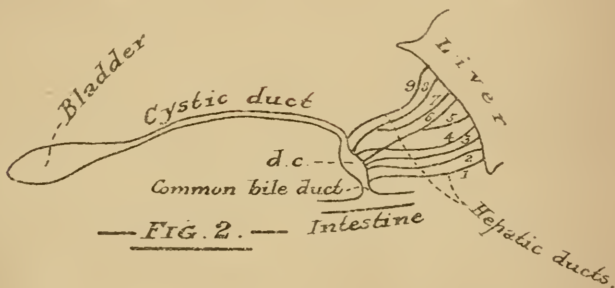
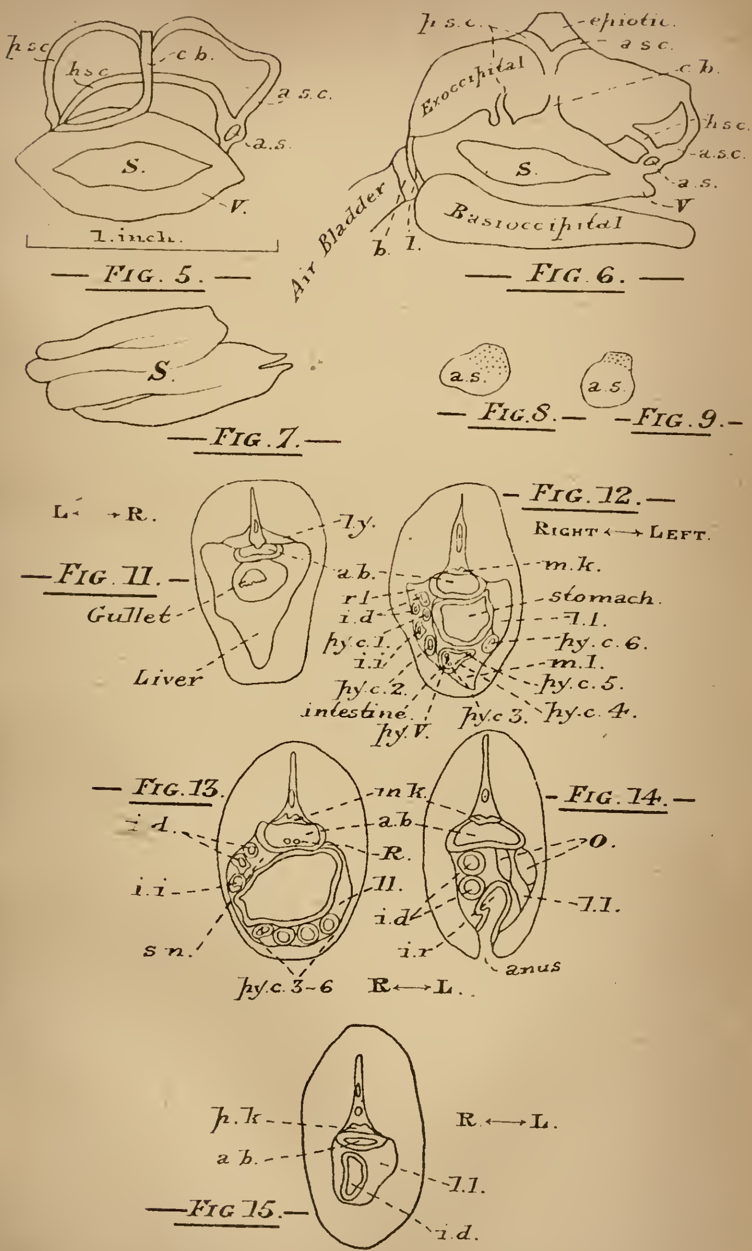


FIG. 2.

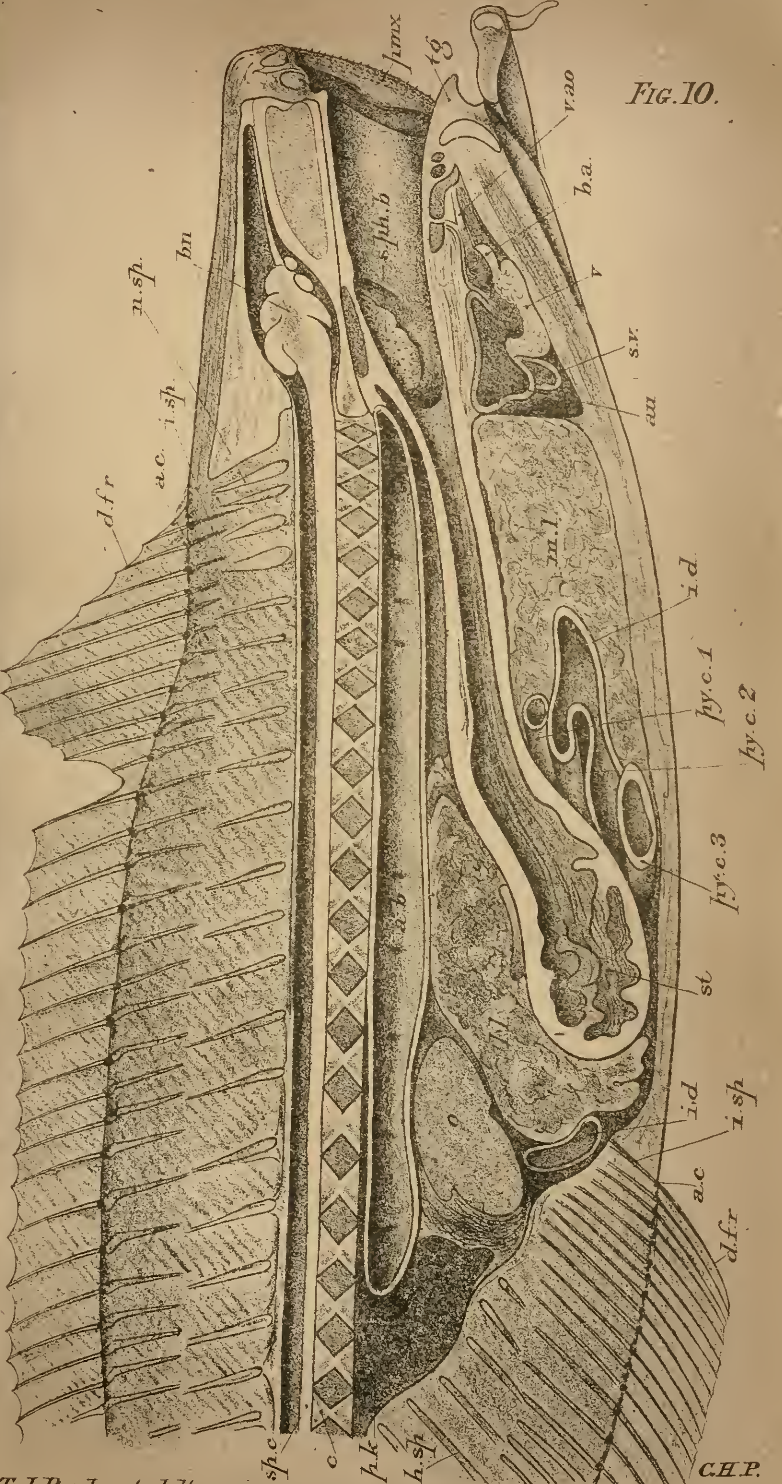
FIG. 3.

FIG. 4.

J.M.B. ad nat delt. LOTELLA BACCHUS.



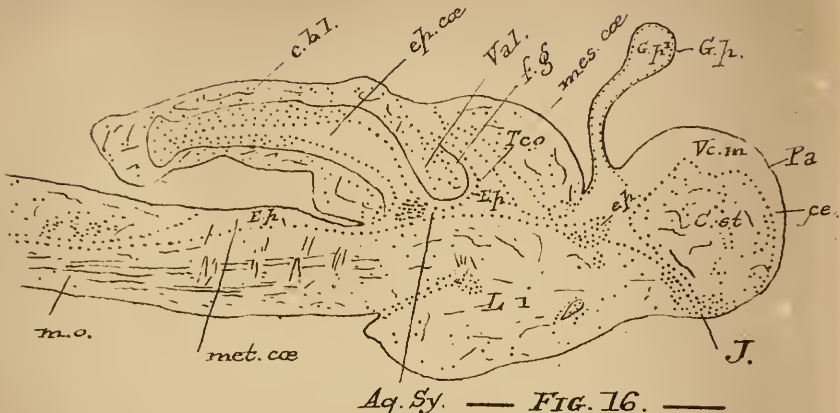
J.M.B. ad nat delt. LOTELLA BACCHUS.



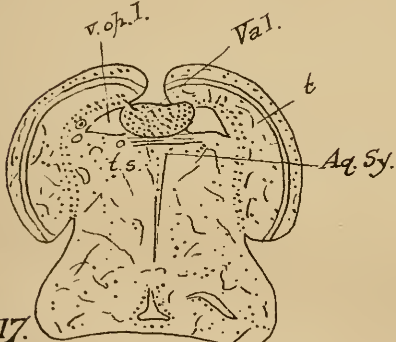
T.J.P. ad nat. delt.

C.H.P. lith.

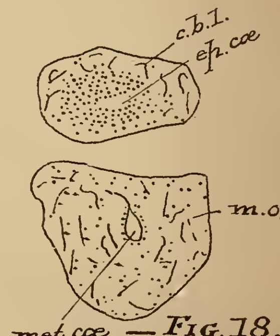
LOTELLA BACCHUS.



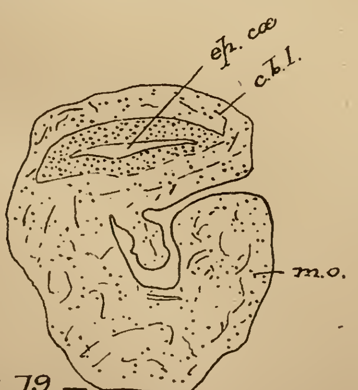
— Fig. 16. —



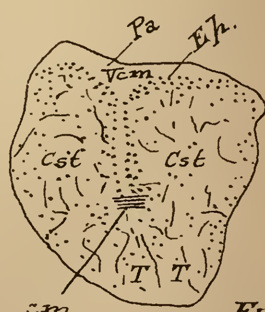
— Fig. 17.



— Fig. 18. —



— Fig. 19. —



— Fig. 20. —

J.M.B. ad nat delt. LOTELLA BACCHUS.

posterior canal being posterior. The ampullæ of the anterior and horizontal canals open into a common branch, probably of the ovoidal vestibule. In this small pouch is a very small calcareous otolith—asteriscus (*as.*). The ovoidal vestibule also contains a large calcareous otolith—sagitta (*s.*).

It will be noted from my description that this auditory organ of *Lotella bacchus* differs very markedly from that of *Gadus morrhua* as figured by Professor G. B. Howes in Parker's "Zootomy," and as figured by Smith and Norwell in their "Illustrations of Zoology." Whereas in *Gadus morrhua* the small otolith, asteriscus, is contained in a separate pouch at the posterior end, in *Lotella bacchus* it is placed in a pouch at the anterior end, and a pouch which is in direct communication with the ampullæ of the anterior and horizontal semicircular canals. The utricle is not sharply marked off from the saccule. There is no trace of the cochlea of *Gadus*.

Relation of Auditory Organ and Air-bladder (fig. 6): At its posterior end the ovoidal vestibule is somewhat flattened. This flattened part, which is composed of an exceedingly thin membrane, fits exactly and very closely against a thin, bony, and perfectly transparent membrane, *l*, which almost closes the auditory fontanelle. This bony membrane consists of two parts: one has its origin on the left side of the fontanelle, and passes parallel with the transverse axis of the cranium towards the centre of the foramen; the other has its origin on the right side of the fontanelle, and passes in like manner almost to meet its fellow of the opposite side. Fitting very closely against this bony lamina is the very thick button- or pad-like process of the air-bladder, already referred to. This button-like body, *b*, actually forms a sort of plug for the foramen. This plug is, in an ordinary-sized fish, about $\frac{1}{10}$in. in thickness. Behind, this plug comes to cavity of the cornu of the air-bladder.

Parasites.—Large numbers of crustacean parasites were found attached to the gills. Others were attached by their star-like extremity to the mucous membrane of the mouth, and to the muscles of the body.

These parasites have been described by Mr. G. M. Thomson in the "Transactions of the New Zealand Institute," vol. 22, pp. 368 *et seqq.* The former have been named by Mr. Thomson *Chondrocanthus lotellæ,* and the latter *Lernea lotella.*

Two tapeworms between 8in. and 9in. long were found in the intestine of one specimen—species of *Tænia.*

Nematoda: These worms were very numerous, and varied from 1½in. to 4in. in length. They were found mainly in the muscles of the cranium. One, however, was found between the olfactory lobes, while another was in the brain-case proper.

One of the specimens was a pregnant female, and contained an immense number of young. Both the adult and the embryos agree in general characters with the figures of *Filaria medinensis* of Bastian and Leuckart, and seem to be a species of *Filaria*.

DESCRIPTION OF PLATES XII.-XV.

Lotella bacchus.

Plate XII.

Fig. 1. Enteric canal, distended with alcohol.
Fig. 2. Gall-bladder, showing the hepatic ducts.
Fig. 3. The liver ($\times \frac{1}{2}$), showing lobes and main lobules.
Fig. 4. Pseudobranch after the removal of the mucous membrane of the mouth.

Plate XIII.

Fig. 5. Auditory organ. ($\times$ 2.)
Fig. 6. Auditory organ *in sitû*, showing its relation to the air-bladder.
Fig. 7. The large otolith.
Fig. 8. The small otolith, from above.
Fig. 9. The small otolith, from below.

Frozen Sections.

Fig. 11. Through the body, just posterior to the supra-occipital spine. A posterior view.
Fig. 12. Through the anterior part of the stomach. An anterior view.
Fig. 13. Posterior view of the same section. The drawing is reversed so as to make it correspond with fig. 12 in position.
Fig. 14. Through the anus. An anterior view.
Fig. 15. Through the posterior end of duodenum. An anterior view.

Plate XIV.

Frozen Section.

Fig. 10. A longitudinal vertical section, extending from the anterior end of the body to a short distance behind the posterior end of the abdominal cavity. This section, besides showing the main viscera, the heart, the air-bladder, the brain and spinal cord, in their relations, shows also the articulation of the interspinous bones and dermal-fin rays. The stomach is relaxed, and consequently the mucous membrane is thrown into folds.

Plate XV.

Fig. 16. A longitudinal vertical section of the brain, taken about the middle line. This is intended mainly to show the continuity of the cavities of the brain, and especially the relation of the cavity of the prosencephalon. It is partly after Weidersheim's figure from Rabl Rückard (the pineal body taken entirely from this figure).
Fig. 17. A transverse section through the anterior portion of the optic lobes of the brain.
Fig. 18. A transverse section through the epencephalon and metencephalon near the posterior end.
Fig. 19. A transverse section further forward than fig. 18.
Fig. 20. A transverse section through the anterior part of the brain, showing pallium, commissure, &c.

KEY TO PLATES XII.–XV.

a.b. Air-bladder.
a.c. Articular cartilage.
Aq.Sy. Aqueduct of Sylvius.
as. Asteriscus.
a.s.c. Anterior semicircular canal.
au. Auricle.
a.v. Aortic valve.
a.v.v. Auriculo - ventricular valves.
b. Button-like process of air-bladder.
b.a. Bulbus arteriosus.
bn. Brain.
c. Centrum of vertebra.
c.b. Common branch of anterior and posterior semicircular canals.
cbl. Cerebellum (epencephalon).
cc. Prosencephalon.
c.m. Commissure between corpora striata.
C.st. Corpus striatum.
d.c. Dilated part of cystic duct.
d.f.r. Dermal-fin rays.
e.p. Pineal body.
Ep. Ependyma that lines the walls of the ventricle.
epcœ. Epicœle.
epen. Epencephalon.
f.G. Fornix of Gottsche.
G.p. Pineal gland, with its cavity *Gp'*.
h.s.c. Horizontal semicircular canal.
h.sp. Hæmal spines.
i.d. Intestine—duodenum.
i.i. Intestine—ileum.
i.r. Intestine—rectum.
i.sp. Interspinous bones.
J. Infundibulum.
l. Bony lamina.
Li. Lobi inferiores.
l.l. Left lobe of liver.
ly. Lymphatic glands.
mes.cœ. Mesocœle.
mescn. Mesencephalon.
met.cœ. Metacœle.
meten. Metencephalon.
m.k. Middle kidney.
m.l. Middle lobe of liver.
m.o. Medulla oblongata (metencephalon).
n.sp. Neural spines.
o. Ovaries.
Pa. Pia mater.
p.k. Posterior kidney.
pmx. Premaxilla.
prosen. Prosencephalon.
p.s.c. Posterior semicircular canal.
py.c. Pyloric cœca.
py.v. Pyloric valve.
R. Rete mirabile.
r.l. Right lobe of liver.
S. Sagitta.
s.a.v. Sinu-auricular valve.
sn. Spleen.
sp.c. Spinal cord.
s.ph.b. Superior pharyngeal bones.
st. Stomach.
s.v. Sinus venosus.
t. Optic lobes (mesencephalon).
T. Olfactory tracts at base of corpora striata.
tg. Tongue.
Tco. Roof of optic lobe.
t.s. Torus semicircularis.
v. Ventricle.
v.ao. Ventral aorta.
V. Vestibule.
Val. Valvula cerebelli.
Vcm. Common ventricle of prosencephala.
v.op.l. Ventricle of optic lobes.

In figures of the brain the pia mater is represented as a single brown line.

Art. IX.—*Descriptions of New Species of New Zealand Land and Fresh-water Shells.*

By H. Suter.

Communicated by the Secretary.

[*Read before the Philosophical Institute of Canterbury, 6th November, 1890.*]

Plates XVI.–XVIII.

Rhytida meesoni, n. sp. Plate XVI., fig. 1, *a*, *b*, A.

Shell subdiscoidal, depressed, umbilicated, horny with a greenish hue at the base, shining, thin and fragile, transparent, epidermis with fine growth-lines, slightly wrinkled and malleated. Spire flat. Whorls 3, slightly convex, rapidly increasing, periphery rounded, the last somewhat deflexed anteriorly. Suture not deep. Aperture obliquely lunate-oval. Peristome simple, acute, margins approximating and joined by a faint callus. Columellar margin arched, reflexed at the upper part, slightly callous. Umbilicus moderate, deep, open, about one-sixth of the diameter.

Diameter, 0·45in. (11·5mm.) ; height, 0·24in. (6mm.). The largest specimen I have seen measured 0·5in. by 0·26in.

Hab. South Island: Wairoa Gorge, near Nelson (J. T. Meeson).

Named in honour of Mr. J. T. Meeson, of Christchurch, to whom we are indebted for this addition to our land-shells.

Animal.—Amongst the specimens Mr. Meeson kindly gave me there were some in which the dried-up animal was left, and of those I succeeded in preparing the radula.

Jaw none.

Dentition: 12—0—12. Transverse rows of teeth forming an acute angle. Teeth slender, aculeate, increasing from the centre up to the 10th, which is the largest. The 11th is not half as long, and the last rudimentary, not found on the posterior part of the radula. The 10th tooth has an angular ridge ; all the others are smooth.

Patula mutabilis, n. sp. Plate XVI., fig. 2, *a*, *b*, B, C.

Shell subdiscoidal, depressed, umbilicated, white, sometimes horny, irregularly streaked with rufous, but the white form seems to be predominant; faintly shining, rather thin, transparent; with sharp, rather distant arcuated plaits, directed strongly forwards on the surface, slightly undulating on the side, the interstices with numerous fine growth-lines. Ribs about 13 in the tenth of an inch (5 per mm.). Spire slightly elevated, flat. Whorls 5½, narrowly rolled up, very slowly increasing, rounded, the last not descending. Suture deep. Aperture slightly oblique, rotundly-lunar, somewhat excavated by the penultimate whorl. Peristome straight, acute, tapering; columellar margin straight, not reflected. Umbilicus broad, perspective, showing all the whorls, about one-third of the diameter.

Diameter, 0·12in. (3mm.); height, 0·06in. (1·5mm.).

Hab. Under rotten wood, dead leaves, and amongst mould in the subalpine bush. Very scarce. South Island: White Horse Hill, and foot of Sealy Range, Hooker Valley. (H. S.)

This species seems to be closely allied to *Helix eastbournensis*, Beddome and Petterd, from Tasmania, but in the latter the ribs on the upper surface are nearly straight, not arcuated; the spire is more elevated and not flat, and the umbilicus rather narrower and deeper. But there also occurs a perfectly white and a darker streaked form.

Animal.—Jaw finely striated, arcuated, not tapering, with a slight median projection.

Dentition: 16—1—16; laterals, about 7. Central tooth rectangular, longer than broad, the reflexed portion tricuspid, covering about one-third of the base, sides concave, median cusp as long as the base, with a moderate cutting-point, lateral cusps small. Laterals much the same as the central tooth. The first marginals with an oblique reflexed portion and three cutting-points, the outer ones rectangular, much broader than long, some of them with four cutting-points, the last very minute, toothless.

Patula sterkiana, n. sp. Plate XVI., fig. 3, *a*, *b*, D, E.

Shell subdiscoidal, depressed, umbilicated, grey-yellowish with very irregular rufous streaks and dots, sometimes tesselated or forming zig-zag lines; not shining, rather solid, transparent; with very fine rib-like arcuated striæ, directed forwards on the surface, undulating on the side and straight beneath. Ribs about 60 in the tenth of an inch (24 per mm.). Spire but little elevated, flat. Whorls 5½ to 6, slowly increasing, rounded, the last slightly descending. Suture rather deep. Aperture oblique, lunately subcircular, but little excavated by the penultimate whorl. Peristome straight, acute, tapering, margins slightly convergent, columellar margin arcuated, very little expanded. Umbilicus moderate, deep, about one-fourth of the diameter.

Diameter, 0·16in. (4mm.); height, 0·08in. (2mm.).

Hab. Under dead leaves and rotten wood in the subalpine bush. South Island: White Horse Hill, Hooker Valley. (H. S.)

This species is, in the form of the shell, allied to *Patula tapirina* and *P. infecta*, but is much closer ribbed.

Named in honour of my friend Dr. Sterki, New Philadelphia, Ohio.

Animal.—Jaw arcuated, not tapering, finely striated, with a slight median projection.

Dentition: 16—1—16; laterals, 4. Central tooth rectangular, not much longer than broad; the reflexed portion tricuspid, the side cusps short, middle cusp with the cutting-point reaching to the posterior margin. Laterals much like the central. Marginals tricuspid, the reflexed portion oblique on the inner ones, the outer ones much broader than long, the last small, bicuspid.

Patula brouni, n. sp. Plate XVI., fig. 4, *a*, *b*, F, G.

Shell minute, subdiscoidal, umbilicated, pale-horny with rather distant dark-horny streaks, forming zig-zag lines on the periphery and beneath; not shining, thin and fragile, transparent; with very fine and close ribs, nearly straight and directed forwards on the surface, straight on the side and at the base; about 60 in the tenth of an inch (24 per mm.). Spire scarcely reaching above the last whorl. Whorls 5, narrowly rolled up, slowly increasing, rounded, the last not descending. Suture impressed. Aperture slightly oblique, rotundly lunar, but little excavated by the penultimate whorl. Margins regularly arched, convergent, straight, acute, the outer lip slightly advancing. Columellar margin short, arcuated, not reflected. Umbilicus broad, perspective, one-third of the diameter.

Diameter, 0·09in. (2·25mm.); length, 0·04in. (1mm.).

Hab. Under decaying leaves and amongst mould in the subalpine bush. South Island: White Horse Hill, Hooker Valley. (H. S.)

Named in honour of Captain Thomas Broun, of Karaka, Drury.

This shell is closely allied to *Pat. sterkiana*, and has the same fine ribs, but may at once be distinguished from it by its smaller size, the different markings, and the somewhat different course the ribs take.

Animal.—Jaw very thin, arcuated, finely striated, not tapering, with a slight median projection.

Dentition: 14—1—14; laterals, 4. Central tooth rectangular, longer than broad, reflexed portion tricuspid, the central cusp long, reaching almost to the posterior margin of the base, with a short cutting-point. First two laterals much the same as the central tooth, the other two with longer cutting-points. Marginals with the base much broader than long, with three long cutting-points; the last rudimentary, minute, unicuspid.

Patula serpentinula, n. sp. Plate XVI., fig. 5, *a*, *b*, H, J.

Shell small, subdiscoidal, umbilicated, pale-horny with regular streaks and dots of rufous; not shining, thin, transparent; with sharp close-set ribs, arcuated, and directed forwards on the surface, sinuated at the periphery and straight beneath; about 38 in the tenth of an inch (15 per mm.). Spire scarcely elevated. Whorls 5, rather narrow, regularly increasing, slightly rounded, the last not descending. Suture deep. Aperture subvertical, rotundly lunar, very little excavated by the penultimate whorl. Peristome simple, straight, the upper margin slightly advancing, margins convergent. Columellar margin short, arcuated, not reflexed. Umbilicus large, perspective, showing all the whorls, one-third of the diameter.

Diameter, 0·1in. (2·5mm.); height, 0·05in. (1·25mm.).

Hab. Under rotten wood and decaying leaves in the subalpine bush. South Island: White Horse Hill, Hooker Valley. (H. S.)

This shell is near *Patula sterkiana* and *P. brouni*, but the ribs are more distant. It is finer ribbed than *Patula infecta*.

Animal.—Jaw arcuate, faintly striated, very thin, no median projection.

Dentition: 11—1—11; laterals, 5. Central tooth rectangular, not much longer than broad, reflexed portion tricuspid, the central cusp long, reaching nearly the posterior margin of the base, all the three cutting-points short. Laterals very much like the central tooth, but almost quadrate. Marginals much broader than long, with three to four cutting-points, of which the two inner ones are stouter and longer; the last marginal minute, quadrate, unicuspid.

Patula eremita, n. sp. Plate XVII., fig. 6, *a*, *b*.

Shell very minute, subdiscoidal, umbilicated, pale-horny with faint broad streaks of darker horny, silky, fragile, transparent; with fine and numerous ribs, slightly arcuated and directed forwards on the surface, straight on the side and beneath; about 70 in the tenth of an inch (28 per mm.). Spire minute. Whorls 4½, narrowly rolled up, regularly but slowly increasing, rounded, the last not descending. Suture deep. Aperture subvertical, rotundly lunate, but little excavated by the penultimate whorl. Peristome straight, acute, regularly arched, margins convergent. Columellar margin short, arcuated, not reflected. Umbilicus broad, perspective, about one-third of the diameter.

Diameter, 0·08in. (2mm.); height, 0·03in. (0·75mm.).

Hab. Under decaying leaves in the subalpine bush. Exceedingly scarce (one specimen only). South Island: White Horse Hill, Hooker Valley. (H. S.)

This shell represents a middle form between *Patula infecta* and *P. corniculum.*

Animal not known, as I would not destroy the only specimen I have.

Patula infecta, Reeve, var. *alpestris*, n. var.

The shell of this variety differs from *P. infecta*, R., by its different colour, it being cinereous-rufous with only a few pale-horny streaks. The ribs are stouter and more distant, about 18 in the tenth of an inch (7 per mm.). The whorls number only 4½ to 5; they are somewhat broader, less rounded, and the suture, in consequence, less impressed. The peristome has no callosity inside.

Diameter, 0·12in. (3mm.); height, 0·06in. (1·5mm.).

Hab. Amongst decaying leaves in the subalpine bush. Scarce. South Island: White Horse Hill, Hooker Valley. (H. S.)

Animal unknown.

Patula bianca, Hutt., var. *montana*, n. var. Plate XVII., fig. K, L.

Shell differs from the type by its larger size, by the darker colour, this being fuscous without any streaks, and the coarser and more distant ribs, there being only about 35 in the tenth of an inch (14 per mm.).

Diameter, 0·11in. (2·75mm.); height, 0·05in. (1·25mm.).

Hab. Under rotten wood and dead leaves in the subalpine bush. South Island: White Horse Hill, Hooker Valley. (H. S.)

Patula bianca, Hutt., is also found in the same locality, but rather scantily, and it differs a little from the type by the diameter being never over 0·08in. (2mm.), by having four whorls, and by the ribs being more distant, about 50 instead of 55 in the tenth of an inch.

Animal.—Jaw very thin, almost straight, not tapering, faintly striated, no median projection.

Dentition: 13—1—13; laterals, 4 or 5. Central tooth rectangular, longer than broad, reflexed portion tricuspid, middle cusp reaching about two-thirds of the length of the base, all the cutting-points short. Laterals a little broader than the central tooth, but similar in shape, the middle cusp with its short cutting-point reaching to the posterior margin of the base. Marginals much broader than long, especially the outer ones; with three stout cutting-points, of which the two inner ones are more developed. Last marginal minute, bidentate.

Patula corniculum, Reeve, var. *maculata*, n. var.

Shell agrees in almost every respect with the type of the species, but the white epidermis is adorned with rufous radiate streaks at very irregular distances and from narrow to broad. There are about 50 ribs in the tenth of an inch (20 per mm.), whilst the species, according to Professor Hutton, has only 40; but I do not think this to be of much value for distinguishing the variety. According to my observations *Pat. corniculum* varies considerably in the number of the ribs in different localities. I collected specimens in the Forty-mile Bush with about 50 ribs in the tenth of an inch, and near Wellington with less than 40.

Diameter, 0·11in. (2·75mm.); height, 0·06in. (1·5mm.).

Hab. Amongst decaying leaves in the subalpine bush; very scarce. South Island: Foot of Sealy Range, Hooker Valley. (H. S.)

Animal unknown.

Pitys cryptobidens, n. sp. Plate, XVII., fig. 7, *a*, *b*, *c*, M, N.

Shell very minute, discoidal, umbilicated, cinereous, not shining, very fragile, subtransparent, with very fine and extremely close-set ribs, which are slightly bent forwards, but almost straight on the surface, and rather sinuated at the periphery, about 85 to 90 in the tenth of an inch (35 per mm.). Spire flat. Whorls 4½, narrow, rounded, regularly increasing, the last not descending. Suture deep. Aperture rotundly lunate, subvertical, slightly excavated by the penultimate whorl. Peristome acute, somewhat flattened at the base, the upper margin advancing. Interior of the aperture with two teeth. There is a callosity on the basal margin, from which to the left rises a stout conical tooth; another tooth of the same shape is near the middle of the parietal wall. Both teeth are at some distance from the margin. Columellar margin short, arcuated, slightly reflected. Umbilicus broad, perspective, showing all the whorls, about one-third of the diameter.

Diameter, 0·07in. (1·75mm.); height, 0·03in. (0·75mm.).

Hab. Amongst mould in the subalpine bush; very scarce (three specimens found only!). South Island: White Horse Hill, Hooker Valley. (H. S.)

Animal.—As I had only three specimens, I would not sacrifice more than one for preparing the jaw and radula. As the animals were dried up in their shells this proved to be a most difficult task, considering the minuteness of the objects. The animal was soaked for a long time in water, then in glycerine, and repeatedly treated with caustic potash, but it was impossible to prepare the radula in a perfectly good condition, and, owing to the great brittleness, I dared hardly touch it with a needle, and had to leave it partly rolled up. Nevertheless I succeeded in seeing some of the teeth perfectly well, but I am unable to say what is their number.

Jaw oxygnath, tapering, with a narrow lamella in the middle.

Dentition: Central tooth quadrate, the reflexed portion tricuspid, the middle cusp with its short cutting-point reaching to the end of the base; there are three or four laterals exactly of the same form, and then follow some laterals with the base much broader than long and three equal cutting-points. The marginals are bicuspid and acuminate.

Mr. Harper Pease has given the name of *Pitys* to a group of *Patula*-like Polynesian shells, some of which have their aperture adorned with laminæ, whilst others are without. To the latter ones Professor A. Mousson, in his collection, has given the name of *Simplicaria*. Most of the conchologists consider *Pitys* to form a group of the genus *Patula*, or a genus of the family of the *Patulidæ*.

I think I am right in referring our shell to *Pitys*. To my knowledge there is no other group or genus in which it could be placed at present. But the jaw and the dentition show clearly that it does not belong to *Patula* or the *Patulidæ*. Its place is in the family of the *Limacidæ*. I never had an opportunity of examining the dentition of a Polynesian *Pitys*, and I do not know whether it has ever been done or not. The anatomical study of these molluscs would be of great interest and value, and would furnish the necessary basis for a correct classification. It is rather astonishing what a large number of very different forms are now included in one group or subgenus, such as *Charopa*, *Endodonta* (including *Pitys*), and many others. It is only by way of anatomical examination that light can be brought into this chaos.

It is the first time a *Pitys* with lamellæ has been found in New Zealand, and I think it to be of great value, as it gives an additional proof of our former land-communication with a part of Polynesia.

Psyra godeti, n. sp. Plate XVII., fig. 8, *a*, *b*, O, P.

Shell discoidal, perforated, colour horny without any markings, not shining, transparent, thin, with strong, rather distant, and almost straight radiate ribs, about 23 in the tenth of an inch (9 per mm.). Spire flat. Whorls 5, slightly rounded, narrow, regularly increasing, the last not descending. Suture impressed. Aperture subvertical, lunar, considerably excavated by the penultimate whorl. Peristome straight, simple, basal margin slightly arcuated. Columellar margin very short, but little reflected, slightly thickened. Umbilicus very narrow, but open.

Diameter, 0·18in. (4·5mm.); height, 0·1in. (2·5mm.).

Hab. Under stones. South Island: Foot of Sealy Range, Hooker Valley. (H. S.)

Our species stands nearest to *Psyra tullia*, Gray, but is easily distinguished from it by the absence of any markings, the stronger and more distant ribs, and the open umbilicus.

Named in honour of Professor Paul Godet, in Neuchâtel, Switzerland.

Animal.—Jaw slightly arcuate, not tapering, flatly ribbed, the ribs indenting the convex margin.

Dentition: 20—1—20; laterals, 6. Central tooth rectangular, not much longer than broad, reflexed portion tricuspid, the central cusp with the cutting-point reaching the posterior margin of the base. Laterals a little broader than the central tooth, bicuspid, the inner cutting-point long, reaching beyond the base. Marginals much broader than long, with four to five cutting-points, the last minute, denticulated. The larger cutting-points of the laterals and marginals reach over the next row of teeth.

Amphidoxa (Calymna) feredayi, n. sp. Plate XVIII., fig. 10, *a*, *b*, Q, R.

Shell small, globosely depressed, imperforate, shining, pale-horny, without markings, thin, transparent; with fine ribs, arcuated on the surface and disappearing beneath, about 25 to 30 in the tenth of an inch (10–12 per mm.). Spire short, obtuse. Whorls 3½, rapidly increasing, rounded. Suture impressed. Aperture oblique, rotundly-ovate. Peristome thin, straight, regularly arched, the upper part advancing. Columellar margin somewhat bent to the left, not reflexed. Margins approximating. Umbilical region infundibuliform, imperforate.

Diameter, 0·14in. (3·5mm.); height, 0·08in. (2mm.).

Hab. Under rotten wood in the bush; very scarce. North Island: Hastwell, Forty-mile Bush. (H. S.)

Named in honour of Mr. R. W. Fereday, of Christchurch.

Animal long, slender, yellowish-grey with fine black spots. Eye-peduncles black, rather stout, slightly clavate; eyes large. A streak on each side of the head black. Mantle subcentral, whitish. Foot 4mm. long, sole separated by a furrow. Tail acutely rounded. Caudal slit (?).

Jaw arcuated, tapering, stegognath, consisting of numerous parallel lamellæ.

Dentition: 20—1—20; laterals, 7. Central tooth rectangular, longer than broad, the reflexed portion tricuspid, the apical cutting-point as long as the base, the cuspids on the convex sides short. Laterals nearly like the central tooth.

Marginals quadrangular, broader than long, with three cutting-points, the last only with a cutting-edge, sometimes without it.

Amphidoxa (Calymna) feredayi, Sut., var. *glacialis*, n. var.

Shell small, globosely depressed, imperforate, silky, pale-horny without markings, fragile, transparent, with very fine, distinct, and close striæ, arcuated on the surface and straight beneath, about 60 in the tenth of an inch (25 per mm.). Spire almost flat. Whorls 3½, rapidly increasing, rounded. Suture impressed. Aperture oblique, rotundly ovate. Peristome thin, regularly arched, the upper part of the outer lip advancing. Columellar margin not reflected. Margins slightly convergent. Umbilical region impressed, imperforate.

Diameter, 0·14in. (3·5mm.); height, 0·07in. (1·75mm.).

Hab. Under rotten wood in the subalpine bush; very scarce. South Island: White Horse Hill, Hooker Valley. (H. S.)

Animal.—Jaw and dentition much the same as in the species.

This variety differs from the species only in the closer ribs and the somewhat less elevated spire.

Phrixgnathus acanthinulopsis, n. sp. Plate XVIII., fig. 11, *a*, *b*, S, T.

Shell small, conoidal, umbilicated; colour pale-horny with regular broad streaks of rufous, faintly shining, transparent, fragile. Epidermis with slightly-sinuated membranaceous plaits, about 12 in the tenth of an inch (5 per mm.). Spire conoidal, rather depressed. Whorls 5, slowly but regularly increasing, rounded; periphery carinated. Suture impressed. Aperture oblique, rotundly lunar. Peristome thin, straight, the margins slightly approximating. The columellar margin scarcely reflected, somewhat callous inside. Umbilicus moderate, deep, open, one-fourth of the diameter.

Diameter, 0·12in. (3mm.); height, 0·08in. (2mm.).

Hab. Amongst dead leaves and mould in the subalpine bush. Rather scarce. South Island: White Horse Hill, Hooker Valley. (H. S.)

This species is very near *Ph. phrynia*, Hutt., but the spire is more depressed and the umbilicus larger.

Animal.—Jaw arcuate, not tapering, lamellate, the lamellæ flat, densely covered with hair-like papillæ; about five of the central lamellæ much broader than the others.

Dentition: 21—1—21. Central tooth rectangular, much longer than broad, reflexed portion nearly half the length of the base, unicuspid, marginal teeth twice as broad as the central tooth, bicuspid, the cutting-points growing larger and reaching the posterior margin of the base as they approach the margin of the radula. The last two teeth much broader than long, with rudimentary cusps.

Amphipeplea ampulla, Hutt., var. *globosa,* n. var. Plate XVIII., fig. 12, *a, b, c.*

Shell ovate, inflated, very thin and fragile, pale-horny, faintly shining, transparent, longitudinally plaited, plaits close-set and well marked. Spire short, acute, apex sometimes eroded. Whorls 4, the last inflated. Suture impressed. Aperture large, ovate, occupying about three-quarters of the length of the shell; the outer lip not reflected, thin and sharp; inner lip very broadly reflected, covering the umbilicus. Columella arcuate, with a spiral fold.

Dimensions: Length, 0·5in. (13mm.); breadth, 0·35in. (9mm.). Aperture: Length, 0·39in. (10mm.); breadth, 0·24in. (6mm.). The measures given are those for perfectly adult specimens.

Hab. South Island: Birch Hill Lagoon, Tasman Valley. (H. S.)

The *animal* is the same as in the species, and in the dentition there is not such a difference as to justify the creation of a new species. Professor F. W. Hutton kindly gave me some specimens of his *A. ampulla,* and I have thus been able to compare the radulæ.

The shell differs from *A. ampulla* by the more globular form, the larger size, the lighter colour, and the more considerable fragility and transparency. The spire is, as a rule, somewhat shorter, and the reflexed portion of inner lip broader.

This is a very variable shell, but adult specimens are always much more inflated than any *A. ampulla* I have seen.

[For explanation of Plates XVI.–XVIII., see end of Article X.]

ART. X.—*Miscellaneous Communications on New Zealand Land and Fresh-water Molluscs.*

By H. SUTER.

Communicated by the Secretary.

[*Read before the Philosophical Institute of Canterbury, 6th November, 1890.*]

Latia lateralis, Gould (phosphorescent).

When living in Wellington I collected a number of *Latia lateralis* in the Kaiwara Creek, and kept them for some time alive in a glass with water. I was greatly astonished when at night-time I found all the animals highly phosphorescent. The margin of the mantle showed a violet light, and this was intensified by a touch with a needle. The secreted mucus was also phosphorescent for some time. I do not know of any other fresh-water shell showing this phenomenon, though it is well known in many marine shells, especially in the *Pholadidæ*. It is very likely that the cells of Mueller, in connection with the nervous system, produce this light. Having no material at my disposal for the time being, I have to postpone an examination of the animal. It would be of interest to know whether *Latia fluviatilis* shows the same phosphorescent power.

Vitrinopsis (Vitrinoidea) dimidiata, Pf.

This mollusc was first described by Pfeiffer (P.Z.S., 1851) under the name of *Vitrina dimidiata*. There can be but little doubt that Pfeiffer never saw the animal, but only the shell; otherwise this distinguished conchologist would at once have seen that it differs widely from the genus *Vitrina*. Professor F. W. Hutton, when undertaking the revision of our Land Mollusca, for which splendid scientific work conchologists owe him their gratitude, saw the error Pfeiffer had made and created a new genus, *Otoconcha* (Trans. N.Z. Inst., xvi., p. 199) for our mollusc. When I first found this slug in the Forty-mile Bush it really puzzled me, but at last I found that it agrees well with the description of the genus *Vitrinopsis*, Semper (1870), a genus which was not known to Professor Hutton at the time of his revision of our land-shells. *Vitrinopsis* was hitherto only known from the Philippine Islands, where it was discovered by Semper.

I will not enter into fuller particulars at the present, as I expect to get some specimens of *Vitrinopsis* from the Philippine Islands next year, thus enabling me to compare them with our *V. dimidiata* and to give a complete record.

Potamopyrgus corolla, Gould (viviparous). Plate XVIII., fig. 13, *a*, *b*, *c*.

A short time ago I had the chance of making a highly interesting observation on the propagation of the above-named mollusc. I kept a number of specimens alive in a glass tube, and, on examining it, I found to my great astonishment sixteen very minute white young molluscs crawling about on the glass. (This was on the 6th of October, and the animals were put in the glass tube on the 5th.) There was no trace of eggs to be seen, and, as I observed on the following days, when some more young animals appeared, our *P. corolla* is *viviparous;* and it is to be expected that our other species of the genus, as well as those in Tasmania, will show the same mode of propagation.

The *Hydrobiidæ*, to which our mollusc belongs, are recorded as being oviparous, but *P. corolla* makes an exception to the rule, thus showing a relation to the families of the *Melaniidæ* and *Paludinidæ*, of which *Paludina* is ovo-viviparous. In Switzerland I kept *Paludina fasciata* for a long time in my aquarium, and many times observed the expulsion of the large white eggs from the female animal. They burst a short time afterwards, expelling the young animals in a milky liquid. Such is not the case with our *P. corolla*, but it is strictly viviparous, as the *Melaniidæ* are. The young, one-day-old shell (Pl. XVIII., fig. 13, *a*, *b*, *c*) has, of course, quite a different form from that of the adult. It is globular, vitrinous, consisting of one whorl only, which shows some fine growth-lines near the aperture. The greatest diameter is 0·02in. (0·5mm.). The operculum is distinctly visible when the animal is extended out of the shell ; it is vitrinous also. The animal, except the liver, is white, showing the black eyes on very short stalks, the rostrum, and the tentacles, which are much shorter and stouter in proportion than in the adult animal.

I hope to be able to continue relative observations on the other species of *Potamopyrgus* next spring.

Psyra godeti, mihi (infested by Trematodes). Plate XVII., fig. 9.

It is a well-known fact that molluscs are sometimes infested by parasites, but up to the present those of the land-molluscs, being of greater scarcity, are not much known. Baudon mentions a sporocyst, *Leucochloridium paradoxum*, as being found in the large tentacles of *Succinea*, which is transformed in different birds, who feed on *Succinea*, into *Distoma macrostoma*. Dujardin has found several species of *Distoma* in the intestines of Helices and Limaces.

When dissecting a specimen of *Psyra godeti*, from Sealy Range, I found in the abdomen about twenty very small trematodes of a whitish colour. A closer examination showed this animal to be a *Distoma* (Pl. XVII., fig. 9) of a lanceolate form, faintly horny under the microscope, with a central cup, about 0·08in. (2mm.) long and 0·02in. (0·5mm.) broad. For want of literature I am unable to say whether it is a new species or not, but I think the fact of a *Distoma* living in a New Zealand Helix is now recorded for the first time. Further investigations in this direction might furnish some very interesting results.

In my last paper on "New Species of New Zealand Land and Fresh-water Shells" I proposed the name of *Huttonella* to be given to a group including *Helix leioda*, Hutt., *pseudoleioda*, *wairarapa*, *hectori*, *microundulata*, and *aorangi*, mihi (Trans. N.Z. Inst., xxii., p. 224). Since writing that I see that Pfeiffer has already (1855) given the name of *Huttonella* to a group of the genus *Ennea*, H. and A. Adams; I therefore withdraw it, proposing the name *Maoriana* instead, this group being endemic to New Zealand.

EXPLANATIONS OF PLATES XVI.-XVIII.

Plate XVI.

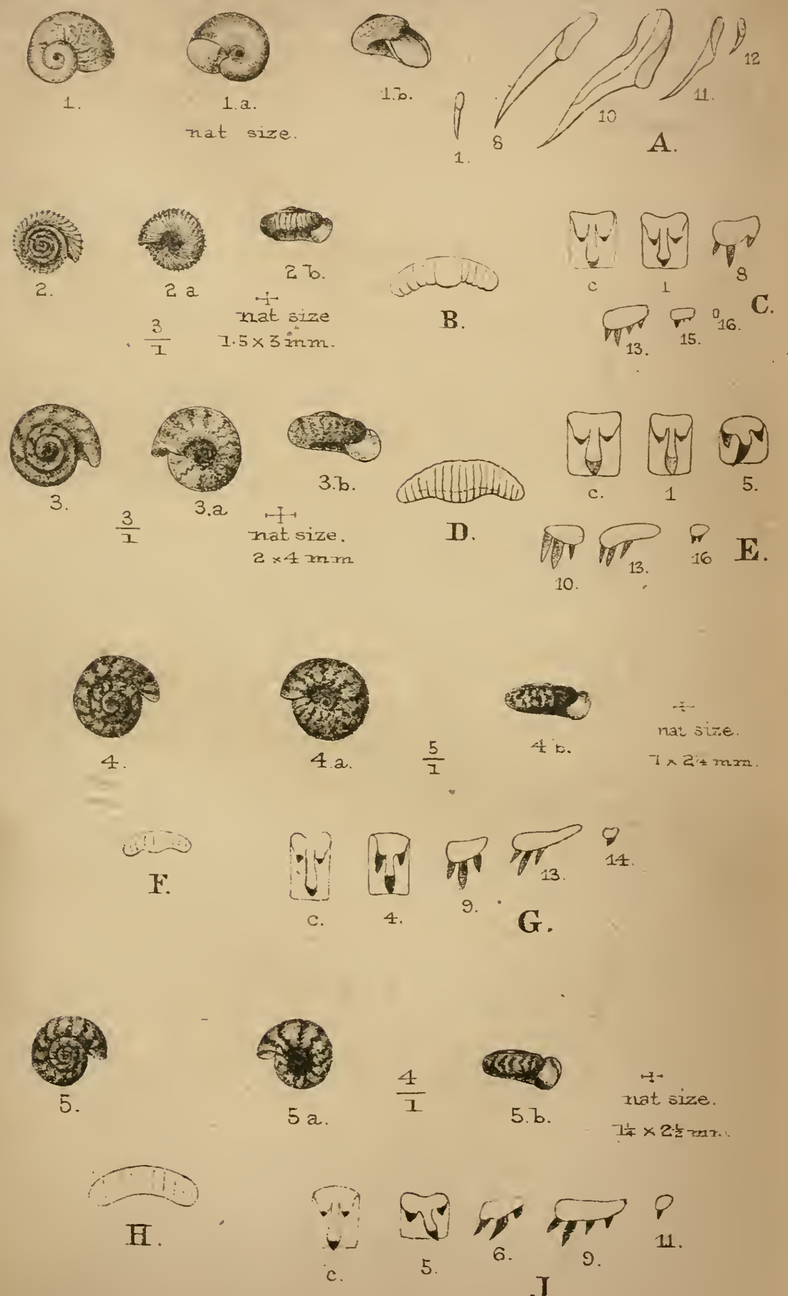
Fig. 1. *a*, *b*. *Rhytida meesoni*, mihi.
„ A. „ „ teeth, × 120.
Fig. 2. *a*, *b*. *Patula mutabilis*, mihi.
„ B. „ „ „ jaw.
„ C. „ „ „ teeth, × 720.
Fig. 3. *a*, *b*. „ *sterkiana*, mihi.
„ D. „ „ „ jaw.
„ E. „ „ „ teeth, × 480.
Fig. 4. *a*, *b*. „ *brouni*, mihi.
„ F. „ „ „ jaw.
„ G. „ „ „ teeth, × 720.
Fig. 5. *a*, *b*. „ *serpentinula*, mihi.
„ H. „ „ „ jaw.
„ J. „ „ „ teeth, × 720.

Plate XVII.

Fig. 6. *a*, *b*. *Patula cremita*, mihi.
„ K. „ *bianca*, Hutt., v. *montana*, mihi, jaw.
„ L. „ „ „ „ „ teeth, × 720.
Fig. 7. *a*, *b*. *Pitys cryptobidens*, mihi.
„ c. „ „ „ aperture with lamellæ.
„ M. „ „ „ jaw.
„ N. „ „ „ teeth, × 720.
Fig. 8. *a*, *b*. *Psyra godeti*, mihi.
Fig. 9. *Distoma*, found in *Psyra godeti*.
„ O. *Psyra godeti*, mihi, jaw.
„ P. „ „ teeth, × 480.

Plate XVIII.

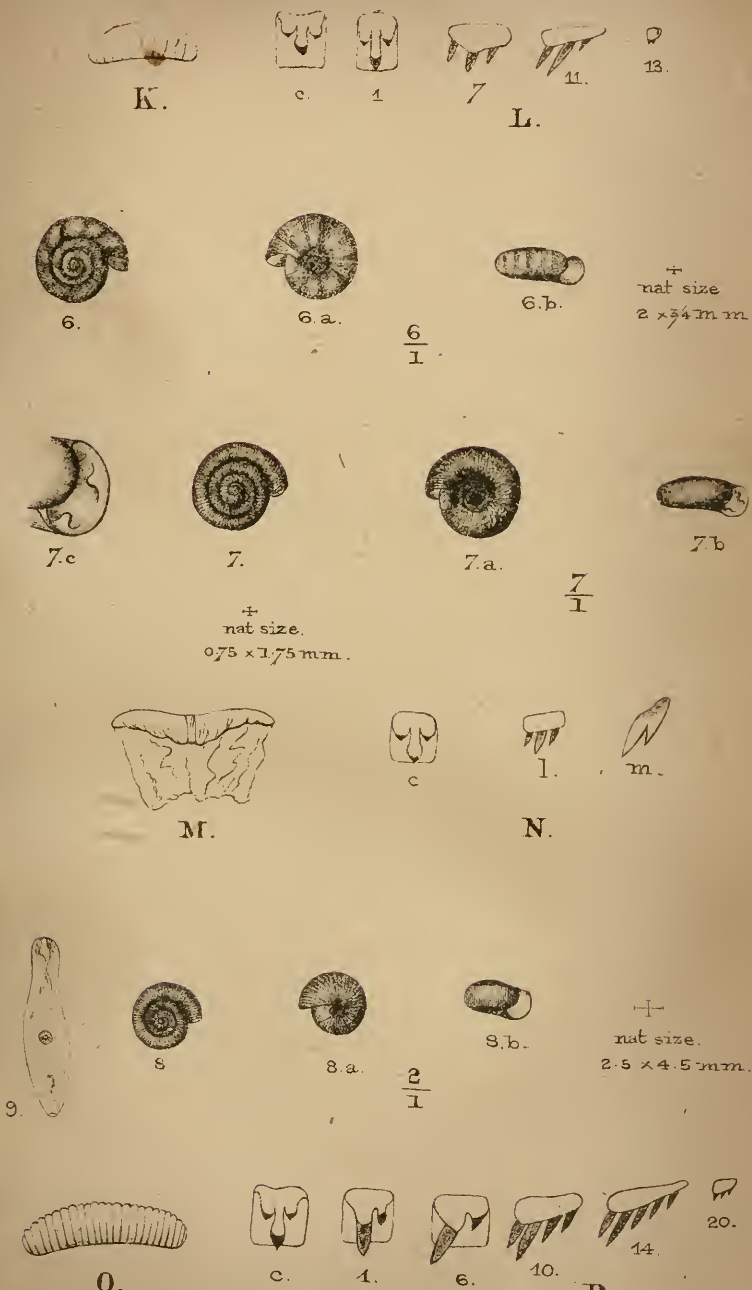
Fig. 10. *a*, *b*. *Amphidoxa feredayi*, mihi.
„ Q. „ „ jaw.
„ R. „ „ teeth, × 480.
Fig. 11. *a*, *b*. *Phrixgnathus acanthinulopsis*, mihi.
„ S. „ „ part of jaw.
„ T. „ „ teeth, × 480.
Fig. 12. *a*, *b*, *c*. *Amphipeplea ampulla*, Hutt., v. *globosa*, mihi.
Fig. 13. *a*, *b*, *c*. *Potamopyrgus corolla*, Gould. One day old.



H. S. del.

C.H.P. lith.

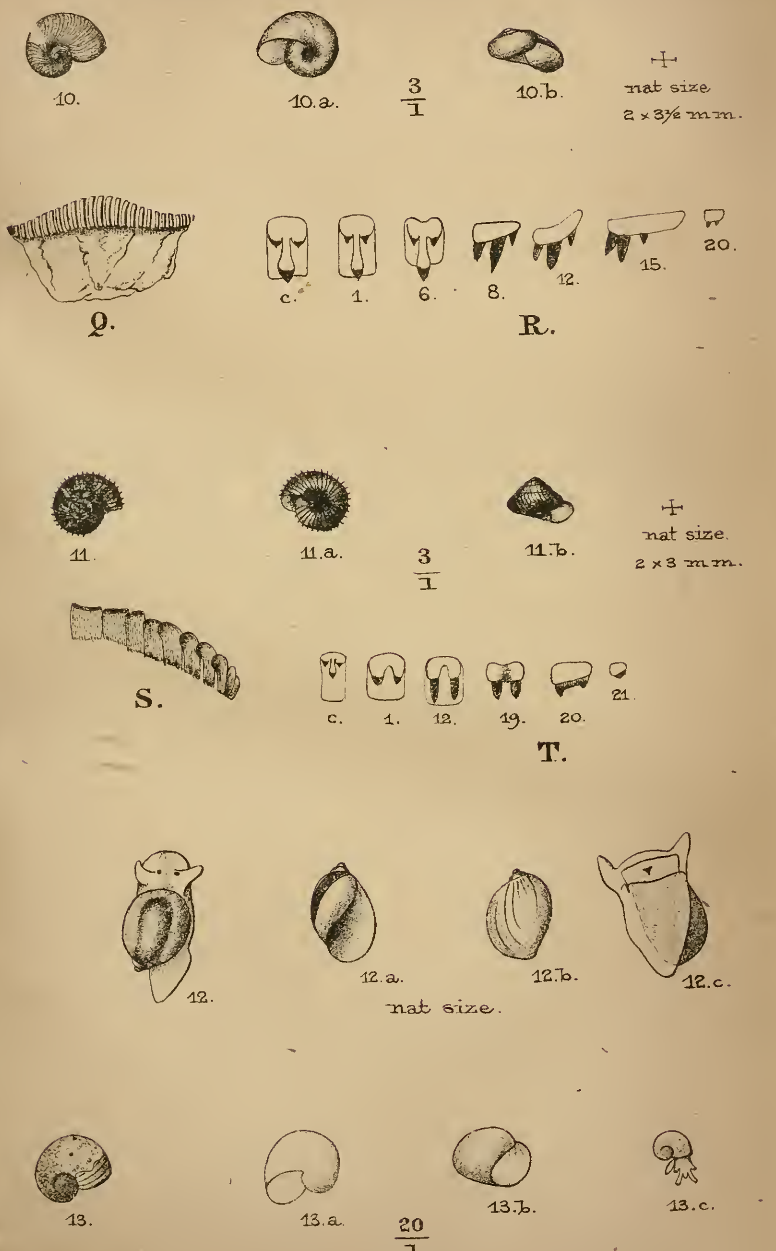
NEW ZEALAND LAND & FRESH-WATER SHELLS.



H.S. del.

C.H.P. lith.

NEW ZEALAND LAND & FRESH-WATER SHELLS.



H.S. del. C.H.P. lith.

NEW ZEALAND LAND & FRESH-WATER SHELLS.

Art. XI.—*New Species of* Lepidoptera.

By E. Meyrick, B.A., F.Z.S.

[*Read before the Philosophical Institute of Canterbury, 6th November, 1890.*]

The following eight new species of New Zealand *Lepidoptera* were all taken in the neighbourhood of Wellington by Mr. G. V. Hudson, and I am indebted to his kindness for the specimens which I have described; he himself possesses other similar specimens.

LARENTIADÆ.

Pasiphila dryas, n. sp.

♂. 25mm. Head, palpi, thorax, and abdomen light reddish-brown irrorated with blackish; palpi 2½. Antennæ light fuscous, ciliated with long fascicles (4). Legs dark fuscous, apex of joints whitish. Forewings with hindmargin bowed, oblique, crenulate, slightly sinuate above anal angle; rather light reddish-brown; numerous curved waved cloudy dark fuscous transverse lines, somewhat marked with black on veins; anterior edge of median band from ⅖ of costa to ⅖ of inner margin, shortly angulated near costa; posterior edge from before ¾ of costa to ¾ of inner margin, forming a broadly-triangular projection in middle; a faint pale waved subterminal line, forming a whitish dot above anal angle: cilia pale brownish, irrorated with dark fuscous. Hindwings with hindmargin unevenly rounded, crenulate, sinuate above middle and above anal angle; light reddish-brown, irrorated with dark fuscous, forming obscure waved transverse lines; a blackish hindmarginal line; cilia as in forewings.

One specimen.

TORTRICIDÆ.

Adoxophyes camelina, n. sp.

♀. 20mm. Head and thorax whitish-ochreous, reddish-tinged. Palpi 4½, grey, becoming ochreous-whitish towards base. Antennæ whitish-ochreous, dotted with blackish above. (Abdomen broken.) Legs whitish, anterior pair partially infuscated. Forewings oblong, costa very strongly arched on anterior half, thence rather deeply sinuate posteriorly, apex obtuse, hindmargin sinuate beneath apex, hardly oblique, rounded beneath; ferruginous, suffused with purplish-fuscous towards costa; a whitish-ochreous streak along costa from before middle to ¾, attenuated to a point at extremities (appearing to exaggerate costal sinuation): cilia ferruginous, mixed with dark fuscous. Hindwings whitish, posteriorly faintly ochreous-tinged, with faint traces of greyish speckling.

One specimen. The generic position requires to be confirmed by the knowledge of the ♂.

CONCHYLIDIDÆ.

Heterocrossa charaxias, n. sp.

♂ ♀. 15mm. Head, thorax, and abdomen white. Palpi in ♂ moderate, in ♀ long; lower half dark fuscous, upper half white. Antennæ whitish. Legs dark fuscous, apex of joints and posterior pair whitish. Forewings elongate, narrow-oblong, costa moderately arched, apex round-pointed, hindmargin slightly sinuate, very oblique; white, densely irrorated with pale fuscous-grey; a short fine black curved streak beneath costa near base, its extremities touching costa at base and $\frac{1}{7}$; a black dot above inner margin near base; costa marked with seven fuscous dots; a short oblique black bar in disc before $\frac{1}{3}$, parallel to hindmargin; a black dot beneath costa at $\frac{1}{4}$, and several scattered black dots or short marks in disc, preceding tufts; an angulated transverse series of irregular black dots near hindmargin, obsolete at extremities; usually a series of indistinct black hindmarginal dots: cilia white, densely irrorated with pale fuscous-grey, with a faint darker line. Hindwings and cilia whitish.

Three specimens. The species is closely allied to *H. cryodana* and *H. epomiana*, but appears to be certainly distinct from both, and constant.

DEPRESSARIADÆ.

Phæosaces liochroa, n. sp.

♂ ♀. 24–27mm. Head and thorax pale ochreous or reddish-ochreous. Palpi and antennæ whitish-ochreous. Abdomen pale whitish-ochreous. Legs ochreous-whitish, anterior pair infuscated. Forewings moderate, suboblong, in ♂ somewhat dilated posteriorly, costa moderately arched, apex rounded-obtuse, hindmargin slightly oblique, rounded beneath; light brownish-ochreous, in ♀ partially or wholly suffused with deep reddish-ochreous and more or less (sometimes densely) sprinkled with dark fuscous; costal edge bright ferruginous; an indistinct dark fuscous dot in disc at $\frac{2}{5}$, a second on fold directly beneath first, and a third in disc at $\frac{2}{3}$, all sometimes very obscure; a very strongly outwards-curved and bent series of blackish dots from $\frac{2}{3}$ of costa to $\frac{3}{4}$ of inner margin, more or less obsolete towards extremities; a much interrupted blackish hindmarginal line: cilia pale reddish-ochreous, above apex ferruginous. Hindwings pale whitish-ochreous, more tinged with pale yellowish-ochreous posteriorly; inner margin broadly suffused with rather dark grey; some dark grey scales on hindmargin; cilia pale whitish-ochreous.

Three specimens.

PLUTELLIDÆ.

Dolichernis, n. g.

Head rough on crown, face smooth; ocelli present; tongue well developed. Antennæ over 1, in ♂ — (?), basal joint moderate, without pecten. Labial palpi long, smooth, recurved, second joint tolerably slender, terminal joint as long as second, acute. Maxillary palpi rudimentary. Posterior tibiæ shortly rough-haired above, more strongly beneath. Forewings with vein 1 long-furcate, 2 from near angle, 3 and 4 from a point, 7 absent, 8 and 9 stalked, 11 from before middle. Hindwings 1, elongate-ovate, cilia $\frac{1}{2}$; veins 3 and 4 from a point, 5 remote, 6 and 7 parallel.

A peculiar genus of somewhat uncertain location, not closely approaching any other known to me.

Dolichernis chloroleuca, n. sp.

♀. 16mm. Head, palpi, antennæ, thorax, abdomen, and legs ochreous-whitish; anterior and middle legs banded with dark fuscous. Forewings elongate, rather narrow, costa moderately arched, apex tolerably pointed, hindmargin slightly sinuate, oblique; pale whitish-ochreous, with a few scattered fuscous scales; a cloudy irregular elongate dark fuscous dot beneath costa near base, two obliquely placed in disc at $\frac{1}{4}$, four forming a straight oblique series from middle of disc to before middle of inner margin, and two transversely placed in disc above anal angle: cilia ochreous-whitish, with a small black spot at apex. Hindwings and cilia whitish.

One specimen; unfortunately it is in somewhat poor condition, but I believe the characters given are essentially correct.

TINEIDÆ.

Decadarchis, Meyr.

Head rough-haired; ocelli present; no tongue. Antennæ $\frac{4}{5}$, in ♂ — (?), basal joint moderate, with small pecten. Labial palpi moderate, straight, porrected, second joint with rather long projecting scales beneath and some apical bristles above, terminal joint shorter than second, obtuse. Maxillary palpi moderately long, filiform. Posterior tibiæ clothed with very long hairs above. Forewings with vein 1 furcate, 2 from rather near angle, 5 absent, 7 absent, 11 from before middle of cell, apex of wing bent up. Hindwings 1, lanceolate, cilia $\frac{2}{3}$–1; veins 3 and 4 remote, 5 and 6 stalked, 6 to costa.

Defined originally to include a species from the South Pacific islands, with which the following agrees entirely in essential structure, although differing much in superficial appearance. The genus belongs to the group of *Erechthias*, which I formerly separated as a distinct family (*Erechthiadæ*), but I am now of opinion that, although a very natural group, it cannot be kept separate from the *Tineidæ*.

Decadarchis monastra, n. sp.

♀. 10mm. Head fuscous, face whitish-fuscous. Palpi, antennæ, thorax, abdomen, and legs dark fuscous, apex of tarsal joints whitish-ochreous. Forewings lanceolate; dark fuscous, strewn with blackish scales with ochreous-whitish tips; a moderate rather irregular whitish-ochreous spot on costa beyond middle: cilia rather dark fuscous, mixed with blackish round apex. Hindwings rather dark bronzy-fuscous; cilia fuscous.

One specimen; it is not in good condition, but is so distinct as to be easily recognisable.

Sagephora steropastis, n. sp.

♂. 11mm. Head white, lower part of face and two streaks on crown dark fuscous. Palpi blackish, terminal joint white with a black subbasal ring. Antennæ ochreous-white, obscurely dotted with dark fuscous, with a dark fuscous band about $\frac{3}{4}$. Thorax blackish, with three longitudinal streaks and inner half of patagia white. Abdomen grey. Legs blackish, ringed with whitish (posterior pair broken). Forewings elongate, costa gently arched, apex round-pointed, hindmargin extremely obliquely rounded; blackish-fuscous; a very irregular pale ochreous streak from base along fold to $\frac{1}{3}$, thence along inner margin to near anal angle; from apex of this proceeds a zigzag ochreous-whitish line near hindmargin to costa at $\frac{5}{6}$: cilia whitish-fuscous, towards base barred with dark fuscous and whitish. Hindwings grey; cilia pale grey.

One specimen. Although *S. phortegella* varies much, I have not seen any form at all nearly approaching this.

LYPUSIDÆ.

Mallobathra homalopa, n. sp.

♂. 14mm. Head, palpi, antennæ, thorax, and abdomen dark fuscous; palpi short; antennal ciliations 3. Legs dark fuscous, ringed with whitish-ochreous. Forewings elongate, moderate, costa gently arched, sinuate in middle, apex rounded, hindmargin very obliquely, slightly rounded; dark fuscous; a subquadrate pale brownish-ochreous spot on inner margin before middle, and a smaller one before anal angle: cilia dark fuscous. Hindwings and cilia dark fuscous.

One specimen. It comes nearest to *M. cratæa*, but differs from that species by the absence of costal spots and of pale irroration.

BOARMIADÆ.

BOARMIA, Tr.

I have been led to modify my conclusions with regard to some of the species in this genus by the examination of a number of specimens sent by Mr. A. Purdie, of Dunedin, and of those in the British Museum collection; the group is certainly puzzling from the great variability of most of the species, but I think the following alterations may be made:—

Boarmia rudiata, Walk. (*Cidaria rudisata*, Walk., 1420; *Boarmia astrapia*, Meyr., Trans. N.Z. Inst., 1889, 218.)

Walker's name, which I had overlooked on account of the bad condition of the specimen, should, I think, be substituted for mine: but I have altered its extraordinary orthography.

Boarmia suavis, Butl.

The species described by me as *B. lupinata*, Feld., appears not to be the true *lupinata*; it must therefore bear the above name, and *usitata*, Butl., is correctly referred as a synonym of it. It is a very variable insect, but is usually easily recognisable by the characteristic form of the second line. When dark longitudinal streaks are present, they lie on the submedian fold, and not along the inner margin itself.

Boarmia lupinata, Feld.

This appears to be a good species, distinct from any other. I do not possess a specimen, but have seen two or three from Dunedin. It is somewhat larger than the last, with the forewings of rather a peculiar light brownish-grey colour (perhaps variable), indistinctly marked somewhat as in *B. rudiata*, with a dark streak along the inner margin, and the subterminal line appearing (through its conjunction with a pale apical streak) to terminate in apex.

Art. XII.—*Revised List of the Marine* Bryozoa *of New Zealand.*

By Professor F. W. Hutton.

[*Read before the Philosophical Institute of Canterbury, 2nd October, 1890.*]

The first list of New Zealand *Bryozoa*, or *Polyzoa*, was that by Dr. J. E. Gray in the Appendix to Dieffenbach's "New Zealand," which contains only ten species. Many others, collected chiefly by Dr. Lyall, were afterwards described by Mr. Busk in his "Catalogue of the *Polyzoa* of the British Museum" (referred to in the list as B.M.C.), and these, together with others collected by myself, were catalogued first in the "Catalogue of the Marine Mollusca of New Zealand," 1873 (referred to as C.M.M.), and later in the "Manual of New Zealand Mollusca," 1880 (referred to as N.Z. Cat.), both published by the Geological Survey Department at Wellington. Since then several species from New Zealand have been described by Mr. Hincks in the "Annals and Magazine of Natural History," and by Mr. Waters in the Journal of the Geological Society of London, and the classification of the whole has been much modified. A nearly complete collection of my types has also been submitted to Miss Jelly for comparison and identification, and thus many corrections have been made. These I have embodied in the present list, which may therefore be looked upon as generally accurate, but probably several corrections will still have to be made, and no doubt there are many more species as yet unrecorded.

It will be noticed that several of my new species of 1873 have been redescribed and renamed by Mr. Hincks or by Mr. Waters. In all these cases my names must be taken as synonyms, for the descriptions were not accompanied by figures.

In making out this list I have freely used Miss E. C. Jelly's "Synonymic Catalogue of Marine *Bryozoa;*" in fact, I have waited for the publication of this book before attempting to correct my former mistakes.

Sub-order CHEILOSTOMATA.

Catenicella ventricosa, Busk, B.M.C., i., 7.
" hastata, Busk, B.M.C., i., 7; *C. bicuspis*, Gray, in Dieff. N.Z., ii., 293.
" cribraria, Busk, B.M.C., i., 9.
" margaritacea, Busk, B.M.C., i., 9.
" perforata, Busk, B.M.C., i., 9.
" ringens, Busk, B.M.C., i., 10.

CATENICELLA ELEGANS, Busk, B.M.C., i., 10.
„ CORNUTA, Busk, B.M.C., i., 11.
„ CARINATA, Busk, B.M.C., i., 12.
„ SCUTELLA, Hutton, N.Z. Cat., 181; *C. alata*, Hutt., C.M.M., 89; *non* Wyv. Th.
„ CRYSTALLINA, Wyv. Th., Nat. Hist. Rev., 1858.
CLAVIPORELLA GEMINATA, Wyv. Th., Nat. Hist. Rev., 1858 (*Catenicella*).
„ AURITA, Busk, B.M.C., i., 8 (*Catenicella*).
ÆTEA DILATATA, Busk, B.M.C., i., 31.
CELLULARIA CUSPIDATA, Busk, B.M.C., i., 19; *C. monotrypa*, Busk, Voy. "Rattlesnake."
MENIPEA CIRRATA, Lamx. (*Cellaria*), Busk, B.M.C., i., 21.
„ BUSKII, Wyv. Th., Nat. Hist. Rev., 1858.
„ CRYSTALLINA, Gray, in Dieff. N.Z., ii., 293 (*Emma*); Busk, B.M.C., i., 28.
„ TRICELLATA, Busk, B.M.C., i., 28 (*Emma*).
SCRUPOCELLARIA SCRUPEA, Busk, B.M.C., i., 24.
CABEREA TEXTA, Lamk. (*Cellaria*); *C. grandis*, Hincks, A.M.N.H., 5, viii., 50.
„ LYALLII, Busk, "Challenger," xxx., 29; *C. boryi*, Hutt., N.Z. Cat., 185; *non* Audouin.
„ ROSTRATA, Busk, "Challenger," xxx., 28; *Selbia zelanica*, Gray, in Dieff. N.Z., ii., 292.
BEANIA ELONGATA, Hincks, A.M.N.H., 5, xv., 244 (*Diachoris*).
„ MAGELLANICA, Busk, B.M.C., i., 54 (*Diachoris*).
„ INERMIS, Busk, B.M.C., i., 54 (*Diachoris*).
„ BILAMINATA, Hincks, A.M.N.H., 5, vii., 44 (*Diachoris*); *Flustra papyracea*, Hutt., N.Z. Cat., 187; *non* Ellis.
BICELLARIA TUBA, Busk, B.M.C., i., 42.
BUGULA NERITINA, Linn. (*Sertularia*); Busk, B.M.C., i., 44.
„ DENTATA, Lamx. (*Acamarchis*); Busk, B.M.C., i., 46.
„ PRISMATICA, Gray, in Dieff. N.Z., ii., 292; *non* Hutt., N.Z. Cat., 186.
„ JOHNSTONIÆ, Gray, in Dieff. N.Z., 292 (*Halophila*).
„ AVICULARIA, Linn. (*Sertularia*); Busk, B.M.C., i., 45; *Halophila johnstoniæ*, Hutt.; N.Z. Cat., 186; *non* Gray.
CELLARIA MALVINENSIS, Busk. B.M.C., i., 19
„ SETIGERA, Desmarest; *S. hirsuta*, Busk, "Challenger," xxx., 87; *Onchopora hirsuta*, Hutt., N.Z. Cat., 184; *non* Lamouroux.
TUBUCELLARIA HIRSUTA, Lamx. (*Cellaria*); Busk, "Challenger," xxx., 100; *C. barbata*, Lamk.; *Margaretta barbata*, Hutt., N.Z. Cat., 196; *Margaretta cereoides*, Gray, in Dieff. N.Z., ii., 293.

TUBUCELLARIA OPUNTIOIDES, Pallas (*Cellularia*); *T. cereoides*, var., Busk, "Challenger," pl. xxiv., fig. 7; *S. farciminoides*, Hutt., N.Z. Cat., 184; *non* Johnston.
FLUSTRA EPISCOPALIS, Busk, B.M.C., i., 52 (*Carbasea*).
„ INDIVISA, Busk, B.M.C., i., 53 (*Carbasea*).
„ „ (Bk.), var. CYATHIFORMIS, McGill, Trans. Phil. Inst. Vict., 1859, 97.
FARCIMINARIA ACULEATA, Busk, B.M.C., i., 33.
„ BLAINVILLII, Lamx. (*Elzerina*); Gray, in Dieff. N.Z., ii., 293.
CALWELLIA BICORNIS, Wyv. Th., Nat. Hist. Rev., 1858.
DIMETOPIA SPICATA, Busk, B.M.C., i., 35.
„ CORNUTA, Busk, B.M.C., i., 35.
MEMBRANIPORA MEMBRANACEA, Linn. (*Flustra*); Busk, B.M.C., ii., 56.
„ PILOSA, Linn. (*Flustra*); Busk, B.M.C., ii., 56.
„ LINEATA, Linn. (*Flustra*); Busk, B.M.C., ii., 58.
„ SPINOSA, Quoy and Gaimard (*Flustra*); Waters, A.M.H.N., 5, xx., 181.
„ TRIFOLIUM, S. Wood (*Flustra*); Busk, Crag. Pol., 32.
„ ROBORATA, Hincks, A.M.N.H., 5, viii., 69; *Carbasea pisciformis*, Hutt., N.Z. Cat., 187; *non* Busk.
„ SOLIDULA, Hincks, Brit. Mar. Pol., 158; Waters, Quar. Jour. Geol. Soc., 43, 46.
„ VALDEMUNIATA, Hincks, A.M.N.H., 5, xv., 248; *M. tessellata*, Hutt., C.M.M., 96; *M. monostachys*, Waters, Quar. Jour. Geol. Soc., 43, 45; *non* Busk.
„ HIANS, Hincks, A.M.N.H., 5, xv., 248; *M. cyclops*, Hutt., N.Z. Cat., 190; *non* Busk.
„ HIANS (Hks.), var. OCCULTATA, Waters, Quar. Jour. Geol. Soc., 43, 48.
„ PURA, Hincks, A.M.N.H., 5, vi., 15.
„ ACUTA, Hincks, A.M.N.H., 5, xv., 249.
„ BRUNNEA, Hutton, C.M.M., 96.
„ MAORICA, Stoliczka, Voy. "Novara," 153 (*Vincularia*).
MONOPORELLA CRASTATINA, Waters, Quar. Jour. Geol. Soc., 38, 270; *Lepralia grandis*, Hutt., C.M.M., 98.
„ DISJUNCTA, Manzoni, Bry. Plioc. It., i., 5; *Lepralia urceolata*, Hutt., C.M.M., 97.
STEGANOPORELLA NEOZELANICA, Busk, Quar. Jour. Micro. Soc., n.s., i., 155 (*Vincularia*).

Steganoporella magnilabris, Busk, B.M.C., ii., 62 (*Membranipora*).

Micropora lepida, Hincks, A.M.N.H., 5, viii., 59; Waters, Quar. Jour. Geol. Soc., 43, 51.

" elongata, Hincks, A.M.N.H., 5, ix., 86; *M. variperforata*, Waters, Quar. Jour. Geol. Soc., 43, 51.

Microporella ciliata, Pallas (*Eschara*); *Lepralia ciliata*. Busk, B.M.C., ii., 73.

" decorata (Reuss), var. angustipora, Hincks, A.M.N.H., 5, xv., 249.

" malusii, Audouin; *Lepralia malusii*, Busk, B.M.C., ii., 83.

" malusii (Aud.), var. disjuncta, Hincks, A.M.N.H., 5, xv., 249.

" yarraensis, Waters, Quar. Jour. Geol. Soc., 37, 331; *Eschara lichenoides*, Busk, B.M.C., ii., 90; *non* Milne-Edwards.

" pellucida, Hutton, C.M.M., 97.

Mucronella præstans, Hincks, A.M.N.H., 5, x., 99; *L. angela*, Hutt., C.M.M., 96; *M. duplicata*, Waters, Quar. Jour. Geol. Soc., 37, 328.

" biincisa (Wts.), var. bicuspis, Hincks, A.M.N.H., 5, xi., 110.

" diaphana (McGill), var. armata, A.M.N.H., 5, x., 98.

" tricuspis, Hincks, A.M.N.H., 5, viii., 66.

" variolosa, Johnston, Brit. Zooph., 278 (*Lepralia*); Busk, B.M.C., ii., 75.

Smittia napierii, Waters, A.M.N.H., 6, iv., 17.

" reticulata, J. McGill, A.M.N.H., ix., 467 (*Lepralia*), 1842.

" unispinosa, Waters, A.M.N.H., 6, iv., 15; *Hemeschara fairchildi*, Hutt., C.M.M., 100.

Porella malleolus, Hincks, A.M.N.H., 5, xiii., 361.

Lepralia cincta, Hincks, A.M.N.H., 5, xv., 254; *L. pertusa*, Hutt.; *non* Busk.

" flexuosa, Hutton, C.M.M., 99 (*Eschara*).

" foraminigera, Hincks, A.M.N.H., 5, xi., 109; *non* Heller.

" lyallii, Busk, B.M.C., ii., 75.

" poissonii, Audouin (*Flustra*); Hincks, A.M.N.H., 5, viii., 63.

" rectilineata, Hincks, A.M.N.H., 5, xi., 110; *Lepralia vellicata*, Hutt., C.M.M., 98.

Retepora cellulosa, Linn.; Busk, C.M.M., ii., 93. (?)

Membraniporella nitida, Johnston, Brit. Zooph., 277 (*Lepralia*); Busk, B.M.C., ii., 76.

CRIBRILINA MONOCEROS, Busk, "Challenger," xxx., 133; *Eschara unicornis*, Hutt., C.M.M., 99.

HASWELLIA AURICULATA, Busk, "Challenger," xxx., 173 (*Tessaradoma*); *Porina grandiporosa*, Waters, Quar. Jour. Geol. Soc., 43, 59; *Pustulipora porcellanica*, Hutt., C.M.M., 102.

HIPPOTHOA FLAGELLUM, Manzoni, Bry. Plioc. It., iv., 6; *H. distans*, Hincks, A.M.N.H., 5, viii., 62.

SCHIZOPORELLA AREOLATA, Busk, B.M.C., ii., 82 (*Lepralia*).

" BIAPERTA, Michelin (*Eschara*), Hincks, Brit. Mar. Pol., 255.

" BISERIALIS, Hincks, A.M.N.H., 5, xv., 250.

" CINCTIPORA, Hincks, A.M.N.H., 5, xi., 109.

" CINCTIPORA (Hks.), var. PERSONATA, Waters, Quar. Jour. Geol. Soc., 43, 67.

" CIRCINATA, McGill, Cat. Mar. Pol. Victoria, 1887 (*Lepralia*).

" CRIBRILIFERA, Hincks, A.M.N.H., 5, xv., 250.

" HYALINA. Linn. (*Cellepora*); Busk, B.M.C., ii., 84 (*Lepralia*); *Diachoris buskiana*, Hutt., C.M.M., 94.

" HYALINA (L.), var. CORNUTA, Busk, B.M.C., ii., 84 (*Lepralia*); *L. cancer*, Hutt., C.M.M., 97.

" MARSUPIFERA, Busk, "Challenger," xxx., 165.

" SCINTILLANS, Hincks. Specimen so named sent by Miss Jelly.

CELLEPORA BISPINATA, Busk, B.M.C., ii., 87.

" CORONOPUS, S. Wood; *C. tubigera*, Busk, Crag. Pol., 60; *C. pumicosa*, Hutt., N.Z. Cat., 193; *non* Linn.

" MAMILLATA, Busk, B.M.C., ii., 87.

" POSTULATA, Busk, "Challenger," xxx., 200.

" AMPLIATA, Hutton, C.M.M., 99.

" AGGLUTINANS, Hutton, C.M.M., 99.

Sub-order CYCLOSTOMATA.

CRISIA DENTICULATA (M.-Ed.), var. PATAGONICA, d'Orb.; Busk, B.M.C., iii., 8.

" EDWARDSIANA, d'Orb. (*Crisidia*); Busk, B.M.C., iii., 5.

IDMONEA MILNEANA, d'Orb.; *I. giebeliana*, Stoliczka, Voy. "Novara," 115.

" RADIANS, Lamk. (*Retepora*), Busk, B.M.C., iii., 11.

" RAMOSA, d'Orb. (*Reptotubigera*), Waters, Quar. Jour. Geol. Soc., 43, 339.

IDMONEA SERPENS, Linn. (*Tubipora*); Busk, B.M.C., iii., 25 (*Tubulipora*); *Alecto disposita*, Hutt., C.M.M., 103.

CRISINA HOCHSTETTERIANA, Stoliczka, Voy. "Novara," 113 (*Idmonea*).

ENTALOPHORA RARIPORA, d'Orb.: *E. haastiana*, Stoliczka, Voy. "Novara," 102.

" INTRICARIA, Busk, B.M.C., iii., 22 (*Pustulipora*).

" PURPURASCENS, Hutton, Trans. N.Z. Inst., ix., 361 (*Pustulipora*).

CINCTIPORA ELEGANS, Hutton, C.M.M., 103.

DIASTOPORA PATINA, Lamk. (*Tubulipora*); *T. patellata*, Gray, in Dieff. N.Z., ii., 295.

" PERANGULATA, Waters, Quar. Jour. Geol. Soc., 43, 343.

TUBULIPORA BIDUPLICATA, Waters, Quar. Jour. Geol. Soc., 43, 343.

" GLOMERATA, Hutton, C.M.M., 103.

STOMATOPORA RACEMOSA, Hutton, C.M.M., 103 (*Alecto*).

HORNERA FOLIACEA, McGill; Busk, B.M.C., iii., 19; *H. gouldiana*, Busk, Crag. Pol., 95.

" STRIATA, Stoliczka, Voy. "Novara," 107.

FASCICULARIA TUBIPORA, Busk, Crag. Pol., 130; Waters, Quar. Jour. Geol. Soc., 43, 344.

SUPERCYSTIS DIGITATA, d'Orb.; Busk, B.M.C., iii., 37 (*Fasciculipora*).

LICHENOPORA HOLDSWORTHII, Busk, B.M.C., iii., 33 (*Discoporella*); *D. ciliata*, Hutt.; *non* Busk.

" NEOZELANICA, Busk, B.M.C., iii., 32 (*Discoporella*).

DEFRANCHEIA DENTATA, Hutton, N.Z. Cat., 199.

HETEROPORA PELLICULATA, Waters, Jour. Micro. Soc., ii., 390; *H. neozelanica*, Busk, Nicholson, A.M.N.H., 5, vii., 329; *Millepora undulosa*, Ten.-Woods, Trans. N.Z. Inst., xi., 345.

Sub-order CTENOSTOMATA.

FLUSTRELLA BINDERI, Harvey (?): Busk, Quar. Jour. Micro. Soc., i., 156 (*Farciminaria*); *Muscaria armata*, Hutt., C.M.M., 93; *Verrucularia binderi*, Busk, "Challenger," xxx., 48.

AMATHIA SWAINSONI, Hutton, C.M.M., 91 (*Beania*).

Art. XIII.—*Note on the Breeding Habits of the European Sparrow* (Passer domesticus) *in New Zealand.*

By T. W. Kirk, F.R.M.S., F.L.S.

[*Read before the Wellington Philosophical Society, 2nd July, 1890.*]

It is my ambition to lay before the society at a future meeting a complete history of the sparrow in New Zealand, its introduction, distribution, rate of increase, the various influences affecting that increase, such as climate, food, &c., together with a quantity of evidence both as to its insectivorous and grain-devouring proclivities, its influence upon the various branches of horticulture, and the means of checking the too-rapid increase, &c.

Being struck with the spirit of partisanship which pervaded most discussions on the so-called sparrow question, I some years ago decided to collect all the obtainable evidence having any possible bearing on the subject, with the result that a large mass of material has accumulated in my hands. But, on attempting to work it up, I found that much more must be done before the history can be considered complete, and a fair and impartial judgment given. For instance, I have the opinions of many persons on the question of whether the sparrow does more harm than good to agriculture; but mere opinions, unless backed by evidence, do not carry much weight, and the point can be settled only by the examination of large numbers of specimens. I have myself dissected fifty-three birds, taken at all seasons of the year, and am forced to admit that the remains of insects found in them constituted but a very small proportion of the total food. I may mention that a record has been kept of the sex and contents of each of the birds obtained; but some hundreds, captured systematically at various seasons and in various localities, will be required before a reliable "food table" can be constructed. So with regard to the rate at which they have spread and are spreading over the country, I find my notes from several districts incomplete. More detailed information is required as to their treatment of fruit.

The account of the most approved methods adopted in other countries for keeping their numbers somewhat within bounds is, I think, tolerably complete. But further inquiry is necessary as to how far our native birds are injuriously affected by the all-pervading sparrow. I have therefore to-night confined myself to one section of the subject; and the statements, though brief, are the result of numerous inquiries 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 (*C. 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 reappear. The sparrows congregated in groups about the bushes, keeping up a constant chattering and noise, evidently on the look-out 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 required 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, reared 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 around 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:—

First year: 1 pair: 5 broods of 6 each $= 30 - \frac{1}{3} = 20 +$ original pair $= 22 = 11$ pairs.

Second year: 11 pairs $\times 30 = 330 - \frac{1}{3} = 220 = 110$ pairs + original 11 pairs = 121 pairs.

Third year: 121 pairs $\times 30 = 3{,}630 - \frac{1}{3} = 2{,}420 = 1{,}210$ pairs + original 121 pairs = 1,331 pairs.

Fourth year: 1,331 pairs $\times 30 = 39{,}930 - \frac{1}{3} = 26{,}620 = 13{,}310$ pairs + original 1,331 pairs = 14,641 pairs.

Fifth year: 14,641 pairs $\times 30 = 439{,}230 - \frac{1}{3} = 292{,}820 = 146{,}410$ pairs + original 14,641 pairs = 161,051 pairs; or an actual increase, after allowing for deaths, of 322,100 birds.

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.

ART. XIV.—*Note on Blights.*

By JAMES HUDSON, M.B.

[*Read before the Nelson Philosophical Society, 4th March, 1890.*]

Plate VIIIA.

I. DACTYLOPIUS CALCEOLARIÆ.

THE chief point of interest about this was its extreme destructiveness and rapidity of multiplication, equalling that of the Aphides. In the course of six weeks from the time when it was first observed it completely killed a large dolichos covering one side of a house. Syringing with kerosene and soft-soap had apparently no effect.

II. LECANIUM HISPIDUM.

This blight infests orange- and lemon-trees, secretes honeydew, and consequently renders the tree unsightly from the growth of black fungus. I observed a few specimens last summer (1888–89); during the winter they were almost stationary, but about last October they increased enormously, and in January there was not a leaf or bit of stem of one lemon-tree but what was infested with them. One evening last month I observed a small larva eating the crown of one of these *Lecania*, and I am now happy to say that I have since discovered adult lady-birds and numerous larvæ, all of which may be observed preying on the *Lecania*. I have submitted the lady-birds and their larvæ to Mr. G. V. Hudson, of Wellington, who informs me that it is a species of *Rhyzobius*, belonging to the lady-bird family, but not a *Coccinella*. He kindly furnished me with magnified drawings of the larva and perfect insect, which I append.

[NOTE IN JANUARY, 1891.—During the winter, both blight and lady-birds completely disappeared, and the tree now looks as clean and healthy as I could wish it. It is interesting to think where the lady-birds could have come from. They came, did their work, and then disappeared. Mr. G. V. Hudson is corresponding with English entomologists in order to exactly identify the species.]

EXPLANATION OF PLATE VIIIA.

Fig. 1. *Rhyzobius.*
Fig. 2. Larva of same.

Art. XV.—*Takahe* versus *Kakapo*.

By James Park, F.G.S., Lecturer, Thames School of Mines.

[*Read before the Auckland Institute, 4th August, 1890.*]

During various explorations among the mountains and sounds of Otago in the years 1881 and 1888 I collected what I considered evidences of the existence of the takahe (*Notornis mantelli*) at Dusky Sound and the Upper Matukituki Valley, and in a paper which I read before the Wellington Philosophical Society* in October, 1888, I narrated the circumstances which led me to that conclusion.

Mr. E. Melland, in a paper read before the Otago Institute† in August, 1889, dissents from my conclusion, and states in the most positive manner that the mysterious note, which I ascribed to the takahe, was not caused by that bird, but by the male kakapo during the breeding-season. While willing to admit that I may be wrong in my identification, I must state at once that I am not satisfied with Mr. Melland's theory, which is not supported by the experiences of explorers or naturalists who have had ample opportunities of becoming familiar with the habits of New Zealand's "owl-parrot."

Without stopping to discuss the manifestly unfair and unusual tone of Mr. Melland's paper, which is probably due to inexperience in scientific discussion, I will briefly narrate, for the better understanding of my paper, the circumstances which led to my original article on the *Notornis*.

During the summer of 1880–81 I was engaged under Mr. A. McKay, F.G.S., Assistant Geologist, who was making a geological exploration of the Wanaka country. Mr. John Buchanan, F.L.S., also accompanied the party as botanist. On the 20th January, 1881, we proceeded up the south branch of the Matukituki River, and camped at Cascade Creek, behind Mount Aspiring. That evening we were startled by the loud booming note of a strange bird, uttered at short intervals throughout the greater part of the night. Next evening a decoy-fire was lit in the bush near the camp to attract the bird, in the hope of being able to effect its capture; but in this we were unsuccessful, although on several occasions it approached quite close to the fire. We learnt, however, that it was of a curious nature, like many of our New Zealand birds; that its height was certainly less than 20in., judging from the free manner in which it moved below the dense matted scrub; and that its note was so deep and intense as to make the

* Trans. N.Z. Inst., vol. xxi., p. 226.
† Trans. N.Z. Inst., vol. xxii., p. 295.

ground vibrate distinctly for a distance of several yards around.

On the 29th January we shifted camp to the forks of Matukituki, opposite Mount Aspiring, and while camped there we again heard the same strange booming note; but, as before, all efforts to capture its mysterious author were futile. However, on one occasion I caught a passing glimpse of it, and on examining the same place next day I found that it had been scratching in the sand. I also examined its footprints in the soft mud near the bank of the river, and at the time made a sketch of them on a loose slip of paper. I did not mention this latter circumstance in my paper on the takahe because I was unable to lay my hand on the sketch, but I remember quite distinctly that the footprints had a general resemblance to those of the weka. They certainly had no resemblance to the shuffling track of the kakapo.

After a lapse of seven years I again met our booming visitant of the Matukituki Valley. In the beginning of January, 1888, I visited Dusky Sound, and the day after my arrival, while accompanying Mr. Docherty to his pyrrhotine lode on the slopes of Mount Hodge, I heard the old, familiar, but almost forgotten, booming note of 1881. On returning to the hut in the evening my field-hand informed me that while fishing off the point he had heard the boom of the takahe in the direction of Mount Hodge. He said he had been rabbiting on the Mararoa Flat, and had seen and heard the takahe killed there in 1881. Previous to this occasion I had never heard the *Notornis* referred to as the takahe. I considered this circumstantial evidence, and my own previous experience, sufficient to justify me in arriving at the conclusion that the takahe was the author of this mysterious note.

Mr. Melland's case is, I understand, as follows: He has heard, he says, the booming note described by me. He admits its unusual and startling character, and speaks of it as a "powerful and alarming sound," which, he says, he has "heard across the still waters of Lake Te Anau, a distance of five or six miles."* As to the author of this unusual note he professes to have no doubt whatever, the mystery having been solved some years ago by Mr. R. Henry, of Lake Te Anau. It is strange that a "powerful and alarming sound" like this should remain unsolved until the arrival of Mr. Henry, a few years ago, and stranger still that, when solved, it was not thought worth recording.

The kakapo is a comparatively common bird among the sounds and mountains of south-west Otago, and it seems to me inprobable that such a remarkable note should have

* Trans. N.Z. Inst., vol. xxii., p. 298.

escaped the observation of the numerous explorers, prospectors, and naturalists who have scoured that country during the past thirty years. Mr. Melland seems to recognise a difficulty here, and attempts to get over it by assuming, first, that the male kakapo is polygamous, and, second, that it breeds only every second year, because, as he asserts, the booming note occurs only every alternate year at Lake Te Anau. The first hypothesis hardly affects the present question, and, as to the second, it will be time enough to discuss that when the author of the booming note has been found and identified.

Mr. Melland, when referring to the circumstances of our adventures with our mysterious visitant at the Upper Matukituki, agrees that it was a matter for regret that we had no dog, and states without hesitation that the dog would have surprised its master by bringing him a kakapo. In reply, I would mention that kakapos were plentiful around our upper camp at Cascade Creek, and for the first few nights made the forest resound with their discordant cries. After that they disappeared higher up the valley, being, no doubt, scared by our continued presence. On the other hand, our friend of the booming note was a nightly visitant during our nine days' stay at that camp, his solitary, unusual note being a source of much speculation and wonder to us all.

Mr. Melland says the booming is warlike, Mr. Henry that it is amatory. On this question I am unable to express an opinion, but would in passing remark that the bird continued its deep booming note as it manœuvred around the decoy-fire.

At our camp near the forks of the river, little more than a mile from Mr. A. Cameron's homestead, we heard nothing of the familiar calls of the kakapo, but only the deep boom of the strange bird first heard at Cascade Creek.

Now, Mr. Cameron had lived at the forks of the Matukituki for a number of years. He was an enthusiastic mountaineer and explorer, and was quite familiar with Mount Fox and the high ranges between the sources of the Shotover and Matukituki Rivers. His run extended almost to Cascade Creek, and he had a hut and mustering-yards about two miles below that stream, where he spent some weeks every year, generally in the months of November, December, and January. In reply to our inquiries as to this strange sound, he said he had heard it on only one occasion, some years before, while mustering on the slopes of Mount Fox, facing Mount Aspiring; but he was puzzled as to the nature of the bird which caused it.

When it is remembered that kakapos were common in the upper valley of the Matukituki, it is certainly unaccountable that the booming should have been heard so seldom, supposing Mr. Melland's assertion to be true.

Among our own party, Mr. McKay was an old experienced bushman and explorer in kakapo country; but this unusual note was new to him. Mr. Buchanan was a naturalist of well-known ability, and an explorer of considerable experience. He was a member of Sir James Hector's expeditions to the West Coast sounds and mountains of Otago in 1862–64. He remembered having heard the same booming note in the Upper Matukituki Valley in 1862; but he had never been able to trace its author. As regards myself, the 1879–80 season was my first experience with the kakapo; but subsequent to that date I have had many opportunities of becoming well acquainted with its habits.

In November and December of 1887 I conducted an exploration of the Humboldt Mountains and the high snow-clad ranges at the sources of the Cascade, Gorge, and Pyke Rivers. Kakapos were common, and in some cases abundant, in the grassy dales at the sources of the Rock Burn, Hidden Falls, Olivine, and Barrier Streams; in the valleys of the Cascade, Pyke, and Hollyford Rivers; and around Lakes McKerrow, Alabaster, and Wilmot. This was the breeding-season too; but in all my travels in these places—the very habitat of the kakapo—I did not hear even a solitary boom.

During this expedition I visited Thomson, the hermit of Awarua Bay, better known as "Maori Bill." Thomson was a keen sportsman (or, rather, I should say his fine dog was), and kakapos, kiwis, and wekas were his ordinary fare. He showed me six or eight large sacks full of the feathers of these birds he had killed and eaten in two seasons. At Martin's Bay I met Mr. J. Webb, an old settler there, who spent much time every year in the open, collecting kakapo-skins; but in the course of many conversations with him he made no reference to the startling note ascribed to that bird by Mr. Melland.

On our return to Wellington after the Wanaka trip our experiences with the strange bird were narrated to Sir James Hector, the Hon. Walter Mantell, and, I believe, also Sir Walter Buller. The booming note puzzled them all, and the *Aptornis*, *Notornis*, and a small species of moa were suggested as the probable author. Sir James Hector said he also heard a mysterious booming note when exploring the Matukituki Valley in 1862, and at that time he thought it was the cry of some small species of moa.

Referring to my own experiences at Dusky Sound, Mr. Melland attempts to discredit the evidence of my field-hand, who was known only as "Jimmy." Now, Jimmy's exclamation that he had heard a takahe shows that he must have had some previous experience of that bird. Mr. Melland tries to get over this difficulty by supposing that Jimmy had often heard the boom of the bittern, which, he says, is common in the Mararoa district. Of course this is not evidence, and I might answer in the same manner, and say that the booming note which Mr. Melland ascribed to the kakapo was really that of the bittern, which is common in his district. But, admitting for the moment that Jimmy may often have heard the bittern near Lake Te Anau, why should he suppose the call of such a common bird to be that of the takahe? And, again, what should lead him at Dusky Sound to attribute the boom, of what Mr. Melland says was a kakapo, a second time to the mysterious takahe? Mr. Melland has no difficulty in recognising the unusual note described by me in my paper on the takahe, and yet he has no hesitation in making Jimmy's ears deceive him twice. I picked Jimmy up at Chalky Inlet, where he was prospecting. I gathered from him that he had spent many years about Riverton, Orepuki, Waiau, Lakes Te Anau and Manapouri, and the West Coast sounds; and it would certainly be strange if he had not in his travels become familiar with the calls of a comparatively common bird like the kakapo.

The third person of our party at Dusky Sound was Mr. William Docherty, the well-known prospector and explorer, who, at the time of my visit in 1888, had spent the greater part of eight years at Dusky Sound and Wet Jacket Arm. He had camped for lengthened periods on the open grass-country above the limits of forest-vegetation, where kakapos were always plentiful. Perhaps no one on the West Coast was better acquainted with the kakapo than Docherty, and yet, when, with me, he heard the booming note on the slopes of Mount Hodge, he did not recognise it as the call of the kakapo or any other bird whatever. So sudden and startling was the sound that he maintained to the last that it was a subterranean noise in some way connected with volcanic action. In explanation of this strange theory, Docherty said that in a previous year he had often heard the same sound. His mate at the time was a Scandinavian, who informed him that noises of a subterranean character were often heard among the mountains of Norway.

Mr. Melland next appeals to the experiences of Mr. A. Reischek, F.L.S., and says, "The mere fact that the indefatigable Mr. Reischek had been industriously searching for the takahe in the very district mentioned for many months without success might have given Mr. Park some doubt as to the truth of his theory."* Unfortunately for Mr. Melland's argument, about the first person I met on boarding the s.s. "Stella" when I was leaving Dusky Sound was Mr. Reischek himself, to whom I narrated the circumstances of the boom-

* *Loc. cit.*, p. 297.

ing note. He said he had never heard the noise I described, nor could he account for it. He was inclined to favour my theory as to the takahe, and regretted that he had no dog with him to help to clear up the mystery. Now, here was a naturalist of no common zeal, who had secluded himself for the greater part of two years among the wilds and solitudes of Dusky Sound, Chalky Inlet, and other equally inaccessible portions of the West Coast, collecting native birds and studying their habits in the open. He had made a special study of the kakapo, both in its breeding-season and at other times, but, strangely enough, he never heard the startling booming note ascribed to the male bird. Perhaps Mr. Melland would reply that if Mr. Reischek "had been at all well acquainted with the habits of the kakapo he would at once have suspected"* the author of this uncommon call.

Oddly enough, Mr. Melland does not attempt to refute my theory by calling to his aid the writings of the many authors who have described in various ways the habits of our unique owl-parrot, the kakapo. I will try and supply this omission. The quotations which follow are copied from Sir Walter Buller's new edition of the "Birds of New Zealand."

Dr. Lyall, in his paper read before the Zoological Society of London in 1852, says, "The cry of the kakapo is a hoarse croak, varied occasionally by a discordant shriek when irritated or hungry. The Maoris say that during winter they assemble together in large numbers in caves, and that at the times of meeting, and again before dispersing to their summer haunts, the noise they make is perfectly deafening."

Sir George Grey describes the kakapo as a greedy bird, and says, "When feeding, if pleased with its food, it makes a continued grunting noise." And, again, "It cries repeatedly during the night with a noise not very unlike that of the kaka (*Nestor meridionalis*), but not so loud."

Mr. G. S. Sale, speaking of a captive kakapo which he possessed for some time, says, "I observe that it rarely makes any noise by day; but about dusk it usually begins to screech, its object being apparently to attract attention; for, if let loose from its cage and allowed to have its usual play, it ceases to make any noise. It also makes a grunting noise when eating, especially if pleased, and I have myself attracted it to me by imitating the same sound. It also screeches sometimes when handled—not, apparently, from anger, but more from timidity." In a note he adds, "The sound of the bird is not a shrill scream, but a muffled screech, more like a mingled grunt and screech."

Among the early explorers of Otago perhaps none can

* *Loc. cit.*, p. 300.

speak with the same authority on the habits of the kakapo as Sir James Hector. His writings on this subject are the result of actual observations made by himself during many arduous and protracted explorations among the sounds, mountains, lakes, and valleys of Otago in the years 1862–64. At that time these places were practically inaccessible, and the native birds consequently undisturbed in their native habitat. This alone must give his observations an unusual interest and value. After referring to the gregarious habits of the kakapo, and the din made at their gatherings, he says, "As they feed their harsh screams can be heard at intervals until they return at daybreak to the depths of the forest."

Baron von Hugel, who studied the habits of the kakapo on the shores of Lake Te Anau, says, "The note of the *Stringops* is very peculiar—quite unlike that of a bird. I think it is when feeding that they indulge in a series of the most perfect porcine squeals and grunts. It is really as like a young pig as anything can be. Then, their other note, which I think answers more to a call or warning, is a very loud aspirated scream, with a sort of guttural sound mixed in with it, almost impossible to describe. Then, when pursued and caught by the dog, it emits a low harsh sort of croak, but some were perfectly silent to the last."

Sir Julius von Haast, who also had many opportunities of studying the habits of the kakapo, says—still quoting from Buller's "Birds of New Zealand"—it has "an irregular shrill call." In his report on his explorations in Nelson Provincial District in 1860–61, the same author, describing the kakapo, says, "The call of the kakapo, heard during the night, very much resembles the gobble of the turkey."*

The evidence supplied by the above quotations, which might be supplemented by many others, is of course of a negative kind, but none the less valuable, as showing that the remarkable note ascribed to the kakapo was not known to the writers.

In the second edition of the "Birds of New Zealand," issued as late as 1888, Sir Walter Buller, in his article on the kakapo, makes no reference to this singular note, and I may remark that Mr. Melland does not point out this important omission. Sir Walter, however, quotes the Maori proverb, "*Ka puru a putaihinu*," which he says refers to the noise made by the kakapos when congregated in their winter quarters. Mr. Melland quotes this, as he thinks it supports his theory, but in doing this he is guilty of an inconsistency which does not strengthen his position, and tends to throw doubt upon his other evidence. The sound, which seemed to denote "the

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* Report of Topo. and Geol. Explorations, Nelson District, 1861, p. 139.

rumbling of distant thunder," was said by the Maoris to be the noise caused by a great number of kakapos, "congregated at night;" and the time of the year when the kakapos do congregate is agreed by all the best authorities to be during the winter. On the other hand, Mr. R. Henry's statement, which appears to be Mr. Melland's only evidence, was that the booming was in every case caused by "an adult male kakapo," and that too during the summer or breeding-season. Mr. Melland more than once refers to the solitary boom heard in the Te Anau district from November to March: how then can he compare it to the confused din of a number of kakapos in the winter time?

When it is remembered that the district around Lake Te Anau, and Dusky Sound, are the only places in New Zealand where living specimens of the takahe have been secured, and that these places are two of the three localities where the booming note has been heard, I think it probable that Mr. Melland is wrong in ascribing this note to the kakapos of Lake Te Anau, and shall continue to believe that it is the call of the takahe until better evidence is produced.

Art. XVI.—*On the Origin of the Sternum.*

By T. Jeffery Parker, B.Sc., F.R.S., Professor of Biology in the University of Otago.

[*Read before the Otago Institute, 14th October, 1890.*]

Plate XIX.

According to Wiedersheim, one of the leading modern authorities on vertebrate morphology, nothing is known of the phylogeny of the sternum, in spite of the fact that its development in many of the more important types has been worked out in detail.

Two kinds of sternum are distinguished by morphologists—the *costal sternum*, formed by the concrescence of the ventral ends of ribs, and found in Amniota (birds, reptiles, and mammals); and the *omosternum* (coracoid sternum, or clavicular sternum), formed by segmentation of the shoulder-girdle, and highly characteristic of Amphibia. No trace of a sternum has hitherto been described in fishes.

In all *Amniota* in which a sternum occurs, its development takes place in the same way. The ribs of each side gradually grow downwards, enclosing the chest. As they do so, those of each side unite by their ventral ends, forming a longitudinal band of cartilage (Pl. XIX., fig. 5, *st.*); the two bands thus constituted then approach one another and unite in the middle ventral line (fig. 6), forming a median structure; areas of connective tissue appear separating it from the ventral ends of the ribs, and thus the sternum is formed as a purely costal product.

In the tailed Amphibia the sternum has a double origin: A pair of cartilaginous bands appear in the inscriptiones tendineæ of the mm. recti abdominis, and a pair of narrow strips are separated off from the posterior borders of the coracoids. From these four elements the sternum is produced. Ruge considers that the first-named chondrites* are to be looked upon as vestigial ribs; the others are obviously parts of the shoulder-girdle.

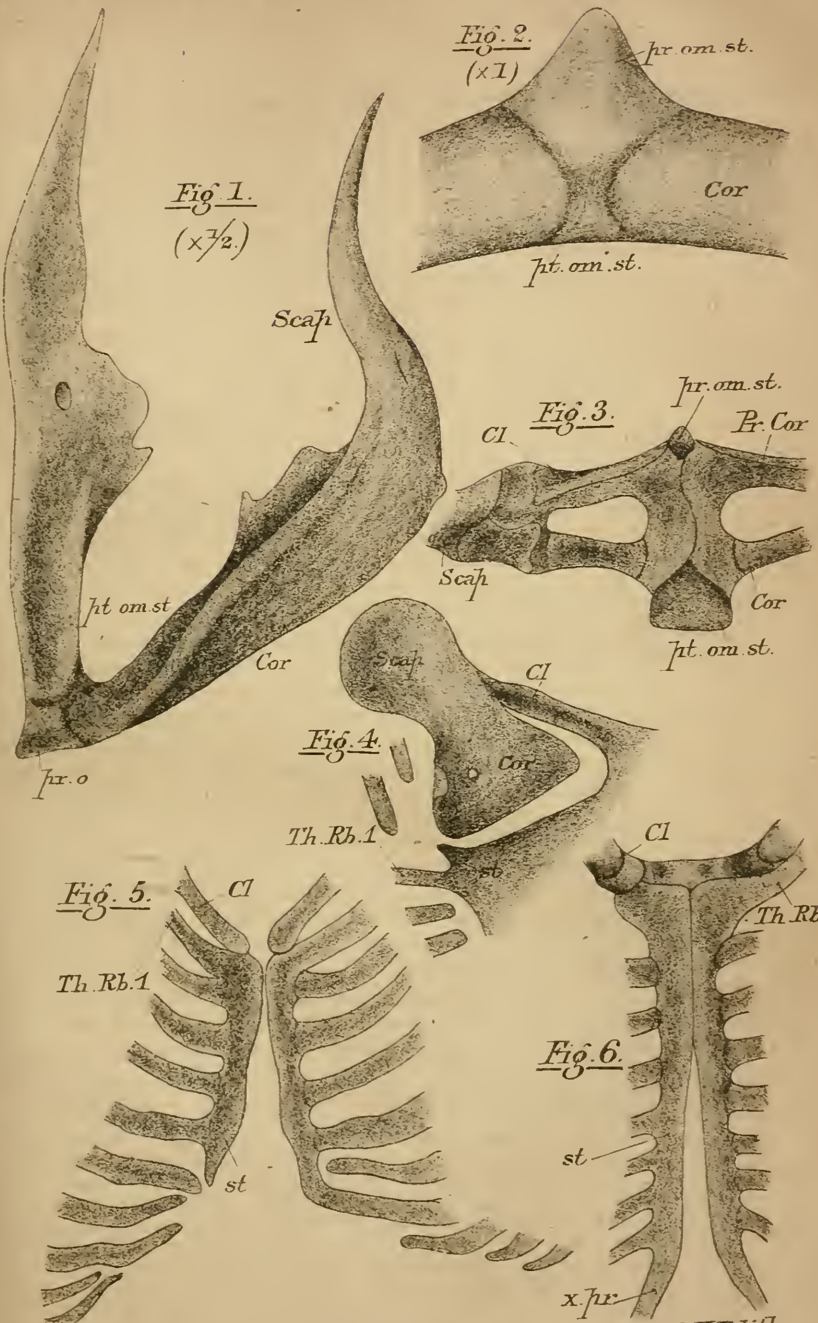
In the tailless Amphibia, such as the frog, the sternum has a similar origin, but in many genera there are formed in addition paired cartilages in front (cephalad) of the shoulder-girdle, and arising by the detachment of narrow bands from the procoracoids. These unite in the middle line, and form a median cartilage (fig. 3, *pr. om. st.*), which was distinguished by my father as the *omosternum*, the name *sternum* being restricted to the post-coracoidean element (*pt. om. st.*). As, however, both structures are formed from the shoulder-girdle, Albrecht's suggestion to call the anterior cartilage the *pre-omosternum*, and the posterior the *post-omosternum*, is worthy of adoption, especially as these names suggest homologies with the similarly-formed median elements of the pelvis, the *pre-pelvisternum* (epipubis) and *post-pelvisternum* (os cloacæ).

In order to form any clear notion of the origin of this element of the skeleton, a sternum in some form lower than the Amphibia is obviously a desideratum. I believe I have discovered such a structure in the Perlon Shark (*Notidanus indicus*).†

The shoulder-girdle of Elasmobranchs is an inverted arch of cartilage attached to the vertebral column either by muscles only (Selachians), or by fibrous union (Rays), and having the pectoral fins attached, one on either side, to its posterior

* Chondrite = an independent cartilaginous element or centre of chondrification.

† Since writing this paper I find that the structure called in the ensuing description the pre-omosternum was discovered in 1884 by Haswell, who says, "The shoulder-girdle [of *Notidanus indicus*] is remarkable for the presence in the middle ventral line of a distinct four-sided lozenge-shaped cartilage, let into the arch, as it were, in front. . . . . The intercepted cartilage is temptingly like a pre-sternal, but the absence of such an element in the skeleton of any group nearer than the Amphibia seems to preclude this explanation" (Proc. Linn. Soc. N.S.W., vol. ix.).—March, 1891.



T. J. P. delt.

C. H. P. lith.

To illustrate Paper by T. J. Parker.

border. The portion of the continuous cartilage lying above (dorsad of) the articulation of the fin is the scapular region; that below (ventrad of) it the coracoid region. In the embryo the shoulder-girdle consists of distinct paired cartilages, which afterwards unite with one another in the middle ventral line by concrescence of their coracoid portions.

In a skeleton of *Notidanus indicus*, prepared a few months ago for the Otago University Museum, the middle region of the shoulder-girdle (figs. 1 and 2) is produced in front into a blunt process, while it is evenly curved posteriorly. Two curved areas of fibrous tissue, with their convexities towards the median plane, extend from the anterior to the posterior border, touching one another in the centre, and thus bounding two distinct cartilaginous areas—an anterior (*pr. om. st.*) of a rhomboid, a posterior (*pt. om. st.*) of a triangular form. The two cartilages are particularly well seen when the shoulder-girdle, which has been prepared by impregnation with carbolized glycerine jelly, is held up to the light.

I think there can be no doubt that the anterior rhomboid cartilage (*pr. om. st.*) is to be considered as a pre-omosternum, the posterior triangular piece (*pt. om. st.*) as a post-omosternum, the coracoid portion of the shoulder-girdle being related to the two median elements in much the same way as the coracoids of *Anura* to the sternal cartilages (compare figs. 2 and 3).

It may be objected that the cartilages in question are unpaired in *Notidanus*, while in Amphibia they arise from the union of paired chondrites. But, in the first place, we know nothing of the development of the shoulder-girdle in *Notidanus*, and, in the second place, an actual unpaired origin would only mean that the sternal elements were detached after the union of the coracoids with one another, each of them being morphologically paired since each is derived in an equal degree from the two originally separate halves of the pectoral arch.

It will be seen that the omosternum of *Notidanus* is related to the shoulder-girdle in much the same way as the copulæ (basi-hyal, basi-branchials) to the visceral arches.

The question then arises as to whether there is any genetic connection between the omosternum of *Notidanus* and Amphibia and the costal sternum of Amniota. I am disposed to think that the latter is derivable from the former, its present mode of origin being a case of retarded development.

In the early Amniota we may suppose there to have been a post-omosternum, developed as in Amphibia, but separated from the coracoids before chondrification, and joined at a late period of development by the first pair of ribs. In a subsequent stage of evolution we should have the second and following ribs becoming successively united in the same manner.

A simultaneous retardation in the chondrification of the sternum would result in the development of a sternum formed of indifferent tissue and subsequently chondrified from the ribs, and from this condition of things it is but a step to the earliest stage in existing *Amniota*, in which the first indication of the breastbone consists of paired patches of cartilage formed by the union of the anterior thoracic ribs.

Any facts tending to show that any portion of the sternum originates independently of ribs will support this view, and in this connection Goette's observations on the development of lizards are significant. In an early stage of *Cnemidophorus* each half of the sternum is a triangular patch of tissue (fig. 4, *st.*) extending beyond the level of the third thoracic rib, but in connection only with the first (*Th. Rb. 1*): in other words, that part of the sternum which corresponds with the second and third ribs is formed independently of them, and as a backward growth from the anterior portion.

My own observations on *Apteryx* tell in the same direction. In the earliest stage in which the sternum is present it extends backwards to the level of the third thoracic rib; the first two ribs are united to it by joints, the third is loosely attached by connective tissue. In the next stage, the first three ribs are attached by joints, and the fourth by fibrous tissue. That is, as it appears to me, the portion of the sternum corresponding to the third and fourth ribs is formed by a backward growth of the anterior region and quite independently of the last two ribs, the union of which with it is a secondary process.

I am disposed to consider the stages in the phylogeny of the sternum to have been somewhat as follows:—

1. Segmentation of anterior and posterior elements (pre- and post-omosterna) from ventral ends of coracoids: there is no evidence to show whether these were originally paired or unpaired, but the former seems more likely. *Notidanus.*
2. Pre- and post-omosterna arise each from paired elements, which afterwards unite, segmented from the coracoids: the pre-omosternum may be absent, and the post-omosternum may be formed in part from chondrites (? vestigial ribs) formed in the inscriptiones stendineæ (*Urodela*). *Amphibia.*
3. Disappearance of pre-omosternum: late union of first pair of thoracic ribs with post-omosternum. Hypothetical.

4. Post-omosternum separated from coracoids while still in the state of indifferent tissue, and chondrification retarded to a later period than that of the ribs. Hypothetical.
5. Sternum (post-omosternum) unites very early with the first pair of ribs, and chondrification extends into it from them; after chondrification it grows backwards, the remaining sternal ribs uniting successively with it. *Cnemidophorus* (? *Apteryx*).
6. Development of sternum further retarded until it first appears in the form of paired longitudinal bars, formed by the concrescence of the thoracic ribs. *Mammalia.*

DESCRIPTION OF PLATE XIX.

Fig. 1. Shoulder-girdle of *Notidanus indicus*, viewed obliquely from the left side; one-half natural size: *Cor.*, coracoid; *scap.*, scapula; *pr. om. st.*, pre-omosternum; *pt. om. st.*, post-omosternum.
Fig. 2. Mid-ventral portion of the same, from beneath; natural size: Letters as before.
Fig. 3. Part of shoulder-girdle and sternum of a young frog (after W. K. Parker): *Pr. Cor.*, pro-coracoid; *cl.*, clavicle; the other letters as before.
Fig. 4. Early stage in the development of the shoulder-girdle and sternum of a lizard (*Cnemidophorus*) (after Goette): *Th. Rb. 1.*, first thoracic rib; other letters as before.
Fig. 5. Early stage in the development of the sternum of man (after Ruge): Letters as before.
Fig. 6. Later stage of the same (after Ruge): *x. pr.*, xiphoid process; other letters as before.

Art. XVII.—*Description of a New Species of* Migas, *with Notes on its Habits.*

By P. Goyen, F.L.S.

[Read before the Otago Institute, 13th May, 1890.]

Plate XX.

Fam. TERRITELARIÆ.

Gen. Migas, Koch.

Migas sandageri, sp. nov.

Femina: Length about 9mm.

Cephalothorax and falces brown; legs and palpi brownish-yellow, with wide dark-brown flecks and annulations; sternum, labium, and maxillæ yellow suffused with brown; abdomen dark-brown, darker above than below, and speckled with minute flecks of a dirty skin-colour. In places these flecks coalesce into narrow bars, transverse above and below, and oblique at the sides; but both flecks and bars are invisible to the naked eye. Spinners and branchial opercula pale-yellow.

Cephalothorax about 1mm. longer than broad, forming in outline an oval truncated in front; from the fovea, which is deep and semicircular, with the curve directed forwards, radiate eight grooves, three running down each side, and two down the posterior slope. In front of the fovea are two yellow spots, one on each side of the thoracic median line, from each of which springs a stout bristle. There are also bristles on the ocular area; but the rest of the surface is quite glabrous. The caput is moderately prominent.

Both rows of eyes curved forward, the posterior more curved and shorter than the anterior row; front central eyes round, of a dark colour, placed on black prominences, and nearer to each other than to the laterals of their own row; the latter of a pale colour, considerably larger than the centrals, oblong, each placed obliquely in front of a black tubercle behind which are situated a central and a lateral of the posterior row; eyes of the latter row minute, subequal, longer than wide, opalescent (the centrals brilliantly so), and posited obliquely, the centrals looking inwards and the laterals outwards, the former being very distant from each other, and each quite near the lateral on its own side; posterior laterals nearer to anterior laterals than the latter are to the fore centrals.

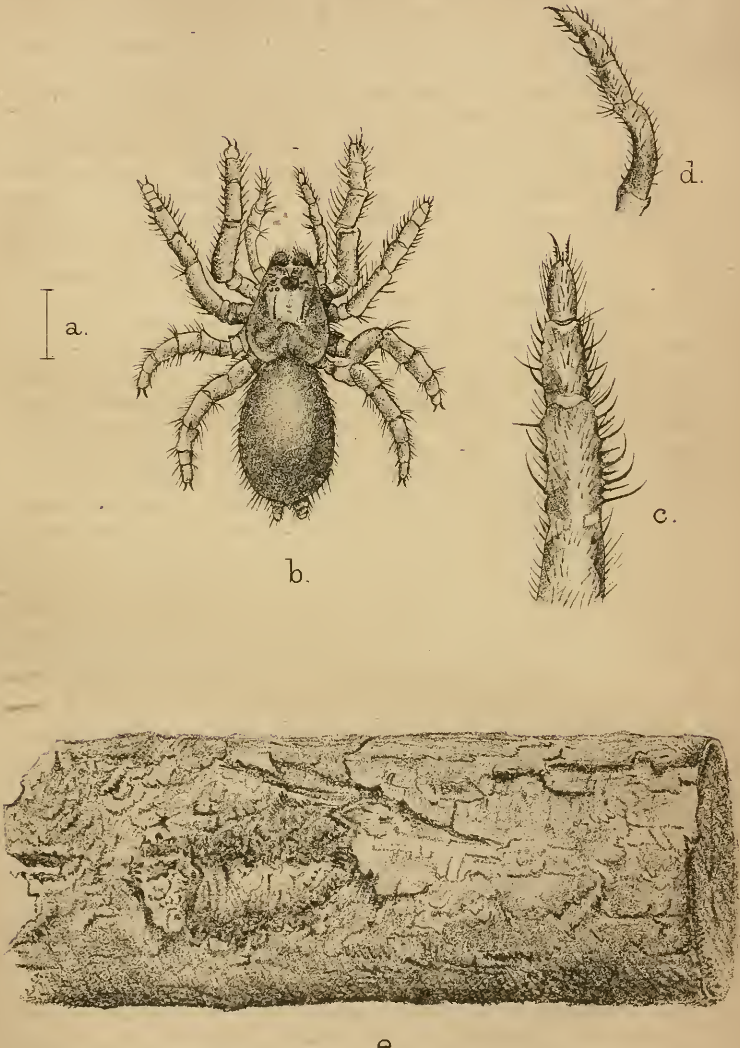
Falces sparingly hairy at the fore extremity, prominent, powerful, knee-shaped; groove toothed, teeth on outer side small and subequal, those on the inner side large and unequal, the one nearest the fang the largest, and the basal one the smallest.

Maxillæ very divergent, and of the same width through their whole length, outer side longer than inner, the latter furnished with a long fringe; the inner half of the inferior surface studded with short tooth-like spines.

Labium about half as long as the maxillæ, slightly convex, triangular in outline, rounded at the apex, the anterior part of it studded with spines like those of the maxillæ.

Sternum ovate in outline, truncated in front, pointed behind, sinuated at the sides, having two small depressions, one on each side, not far from the margin, between the 2nd and 3rd pair of legs, and sparsely hairy.

Abdomen oblong-oval, convex, and copiously furnished with short stoutish hairs; spinners compactly grouped, the inferior pair slender and of moderate length, the superior pair stout and twice as long as the inferior.



MIGAS SANDAGERI, n.s.

D.E.H. del. C.H.P. lith.

Both in shape and armature the legs and the palpi are like those of *M. distinctus*.

The genital aperture is a simple transverse slit.

This spider bears a resemblance to *M. paradoxus*, Koch, but differs from the latter in having its front row of eyes curved forward and its hind laterals closer to the fore laterals than these are to the fore centrals, in the shape of the joints of the legs and palpi, in the denticulation of the claws, in having no distinct abdominal pattern, in the length of the superior pair of spinners, in not having its sternum "äusserst fein netzartig," and in the absence of "ein den Schenkeln des vierten Paares entsprechenden Eindruck."

Hab. Mokohinou Islands, Sandager.

I have much pleasure in associating this *Migas* with the name of Mr. F. Sandager, who is the author of some valuable papers on the fauna and flora of Mokohinou Islands, and to whom I am indebted for my examples.

This interesting little spider builds its nest on the bark of trees (*Coprosma*, *Cordyline*, and *Fagus*). There are generally several nests on each tree, the lowest being at least a foot from the ground, and the highest as high as the base of the larger branches. The larger nests are for the most part built in the hollows, and the smaller ones on the more even surface of the bark. On this account the latter present the appearance of small prominences or knots in the bark. The lid is round, and in all my specimens hung on the outer side of the tube, which is always lower than the inner side by the diameter of the lid. This build of the nest makes the lid when closed lie in the same plane with the bark of the tree—an arrangement that seems designed to conceal the entrance to the nest from the enemies of its occupant. The tubes in my possession vary from 3mm. to 5mm. in diameter, are from three to four times as deep as wide, and are thickly lined throughout with web. The shallowness of the nest is no doubt of great advantage to the spider, for, should the entrance be discovered by an enemy, the tenant is enabled to reach the lid in an instant, and, by thrusting the claws of its powerful fore-legs into the web lining the under-surface, to hold the lid down so firmly as to prevent the ingress of its would-be devourer. This is the method adopted by all trap-door spiders to resist the attempts of their enemies to open the door of their nest. But the most wonderful feature of the nest of *Migas sandageri* is the marvellous resemblance of its exterior surface to all the details of the bark on which it is built. The colour, the variations of colour in different trees, the scales, the very rugulosities of the bark, are reproduced with a fidelity that would do credit to an artist. A more perfect example of protective mimicry I have never met with. It has been urged against the theory of sexual selection that it postulates the existence of an æsthetic sense in the lower animals; but, when one sees an animal so lowly organized as the spider able to weave for its protection a well-shaped tube, to make and attach to it by a strong flexible hinge a perfectly-fitting lid, and then to cover the entire exterior surface of both tube and lid with materials so selected and adjusted as to produce an exact imitation of the varying surface of the objects on which it builds, one does not feel disposed to attach much weight to the objection.

EXPLANATION OF PLATE XX.

a. Natural length of spider.
b. *Migas sandageri.*
c. Under-side of four joints of a leg of the first pair.
d. Left palpus.
e. Piece of bark with nest, the latter purposely made less inconspicuous than in nature.

Art. XVIII.—*Notice of the Occurrence of the Basking Shark* (Selache maxima, *L.*) *in New Zealand.*

By T. F. Cheeseman, F.L.S., Curator of the Auckland Museum.

[*Read before the Auckland Institute, 6th October, 1890.*]

In November, 1889, an unusually large shark, measuring over 34ft. in length, was exhibited for a few days at Devonport. It had been stranded near the mouth of the Wade River, where it and another had been noticed for some days previous. Some enterprising individuals secured it, and towed it to Devonport, partly with the hope of earning a few pounds by exhibiting it to the Auckland public, and partly to extract the oil from the liver, that organ containing in sharks, as is well known, a large supply of valuable oil. Being by far the largest ever exhibited in Auckland, it attracted considerable attention. I was unable to visit it for a day or two, and, as reports were circulated that it had large triangular teeth, I felt confident that it was an unusually large specimen of the White Shark (*Carcharodon rondeletii*), which visits our coasts every summer. When an inspection of the specimen was made, however, a glance showed that it was not that species. The body was of enormous girth, giving it a very different appearance from the rather slenderly-built white shark, and the shape of the fins and tail was also different. With some little trouble its mouth was prised open, disclosing the fact that its teeth, instead of being large, were excessively small and numerous. Further examination proved that it was an individual of the Basking Shark (*Selache maxima*), which is perhaps the largest of all fishes, and which is common in some parts of the Northern Hemisphere. In southern waters it is only known from a single specimen, caught at Portland, on the western coast of Victoria, in November, 1883, and which has been figured and described by Professor McCoy in his "Prodromus of the Zoology of Victoria" (vol. ii., p. 12).

Unfortunately, my specimen was in much too advanced a stage of decomposition to permit of complete measurements being taken—in fact, it was with difficulty that a spectator could remain near it for more than a few minutes at a time. Its total length, from the tip of the snout to the end of the upper lobe of the tail, was 34ft. 3in.; girth at the middle of the body, 20ft. 9in.; height of first dorsal fin, 5ft. 1in.; depth of pectoral, 5ft. 6in.; width across the tail, from tip to tip of the lobes, 7ft. 2in. From these measurements it will be seen that its size is much in excess of Professor McCoy's specimen, the total length of which was 30ft. 6in.

Mr. R. H. Shakspere, of Whangaparaoa, who saw the specimen very shortly after it was stranded, informs me that every spring several individuals of the same species can be seen near the entrance of the Wade River, and along the shores of Whangaparaoa Peninsula. He believes that they visit these localities in search of their food, which he thinks is composed of small *Medusæ* and other pelagic organisms. They can be easily recognised from their habit of swimming on the surface of the water, a portion of the back and the huge dorsal fin being usually exposed. It is from this circumstance, taken with the fact that their motions are very often slow and sluggish, that they have received the name of the "basking shark." They are easily approached and harpooned, and on the west coast of Ireland as many as five hundred have been taken in a single season. The liver often weighs as much as two tons, yielding six to eight barrels of oil. A few years ago, when sharks' oil was of greater value than it is at present, the oil from a single full-sized specimen would often realise from £40 to £50.

Art. XIX.—*On New Species of* Araneæ.

By A. T. Urquhart, Corr. Mem. Royal Society of Tasmania.

[*Read before the Auckland Institute, 3rd November, 1890.*]

Plate XXI.

Fam. DYSDIRIDÆ.

Gen. Oonops, Templeton.

Oonops septem-cincta, sp. nov. Plate XXI., fig. 1.

Femina.—Ceph.-th., long, 5; broad, 3. Abd., long, 5; broad, 2. Legs, 1, 2, 4, 3 = 13, 12·5, 11·5, 10·3 mm.

Cephalothorax bright-mahogany colour, fuscous clouding about margin of cephalic region; hairs very short, sparse; elongate-oval, prominently convex, roundly truncated; *clypeus* inclined forwards, depth equal to the greater diameter and one-half of a centre eye; thoracic indentation slight, normal grooves faint; profile-contour represents an even arch, dips somewhat abruptly across ocular area.

Eyes of about equal size, oval, opalescent, posited on low dark eminences, in three subcontiguous groups; centre pair placed slightly in advance of hind-laterals, perceptibly more distant from them than they are from anterior laterals, an interval rather surpassing their greater diameter.

Falces lake-black; few hairs; conical, gibbous at base in front, outwardly inclined, rather longer than radial + digital joints of palpus; breadth at base exceeds one-half length.

Maxillæ much dilated at insertion of palpi, spathulate, more distinctly curved on superior side.

Labium suboval, sides apparently pressed inwards by maxillæ; about half as long as the latter; organs red-mahogany colour, clouded with a deeper shade.

Sternum fulvous; elongate-oval, terminates above fourth pair of coxal joints, prolonged beyond first pair for a distance equal to three-fourths breadth of lip.

Legs yellowish-mahogany, moderately strong; hairs fine, rather long; femora of first, second, and third pairs have 2 short black spines on fore-end, fourth 1 distal spine, 2 basal; tibia of first leg, 2, 2, 2 beneath, 2 side spines; metatarsus, double row, 4–6; tibial joint of second, 2, 2, 2; metatarsus, 2, 2, 2: tibia of third leg, 1, 1, 2; metatarsus, 2, 1, 3: fourth leg, tibial joint, 1, 2; metatarsus, 2, 1, 4, or 3, 1, 4. Superior tarsal claws—First pair strong, well-curved, outer 11 comb-teeth; inner claw, 12 long, 1 short basal tooth; inferior claw short, sharply bent, 1 long curved tooth.

Palpi and legs concolorous; stout; pars humeralis, length about equal to cubital + radial joints together; cubital joint somewhat shorter than penultimate article; pars digitalis scarcely as long as two former joints together; hairs numerous; palpal claw short, stout, well curved, no teeth.

Abdomen elongate-oviform; hairs somewhat sparse, chiefly on base; pale-yellowish stone-colour, crossed by seven brownish-purple, recurved, arcuate bars, thickening somewhat in centre; basal bar narrowest and straightest, connected with second and third bars by a rather narrow median band, interval separating two latter bars less than one-half space between the second and first; posterior bars closer to one another, less pronounced; ventral region speckled, displays a wide median streak, dilated at spinners; broad band above vulva, shade lighter than dorsal marks. Spinners orange-colour. *Corpus vulvæ* orange-yellow; wide, convex, represents a segment of a circle, projects over the rima genitalis. Two pairs of spiracular openings, second not far from first pair, and not quite so distant from each other.

According to Thorell, Simon, and Cambridge, there appears to be some doubt as to whether the typical form *O. pulcher*, Templeton, possesses more than two stigmata; the Rev. O. P. Cambridge believed that he could discern four. In *O. septemcincta* the first pair of spiracular openings are easily discernible, the second not so, in fact scarcely visible, but when stretched the stigmata prove to be as large and well-developed as the first pair.

I am indebted to *Mr. T. Kirk, F.L.S.*, for this interesting example, which was contained in his collection from Wellington.

Fam. AGELENIDÆ.

Gen. TEGENARIA, Ltr.

Tegenaria arboricola, sp. nov. Plate XXI., fig. 8.

Mas.—Ceph.-th., long, 4; wide, 3. Abd., long, 5; wide, 2·4. Legs, 1, 4, 2, 3 = 24, 21, 18·5, 16 mm.

Cephalothorax fulvous, dorsal band broad, lightly shaded with black, bifurcates forwards at fovea, leaving a narrow streak, tapers rapidly close to posterior median eyes; similar shading on lateral margins; border narrow, dark; glabrous; pars cephalica moderately convex, quadrate, facial index surpasses lateral by one-fourth; *clypeus* convex, depth equals half space occupied by fore-central eyes; pars thoracica oval, convex; fovea oval, longitudinal; radial and caput striæ fairly well defined; profile-contour represents an angle of 45° at posterior inclination, occiput somewhat horizontal, perceptible double curve, slopes across eye-area.

Eyes pearl-grey, on black rings; posterior row moderately procurved, centrals on oval spots; of about equal size, nearly equidistant; space between median pair, which are visibly the most distant apart, less than an eye's breadth; anterior row slightly recurved, centrals more than half size of hind-pair, separated from each other and side-eyes by an interval equal to two-thirds their diameter; laterals posited obliquely on separate low tubercles, fully the radius of a fore-eye apart; latter eyes suboval, visibly larger than hind-pair.

Legs fulvous, blackish annulations, more or less faint; annuli on coxal joints; rings evanescent on two first pairs; moderately slender; hairs fine, sparse; spines slender, black; about 6 or 7 on femora + tibiæ; single spine on patellary joints; about 7 on metatarsi of two first pairs; 6 or 7 and ring of 4 on hind metatarsi.

Palpi, colour and armature of legs; slender, length 9mm., equal to metatarsus + tarsus of a fore-leg; pars humeralis more than one-third longer than cubital + radial joints; pars cubitalis subquadrate, more than half length of penultimate joint, projects black bristles; radial joint moderately incrassated forwards, prolonged on outer side into a subquadrate, black-margined, membranous process, about twice as long as broad, apex grooved; immediately beneath is a stout darkish-brown process; posited on superior angle of article is a strong, acute, downward-curved, blackish process; below and contiguous to the latter is an oblong dark projection, whose short, pointed angles are connected by a U-shaped costa on its outer face; digital joint about twice as long as the pars radialis, bulb one-fourth length of article; genital bulb orange-brown, fading into a yellowish stone-colour towards fore-end; base semi-globose, anterior half rather more, depressed, displays round margin of lamina a wide, everted, brown border; projecting forwards from centre of bulbus is a large, membranous, sinuating process, base colour of bulb, fore-end blackish-lake; flanked by two acute, somewhat ear-shaped apophyses, reaching forwards to about one-half its own length; outer apophysis yellowish, apex brownish, inner green tinge, passing into dark-green on second half; lamina ovate, above bulbous, strongly convex, prolonged in a cylindrical form for 2·5mm., extension resembles digital joint of female's palpus; armature fine hairs, long slender bristles, three strongish spines at extremity; reddish-brown, slender extremity fulvous.

Falces brownish-orange; project forwards at an angle of 30°, divergent, of somewhat even breadth, second half curved, extremities—which are dilated on inner side—directed towards each other; small oval, plano-convex protuberance beneath angle of caput; fangs long; falx equal to cephalothorax in length, armed with only 2 short teeth projecting from beneath fore-end, first tooth longest.

Maxillæ fulvous, long, moderately enlarged forwards, obtusely pointed, somewhat curved towards each other.

Labium deeper tone, clouded; length somewhat surpasses width, subquadrate, emarginate, nearly one-half length of maxillæ.

Sternum fulvous, margins clouded; broad-cordate, eminences opposite coxæ.

Abdomen elongate-oviform, lateral margins and posterior third rugose; light yellowish-brown, shading off to black-brown at posterior end, dappled with pale flecks.

Femina.—Ceph.-th., long, 5; broad, 3. Abd., long, 6; broad, 3. Legs, 1, 4, 2–3 = 23·5, 20, 16 mm.

Cephalothorax fulvous, median band shaded with dark-brown, bifurcates at the red thoracic indentation, rapidly compressed at posterior centre eyes; marginal band broad, similar shade; almost glabrous; length equals tibia of a fourth leg; cephalic region quadrate, lateral index equals breadth of hind-row of eyes; height of *clypeus* exceeds diameter of a fore-central eye; thoracic part oval, indentation narrow, longitudinal; radial striæ very perceptibly stronger than caput grooves; profile-line slopes slightly from hind-row of eyes, dips posteriorly at an angle of about 40°.

Eyes grey, on blackish oval spots, enclose an oval space; posterior row of moderate and about equal size, equidistant, an eye's breadth apart; centrals of anterior row smaller than hind-pair, separated from each other by a space equal to three-fourths their breadth, and from side-eyes by rather more than an eye's diameter; laterals posited on low blackish tubercles, divided by an interval equalling two-thirds breadth of the hind-eye; fore-eye oval, rather the largest of eight.

Legs in colour and armature do not differ essentially from male's; second leg slightly exceeds the third in length; superior tarsal claws—first pair strong, moderately curved, 12 teeth increasing in length and strength; inferior claw stout, sharply bent, 3 strong backward-curved teeth.

Palpi fulvous, annulations evanescent; few spines on all joints; palpal claw strong, 8 comb-teeth increasing in length, directed forwards; free end moderately curved, nearly one-half length of claw.

Falces yellowish-brown; black hairs; inclined forwards and outwards, conical; first half of profile arched; short, tapering (plano) process beneath angle of caput.

Maxillæ yellow-brown; black hairs; dilated forwards, obtusely pointed, inclined towards each other.

Labium greenish tinge; oval, strongly emarginate.

Sternum fulvous, bordered by a deeper shade; cordate, nearly as wide as long, well-developed eminences opposite coxæ.

Abdomen narrow, oviform; second half and lateral margins rugose; light yellow-brown, shading off to black-brown on posterior third; base dappled with a lighter brown; lightish-yellow parts spotted with dark-brown; ventral shield yellow-brown, fuscous spots; hairs sparse, golden. *Corpus vulvæ* transverse, prominent, reddish-brown, oval elevation, bears on face a somewhat dagger-shaped depression, hilt and quillon represented by three oval foveæ, blade tapers to a point above the rima genitalis.

This species frequents the loose bark of *Fuchsia excorticata;* the female fabricates a globose cocoon 10mm. in diameter, of a hard, parchmenty texture, approximating in colour to its surroundings, suspended by a short web; male examples were generally captured with the females (January). The somewhat extensive sheet of web is composed of a fine open mesh, and attached to the surrounding objects by fine lines.

Captured in the forest on Mount Egmont, *A. T. U.*

Fam. ENYOIDÆ.

Gen. Habronestes, L. Koch.

Habronestes celeripes, sp. nov. Plate XXI., fig. 2.

Mas.—Ceph.-th., long, 2·1; broad, 1·7. Abd., long, 2·6; broad, 1·5. Legs, 1, 4, 2, 3 = 10, 7·8, 7·2, 5·5 mm.

Cephalothorax pale-brownish flesh-colour, cephalic part stained with brownish-yellow; from limit of caput two brown lines project forwards, curving upwards midway to posterior row of eyes; streaks of a lighter tone nearly connect these lines with side-eyes; lightly-shaded semi-oval patch encloses the red thoracic indentation; thorax displays two bands, marginal faint, submarginal resolved into a few dark spots; hairs white, compound-sessile, extend along unshaded ridge of caput; pars cephalica strongly convex, squarely truncated, facial index perceptibly shorter than lateral; *clypeus* nearly vertical, depth rather surpasses space occupied by fore-centre eyes; pars thoracica conoid, rises abruptly from margin, apex at limit of cephalic part; narrow longitudinal groove represents thoracic indentation; radial striæ well defined; profile-contour rises at an angle of 55°, visibly inclined forwards across second half of caput, fore-end curved.

Eyes on blackish spots; hind-centrals oval; posterior row rather strongly procurved, fore-margin of centrals being in line with hind-margin of laterals; of moderate and nearly equal size; median pair separated by rather more than an eye's breadth, divided from laterals and fore-centrals by intervals equalling their diameter and a half; anterior row procurved, fore-margin of centrals in line with space between laterals; median pair visibly less than an eye's breadth from one another, rather more than their diameter from side-eyes; laterals nearly equal centrals in size, posited obliquely on very low eminences, separated by a space equal to two-thirds breadth of a fore-lateral eye.

Legs shade yellower than cephalothorax; annuli somewhat obliterated, orange-yellow, deepening in tone forwards, shaded on posterior pairs; two central annulations on femora; three rings on tibiæ + metatarsi; moderately slender; hairs fine, outstanding; 7 or 8 short spines on femoral joints; patellæ, 2; tibial joints, about 7; metatarsi show 5 or more irregular spines, ring of 4 at extremity; superior tarsal claws —first pair rather slender, curved, 13 long, somewhat even, open comb-teeth, exceeding length of claw; inferior claw shortly and sharply bent, 2 points.

Palpi fulvous, except radial + digital joints, which have a deeper brownish tinge; humeral joint strong, linear, fully equal in length to cubital + radial together; projects 3 black bristles in line on superior surface; pars cubitalis somewhat slighter, 2 bristles; pars radialis rather surpasses former article in length, about as broad as long near base; bifurcates, prolonged outwardly into a large, pointed, ear-shaped process, posterior and upper margin armed with a series of black, acute, tooth-like projections, basal tooth much the longest and stoutest; projecting from base of process, lower side, is a brown, translucent, stout, outward-curved apophysis; somewhat slender at articulation with digital joint; few bristles; pars digitalis scarcely exceeds two former articles in length; lamina ovate, base slender, tapers somewhat sharply at extremity; moderately clothed with fine hairs; genital bulb brownish; viewed partially from front, shell-shaped, wide and convex posteriorly, concave within, curved forwards, upper margin tapers beneath lamina; lower margin pinched into an angular form; bulbus produced towards fore-end, beneath, into a strong, blunt, forward-curved process of its own colour; projecting from within fore-half of bulb are, apparently, two membranous lobes; divergent extremities of first or outer lobe, dark, recurved; second lobe pale within, broad, somewhat triangular on inner side, displays at apex a short, pointed, black process; a long, fine, black apophysis curves across face of genital bulb, close to margin of lamina, from inner side.

Falces red-mahogany colour; linear-conical, vertical; basal third, superior side, displays a plano-conical elevation; as stout as thigh of a fore-leg, length equals humeral + cubital joints of palpus; fangs short, slight.

Maxillæ yellow-brown, fore-third brownish; about twice as long as wide, straight on inner side, curved outwardly; inclined towards each other.

Labium colour of maxillæ, base darkest; rather longer than broad, oval, apex concave.

Sternum cordate.

Abdomen slender, oviform, tapers to base, convex above; stone-green; basal fourth of folium ovate, posterior three-fourths lanceolate, margins acute-crenate; oval part spotted with black dots; lanceolate extremity shows large, pale stone-coloured flecks; border of folium defined by greenish-black, confluent, mottled blotches; lateral margins lightly speckled with green-black; a shaded undulating band extends from base to spinners; specific pattern more or less picked out with white, compound-sessile hairs.

Femina. — Ceph.-th., long, 2·4; broad, 1·6. Abd., long, 2·5; broad, 2. Legs, 1, 4, 2, 3 = 6, 5·7, 5·2, 5 mm.

Cephalothorax pale-brownish flesh-colour, cephalic region partially suffused with a brownish-yellow, brown lines curve forwards above lateral grooves from posterior extremity of caput; similar streaks on fore-margin; lightly-shaded semi-oval mark encloses red indentation on thorax; marginal band pencilled, submarginal band resolved into brown spots; few black bristle-like hairs and white compound-sessile hairs on caput, latter extend along unshaded median line; pars cephalica strongly convex, squarely truncated, lateral index fully equals facial; *clypeus* vertical, in height rather shorter than interval between fore- and hind-median eyes; pars thoracica oval, conoid, indentation longitudinal, grooved; contour of profile rises from thoracic junction at an angle of 55°; second half of cephalic part straight, perceptibly inclined forwards, fore-end curved.

Eyes in size and position resemble male's.

Legs yellowish flesh-colour, annulations more or less effaced, orange-yellow, darker and more pronounced on metatarsal joints; spine armature does not differ essentially from male's, also form and pectination of claws.

Palpi yellowish, fore-half of pars digitalis brown-lake; somewhat sparsely armed with hairs and bristle-like spines; moderately slender, length equals metatarsus + tarsus of first leg.

Falces red-mahogany colour; conical, vertical, tumid at base in front; plano-convex conical protuberances on sides.

Maxillæ brownish-yellow, pale greenish-yellow apices; taper perceptibly to base, rounded on superior side, nearly twice as long as broad, inclined towards each other.

Labium brownish-lake, apex greenish; oval, rather longer than wide, apex concave.

Sternum fulvous; cordate, width between coxæ of first pair rather exceeds one-half its length.

Abdomen oviform, basal extremity broadest, convex above; ground-colour green; anterior fourth of folium ovate, posterior three-fourths broad-lanceolate, acute-crenate; margin defined by greenish-black blotches and spots, more or less effaced towards spinners; lateral margins spotted, normal coloration, series of confluent spots form an undulating longitudinal band; ventral surface light greenish-brown; fairly clothed with brownish hairs, pattern partially picked out with white, compound-sessile hairs. *Vulva* brownish-yellow, glossy; scapus springs from a slight elevation, large, tumid, about one-third wider at base than long, rather narrower and rounded in front, curves towards the rima genitalis; the somewhat cylindroid lateral margins terminate in subfree, ovate, flatly-convex apices, directed towards each other.

This pretty little species was not uncommon amongst vegetation growing over fallen trees.

Mount Egmont, Stratford, *A. T. U.*

Habronestes scitula, sp. nov. Plate XXI., fig. 5.

Femina.—Ceph.-th., long, 1·9; wide, 1·2. Abd., long, 2·2; wide, 1·5. Legs, 4, 1–2–3 = 5·5, 4·9 mm.

Cephalothorax brownish-yellow, dorsal aspect of cephalic region coffee-brown, displays a narrow dark medial streak; dorsal band streaked mahogany-brown, broad, extends from lateral eyes to base of thorax, intersected by a tolerably wide line of the normal ground-colour, which bifurcates forwards from limit of caput; marginal zone dark-brown, narrow; cephalic area clothed with few whitish hairs, chiefly on the lighter parts; ovate, lateral compression at caput slight; pars cephalica moderately convex, sides abrupt, roundly truncated; *clypeus* squarely truncated, directed outwards, height nearly equal to diameter of a lateral eye; thoracic part slopes somewhat abruptly from summit, posterior incline scarcely steeper than lateral; slight longitudinal reddish groove on crown of thorax; striæ well defined; profile-contour rises at an angle of 60° from stalk, slopes moderately across occiput, eye-region rounded.

Posterior centre *eyes* and laterals large, of about equal size, nearly equidistant, enclose a subcircular space, perceptibly wider than long; anterior centrals very small, separated from each other by nearly an eye's breadth, somewhat less than that interval from side-eyes of same row, which are divided by a space exceeding their diameter; line drawn across fore-margin of anterior centrals intersects fore-laterals.

Falces brownish-orange, oblong-oval, olive-brown mark on face; conical, directed inwards, stout, occupy breadth of clypeus; in length nearly equal radial + digital joints of palpus.

Maxillæ fulvous, olive-green tinge, base clouded with dark-brown; rather longer than broad, dilated somewhat forwards, obtusely pointed, inclined towards each other.

Labium similar coloration; conical, abscinded, length somewhat surpassed by breadth, rather more than one-half length of maxillæ.

Sternum yellowish, margin dark-chocolate, subcrenate; two somewhat angular interrupted brown bars in centre; two dots near the sharply-pointed apex; broad-cordate.

Legs greenish-yellow, spots and annulations olive-brown; femora have basal and nearly central annuli, resolved more or less into spots on superior aspect; tibial joints, ring on first half, somewhat broken into spots on first and second pairs; metatarsi show central and distal annulations of a lighter shade; hairs whitish, sparse; spines fairly numerous on all joints except tarsal; spines long and strong, metatarsal longest. Superior tarsal claws—fourth pair, rather fine, evenly curved, 5 open teeth; inferior claw fine, sharply bent, teeth (?)..

Palpi colour of legs; hairs sparse; few bristles; moderately strong, less than twice length of falces; palpal claw, well curved, 2 long curved teeth.

Abdomen ovate; greenish stone-colour, passing into a darker tone on lateral margins; anterior fourth stained with lake; markings dark olive-brown; dorsal aspect spotted, sparingly in centre, more thickly at extremities; basal end bordered by bars increasing in width forwards; lateral margins marked with interrupted, irregular, oblique streaks, terminating on posterior half in four well-defined, spotted, lanceolate figures encroaching on dorsum, inclined forwards; ventral field similar hue to dorsal, few spots; lighter parts of abdomen, except central area, moderately clothed with white hairs. *Vulva* represents a large, transverse, oval, lip-like projection, depressed and yellowish in centre; lateral margins reddish-brown, tumid.

Single example, taken in the forest near Stratford, *A. T. U.*

Fam. THURIDIIDÆ.

Gen. Ariamnes, Th.

Ariamnes flavo-notatus, sp. nov.

Femina.—Ceph.-th., long, 1. Abd., long, 1·6; depth at spinners, 1·1. Legs, 1, 2, 4, 3 = 8, 4·6, 3·4, 2·3 mm.

Cephalothorax brown, suffused with blackish-purple; transversely rugulose; few bristles on caput; broad-ovate, lateral constriction at caput slight; pars cephalica convex, ocular eminence rather prominent; *clypeus* visibly inclined forwards, height exceeds one-half depth of eye-area; pars thoracica convex, fovea oval, small; normal grooves moderately prominent; contour of profile represents a strong curve.

Eyes rather large; fore-pair dark; posterior row slightly procurved; centrals perceptibly smaller than laterals, separated from each other by a space scarcely equalling an eye's breadth, about twice that distance from side-eyes and fore-centrals, latter interval somewhat the shortest; anterior row recurved, median pair about one-third smaller than hind-pair, one-fourth their diameter from each other, separated from side-eyes by two-thirds their space; laterals posited obliquely on a stony tubercular eminence, contiguous.

Falces yellowish mahogany-colour; transversely rugulose; broad, somewhat flat, gibbous at base in front, vertical, equal digital joint of palpus in length; breadth more than one-half length, second half rounded on inner side, directed somewhat outwards, 4 stout teeth in outer row.

Maxillæ fulvous; somewhat linear, fore-half broadest and sharply bent over lip.

Labium, base fuscous, margins brownish; wider than long, tumid and somewhat truncated, transverse groove.

Sternum chocolate-brown; broad-cordate, studded with papillæ.

Legs brownish-yellow, three faint annuli on femora; patellæ brown; tibial joints have central and apical rings, narrower and more pronounced on hind-pairs; long, slender; armature dark hairs, few slender erect bristles.

Palpi straw-colour, except digital joints, which have a mahogany shade; slender, pars digitalis equals cubital + radial joints in length; few long hairs and fine bristles.

Abdomen, fore-half dark-brown, passing into a pale shade on posterior half and lateral margins, spotted with large stone-coloured flecks; elongate-ovate, profile somewhat triangular; distance from the lower angle—from which the rather long spinners project—to the rounded posterior extremity is slightly shorter than dorsal line. *Corpus vulvæ* yellowish; represents a transverse oval area, occupied by large ovate foveæ, intersected by a rather broad septum; a reddish-brown bead-like pimple projects above base of septum.

Single specimen captured in the forest near Stratford, *A. T. U.*

Gen. Linyphia, Latr.

Linyphia sennio, sp. nov. Plate XXI., figs. 15, 16.

Mas.—Ceph.-th., long, 2·1; broad, 1·8. Abd., long, 2·2; broad, 2. Legs, 1, 2, 4, 3 = 13, 10, 7, 5·5 mm.

Cephalothorax brownish-orange, light-fuscous shading mostly about median line, normal grooves and marginal zone; line composed of lake-coloured dashes bifurcates at limit of caput, joins posterior lateral eyes; triangular lake mark beneath fore-centrals; few black bristles, chiefly about occiput; oval, lateral margins of caput moderately compressed; pars cephalica convex, roundly truncated, eye-eminence prominent, angles cup-shape; facial index perceptibly exceeds lateral; *clypeus* inclined forwards, sides less tumid than female's, height equal to two-thirds space of fore-centre eyes; pars thoracica convex, fovea oval, deep, longitudinal; caput and radial striæ faint; contour of profile slopes across caput, perceptibly curved; angle of posterior inclination about 45°.

Posterior row of *eyes* slightly procurved, median pair scarcely their diameter from each other, three-fourths their space from lateral eyes; anterior row recurved; centrals dark, largest of eight, separated from one another and side-eyes by an interval slightly exceeding their own breadth; laterals contiguous, seated obliquely on a common, fair-sized, lake-coloured tubercular prominence.

Falces red-mahogany, passing into a darker shade at extremity; transversely rugulose; linear, vertical, moderately stout, length nearly equal to the pars humeralis of palpus.

Maxillæ long, linear-oval, somewhat pointed, inclined towards each other.

Labium nearly as long as broad, roundly pointed, everted, less than one-half length of maxillæ; organs orange-brown, base suffused with lake.

Sternum lake-colour, centre band yellowish, cordate, eminences opposite coxæ.

Legs light orange-yellow, lake stains on coxal joints; annuli light cinereous-brown, bordered and more or less suffused with lake; rings on thighs more or less evanescent, resolved into spots; two on patellar joints; four annulations on tibiæ of fore-pairs, three on hind-pairs; metatarsal joints have two annuli; hairs somewhat sparse, outstanding; spines long, slender, mostly project laterally; 4 spines on femora; patellæ, 2; tibiæ of first pair, 15; second, 10; metatarsi of first, 13; second pair, 8; tibial joints of hind-pairs, 5; metatarsi, 2 spines.

Palpi shade paler than legs; slender; pars humeralis rather surpasses cubital + radial joints together in length, thickens slightly at fore-end; cubital joint tapers somewhat to base, more than one-half length of penultimate article, projects two bristles; radial joint lageniform, fore-half tumid, prolonged above outer side into a reddish, flat, tapering process;. base slender; projects above long bristles; digital joint subglobose, about length of pars radialis; lobes lake-brown, appendages lake-black; laminæ bulbi yellowish-brown, passing into olive-green on fore-end; directed towards each other; hairs coarse, sparse; inversely ovate, broad, strongly convex; rise above bulbus; lamina on outer side exhibits a large moderately-deep concavity—segment of a circle—of nearly its own length, margin—base of segment intact, lake-colour; base of lamina at termination of cavity prolonged into a twin, submembranous, brownish, curved process, apices directed outwards; projecting from a ring on summit of lamina is a long, conspicuous, dark, cylindrical process, obliquely truncated, on its outer side, for nearly whole length; lobes of bulb wide, subvertical; first lobe of somewhat even width, figured with a blackish ciliate-like mark; second lobe rapidly compressed below, prolonged into a strong, black, forward-curved apophysis; above the latter organ is a large, broad, pitted, brownish-yellow, up-curved process; anterior appendage, viewed somewhat in front, represents a rather large compressed or pinched membranous process curving downwards to the large yellowish process.

Abdomen broad-oviform, depressed, sides abrupt, humeral tubercles large, conical, project outwards and backwards; profile of abdomen somewhat diamond-shaped; sparingly clothed with orange and black bristle-like hairs; stone-colour, approximating to olive-green: design formed by a series of re-curved irregular bands, composed of creamy-stone, purple margined and spotted, free and coalescing flecks; bands angular and more defined on posterior slope; lateral margins bordered by a brown band without very determinate limits; ventral field olive-stone colour, displays a broad transverse band of mixed normal colours.

Femina.—Ceph.-th., long. 3: wide, 2. Abd., long. 3: wide, 2·5. Legs, 1, 2, 4, 3 = 14. 10·1, 8·8, 6·5 mm.

Cephalothorax brownish-orange, lightly shaded, chiefly on grooves and margins, with black-brown; splashed, lake-coloured, bifurcating line extends from limit of caput to posterior lateral eyes; triangular lake mark on *clypeus*; hairs sparse, black, bristle-like; cephalothorax equal in length to metatarsal joint of first leg; oval, fairly compressed forwards; pars cephalica strongly convex, roundly truncated, lateral index scarcely equals facial; eye-eminence well developed; *clypeus* outwardly inclined, depth exceeds space between a fore-central and lateral eye next to it; an angular furrow beneath anterior row of eyes gives its tumid sides a conical (plano) form; pars thoracica convex; large circular depression on posterior slope; normal grooves faint; profile-contour rises from thoracic junction at an angle of 45°, slightly curved across caput.

Posterior row of *eyes* perceptibly procurved, centrals separated by an interval equal to an eye's breadth, their space from laterals; anterior row recurved, median pair larger than posterior centrals, somewhat less than their diameter from each other, rather more than that distance from hind-pair, interval between them and side-eyes surpasses one-half their space; laterals have the opalescent lustre of posterior centrals: smallest of eight, posited obliquely on a low, common tubercle, contiguous.

Falces red-mahogany, deepening in tone at fore-end: moderately strong, vertical.

Maxillæ light brownish-yellow, suffused with lake-brown: linear-conical, inclined moderately over *labium*, which is oval, about half as long as maxillæ, similar colour.

Sternum brown-yellow, suffused with lake; cordate, eminences opposite coxæ.

Legs yellow-orange, coxæ blotched with lake; femora have four interrupted light cinereous-brown rings, bordered with lake; tibiæ of fore- and hind-pairs have respectively 3 and 4 annulations; metatarsi, 2; hairs somewhat sparse; thighs armed with few black spines; patellæ, 2; tibiæ of first and second, 15 + 8, hind-tibiæ 4 + 8, long black spines; metatarsi of first pairs, inner row of 6 projecting spines surpassing tibials in length, 6 outer somewhat shorter; metatarsal joints of second pairs, 4 + 6 similar spines; metatarsi of hind-pairs have 2 centrally-placed strongish spines. Superior tarsal claws —first pair, somewhat shortly bent, 4 teeth increasing in length and strength; inferior claw long, fine, sharply bent, small points.

Palpi coloration of legs; strongish bristles; slender, as long as cephalothorax; palpal claw less bent than tarsal; 4 teeth similar in form to teeth of tarsal claws.

Abdomen does not differ essentially in form or coloration from male's. *Corpus vulvæ* orange-brown, clouded with brownish-lake; represents a large transverse oval eminence: somewhat clathrate; median line concave; above the rima genitalis is a large, rather deep, oval fovea, laterally bounded by blackish tumid costæ; a semi-free dark costa forms a somewhat depressed arch in line with margin of fovea, the involute basal ends confluent with outer costæ.

Several examples of this brightly-coloured species were captured amongst shrubs in the forest near Stratford, and on Mount Egmont, *A. T. U.*

Linyphia multicolor, sp. nov.

Mas.—Ceph.-th., long, 1·5; broad, 1·1. Abd., long, 1·7; broad, 1·3. Legs, 1, 4, 2, 3 = 10, 6, 5·5, 4·5 mm.

Cephalothorax brownish amber-colour, streaked with lake, lateral borders lightly suffused with a blackish-olive; median band tapering, stretches from frontal margin to fovea. mottled with a deeper hue; glabrous; broad-ovate, depressedly convex; ocular eminence prominent; *clypeus* nearly vertical, height equals one-half facial space; thoracic fovea oval, deep; caput and radial striæ tolerably strong; profile-contour represents a slight posterior incline.

Eyes rather large, hind-centrals and laterals opalescent; posterior row slightly procurved, median pair about one-fourth larger than fore-centrals, removed from laterals by an interval scarcely equalling their diameter, and from each other by rather more than one-fourth that space; anterior row recurved, centrals posited somewhat obliquely on strong prominences, nearly twice their breadth apart, separated by rather more than that distance from hind-pair, about their radius from side-eyes; laterals fully as large as anterior centrals, seated obliquely on a strong eminence, contiguous.

Falces light-red mahogany; of somewhat even width, moderately gibbous at base in front, second half divergent, perceptibly inclined outwards, moderately stout, length equals twice depth of clypeus.

Maxillæ yellowish-mahogany, suffused with olive on first half; spathulate, base dilated, long, moderately inclined towards each other.

Labium fulvous, nearly twice as wide as long, rounded, perceptibly emarginate, scarcely reaches second half of maxillæ.

Sternum brownish, fulvous, heart-shaped figure with seven acute projections occupies centre; broad-cordate.

Legs and cephalothorax concolorous, annuli light chocolate-brown; central and distal rings on femoral joints tinged with olive-green; three annulations on tibiæ, basal more or less obliterated; centre and apical rings on metatarsi; hairs sparse; very few bristle-like spines, longest and strongest on patellæ, which project two.

Palpi colour of legs; humeral joint about one-third longer than two following articles; pars cubitalis dilated forwards, projects a long bristle; pars radialis rather surpasses former article in length, cup-shaped, deeply emarginate at insertion of lamina, few long bristles; laminæ bulbi orange-brown, hairs fine, sparse; directed towards each other; basal two-thirds subobovate, broad, fore-third moderately compressed, tumid, upturned; genital bulb colour of lamina, cap consists of two membranous lobes, base of lowest produced into a short, dark, triangular process; suspended from front of bulb is a wide, sharply-constricted, dark-margined, membranous process, directed downwards and outwards; next to it is a larger appendage of somewhat similar form, whose compressed extremity is wider and more distinctly curved; base enclosed by a subtriangular dark-bordered lobe.

Abdomen oviform, strongly convex, almost glabrous, folium extends over first half, sublanceolate, olive-brown, series of free and coalescing fuscous flecks along margins; the blackish petiole exhibits on either side a conspicuous oblique white bar; second half of dorsum displays an olive-brown, dark-spotted, oval mark; median band creamy-white, lake stains, fore-half formed by two triangular figures enclosing two lake-coloured dots; lateral margins light olive-brown, dark fuscous spots interrupted by creamy marks, most conspicuous along border of dorsal pattern, lake stains; blackish olive-green shield on ventral surface, constricted above spinners, white spot in each indentation.

Single example, captured in the forest near Stratford, *A. T. U.*

Linyphia cruentum, sp. nov.

Mas.—Ceph.-th, long, 2; wide, 1·8. Abd., long, 2·3; wide, 1·2. Legs, 1, 2, 4, 3 = 12·5, 7, 6·5, 5 mm.

Cephalothorax fulvous, splashed with lake, median band shaded with brown, tapers slightly from hind-lateral eyes to base; few coarse hairs on caput; clathrate; pars cephalica convex, ocular prominence moderate; facial index equals one-half breadth of thorax, lateral index under two-thirds of former; *clypeus* convex, depth equal to two-thirds length of eye-area; thoracic part broad-oval, fovea transverse broad-oval; normal grooves well defined; profile-contour slopes backwards with a slight double arch.

Eyes of moderate size, on dark rings; posterior row perceptibly procurved; centrals rather less than an eye's breadth apart, a diameter and a quarter from laterals, visibly less than that interval from fore-centrals; anterior row moderately recurved, median pair rather smallest of eight, separated by rather more than their diameter, three-fourths their breadth from side-eyes; laterals have the pearly lustre of hind-centrals, posited obliquely on a dark common tubercular eminence, contiguous.

Falces colour of cephalothorax; outwardly inclined, somewhat gibbous at base, second half tapering, curves upwards and outwards.

Maxillæ fulvous, yellowish reflections, passing into mahogany-brown at apices; long, somewhat enlarged at extremities, pointed, rounded on superior side, sharply truncated on inner side, inclined towards each other; furnished with stiff bristles.

Labium and maxillæ concolorous; more than one-third length of latter, large, rather wider than long, roundly emarginate.

Sternum light olive-brown, spotted and bordered with brown; subcordate, nearly as wide as long between first pair of coxal joints.

Legs orange-yellow, passing into orange-lake on fore-ends of femoral joints, first pair most shaded; tibiæ have two or three not-well-defined orange-lake annulations; metatarsi two; legs strong; bristle-like hairs on femoral joints, more especially clustered on inner side of first pair, and on superior surface of hind-pairs, which are armed beneath with a double row of bristle-like spines, strongest on second and third legs; patellæ, 1 spine; single row beneath tibiæ + metatarsi. Claws weak.

Palpi light orange-yellow; pars humeralis fully one-third longer than cubital + radial joints; pars cubitalis short, dilated forwards, projects a strong black bristle; pars radialis twice length of former article, outer side prolonged, much enlarged forwards, rounded, armed at extremity with a row of strong long bristles; viewed from inner side somewhat cup-shaped, short; digital joint about as long as cubital + radial joints together, well developed; laminæ bulbi reddish mahogany-colour; moderately furnished with stiff black hairs; oval, directed towards each other; genital organs partially covered by a brownish-yellow, spotted membrane, projecting forwards from beneath is a greenish, elongate, pointed process, which, viewed from beneath, discloses a membranous truncated process, margins involute; immediately under it is a brownish curved lobe, convex side directed backwards; extremities prolonged, free, upper tapering, lower—not visible from outside—somewhat membranous; bulb partially enclosed on lower side by a greenish, somewhat oval, or pointed membrane.

Abdomen elongate-oviform, yellowish stone-colour; folium covers dorsal region, deeper tone, green tinge, second half stained with lake, margins sinuating, olive-black, interrupted, centre pair of curves creamy-white; median band exhibits a series of six large creamy-white spots on first quarter; irregular-shaped figure near centre, of similar colour; second half displays three tapering groups of coalescent, yellow, lake-tinged spots; oblique brown marks on lateral margins; ventral shield brown.

Forest, Stratford, *A. T. U.*

Linyphia albi-apiata, sp. nov.

Mas.—Ceph.-th., long, 1·7; wide, 1·1. Abd., long, 1·5; wide, 1. Legs, 1, 4, 2, 3; 1st pair, 5·4 mm.

Cephalothorax light-brown, green tinge, shaded, especially on lateral margins and radii, with olive-brown: clathrate: oval; pars cephalica convex, not constricted at junction with thorax, lateral index surpasses facial, ocular eminence prominent; *clypeus* subvertical, depth equal to two-thirds length of eye-area; pars thoracica convex, fovea deep, somewhat triangular, apex directed forwards; caput striæ strong, thoracic moderate; profile-line rises moderately, with an even contour, from the stalk, rounded across occiput.

Eyes on dark rings, enclose a linear-oval space; posterior row of tolerable and about equal size; centrals scarcely two-thirds of an eye's breadth apart, one-fourth more than their diameter from laterals; median pair of anterior row dark, much the smallest of eight, separated from one another by a distance perceptibly less than their radius, and from side-eyes by an interval surpassing their diameter, divided by more than their space from hind-centrals; laterals have the pearl-grey lustre of posterior median pair, fore-eye somewhat the largest, seated obliquely, about one-fourth their breadth apart, on a low, dark, tubercular eminence.

Falces brownish, lightly clouded; rugulose; strongly inwardly inclined; base tumid, fore-third divergent; about twice as long as broad at base; length exceeds width of eye-area by nearly one-third.

Maxillæ yellowish-brown; stout, fore-half dilated, pointed; somewhat inclined towards each other.

Labium fuscous; pale apex; perceptibly broader than long, margin tumid, everted.

Sternum dark mahogany-brown; cordate.

Legs yellowish, annulations greenish-black; femora show basal and subcentral rings, faint on two first pairs; tibiæ + metatarsi have two rings, first on basal half, second at apex; tarsi one; legs moderately stout, first and second somewhat exceed third and fourth in length and strength; hairs sparse, fine; few erect, black, bristle-like spines on all joints except tarsal.

Palpi, humeral joint yellowish, surpasses cubital + radial together in length; cubital joint broad: radial pale-straw-colour; few bristle-like hairs; wide at extremity; pars digitalis about one-third longer than penultimate article; lamina oval, tapering, prolonged for nearly half its own length beyond bulbus, armed with strong bristles; accessory lamina oval, projects somewhat beneath, extends nearly half-way across bulb; genital bulb yellow, fore-end and apophysis splashed with red; subobovate, depressed above, prolonged into a rather wide, grooved, subfree apophysis, which is sharply bent backwards on superior face nearly to base of bulbus, from thence bent upwards, its short darkish free end curving over its own base, which projects a rather short, black, curved process from beneath the free end.

Abdomen oviform; dorsal field light stone-colour, flecks lobate, large, creamy-white, more pronounced round fore-margin; displays a black sublanceolate figure in front, haft terminates half-way to spinners; black spot on either side close to lance-head; sides bordered by two wide bands, upper greenish-black; lower brownish, white flecks; ventral surface brown.

Femina.—Ceph.-th., long. 1·8; broad, 1. Abd., long. 1·6 broad, 1. Legs, 1, 2, 4, 3. Leg of 1st pair, 4·5 mm.

Cephalothorax reddish-brown, shaded, chiefly on margins and grooves, with a darker tone; almost glabrous; clathrate; oval, constriction at caput slight; pars cephalica strongly convex, truncated; lateral index about equals facial; *clypeus* directed forwards, slightly shorter than depth of ocular area; pars thoracica convex, fovea elliptical, longitudinal; normal grooves fairly strong; profile-contour rises at an angle of 40°, almost horizontal across occiput, slopes at eye-region.

Eyes rather large; posterior row slightly procurved, median pair an eye's breadth from laterals, about two-thirds that space from each other; anterior row sensibly recurved, centrals about one-third smaller than posterior pair; scarcely their radius from one another, removed from side-eyes by an interval equal to their diameter, and from hind-centrals by rather more than that space; laterals have the pearl-grey lustre of posterior median eyes, surpass them in size by about one-third, placed obliquely, one-fourth their breadth apart, on moderately stout tubercular prominences.

Falces orange-brown; clathrate; tumid at base, taper somewhat, divergent, vertical, stouter than the femur of first leg, nearly as long as radial + digital joints of palpus.

Maxillæ yellow-brown, clouded with brown; strong, fore-half dilated, pointed, moderately inclined towards each other.

Labium, base dark-brown, margins yellow-brown; rather wider than long, margin tumid, everted.

Sternum dark mahogany-brown; clathrate, cordate, conoid prolongation between posterior coxæ.

Legs brownish-yellow, moderately wide greenish-black annulations; basal and nearly central rings on femora, faint on two fore-pairs; tibiæ + metatarsi have central and apical annuli; legs strong, first and second, third and fourth do not differ much in length or strength; hairs rather sparse; femoral spines short, sparse; genual, tibial, and metatarsal spines tolerably long and numerous.

Palpi colour and armature of legs; slender, about equal to cephalothorax in length.

Abdomen oviform; dorsal area light stone-colour, flecks rather large, lobate, creamy-white; somewhat ill-defined black lanceolate figure on fore-part, haft extends midway to spinners; black spot on either side near base of lance-head; lateral borders display two broad bands, superior band greenish-black, inferior stone-colour; ventral surface brown; *corpus vulvæ* pale-brown, mottled with greenish-black; transverse oval area, projects over the rima genitalis, indented by two yellowish foveæ; lateral margins shortly involute, red-tipped; centrally produced into a yellowish, moderately broad and long, emarginate, upcurved scapus.

Stratford, *A. T. U.*

Linyphia pellos, sp. nov. Plate XXI., fig. 10.

Mas.—Ceph.-th., long, 2·5; wide, 1·8. Abd., long, 2·9; wide, 1·8. Legs, 1, 2–4, 3 = 9·8, 7·5, 6·8 mm.

Cephalothorax creamy stone-colour, base of caput displays oval patches of a gamboge hue, with rather faint blackish margins on outer side, prolonged forwards into angular marks; narrow streak intersects hind-central eyes; darkish line extends backwards from each lateral eye; red thoracic indentation, enclosed by a broad, gamboge-coloured patch; radial striæ and marginal zone faintly defined by blackish streaks: two spots of a similar shade occur on each side on fore-half; almost glabrous; oval; pars cephalica large, nearly squarely truncated; lateral index less than facial; convex, sides abrupt; pars thoracica convex, normal grooves slight; medial indentation longitudinal; profile-line rises from thoracic junction at an angle of 60°, runs nearly horizontally to base of caput, from thence slightly arched; *clypeus* vertical, depth about equal to space occupied by anterior central eyes.

Posterior row of *eyes* rather strongly procurved, of fair and nearly equal size; central pair on dark-brown oval spots, rather the largest, and placed somewhat closer together; anterior row slightly recurved, of about equal size, less than two-thirds smaller than hind-centrals; median pair on dark rings, separated by an interval exceeding their diameter, scarcely one-fourth more than that space from side-eyes; laterals divided by an interval surpassing breadth of a fore-eye, posited on separate low, brown, tubercular eminences, posterior strongest.

Falces mahogany-brown; transversely rugulose; conical, vertical, perceptibly exceed humeral joint of palpus in length; rather stouter than a femoral joint; coarse black hairs.

Maxillæ linear, rounded, perceptibly truncated on superior side; slightly inclined towards *labium*, which is oval, apex emarginate; rather narrow, one-half length of maxillæ; organs yellowish-brown, clouded with a deeper shade.

Sternum subovate, nearly as broad as long, sharply compressed, tapers between coxæ; yellow-brown.

Legs, femoral, genual, and tibial joints yellowish, faint-green tinge; about four not very clearly-defined annulations of a deeper hue on pars femoralis + tibialis; metatarsi stone-colour, three brown annuli, darkest on hind-pairs; legs slender, second and fourth of about equal length; tarsal claws—first pair, strongly curved, 11 comb-teeth, form an even line from base to apex; inferior claw sharply bent, 2 open teeth; hairs sparse, spines rather strong.

Palpi, pars humeralis pale greenish-yellow, slightly exceeds cubital + radial joints in length; cubital joint colour of humeral, viewed from above somewhat ovate, fore-end rather the widest; radial joint light sienna-brown; furnished with few long bristles; more than one-third longer than former article, somewhat linear, bent into an obtuse angle; projecting from base is a wide and long, viewed from above somewhat ear-shaped process, whose outer margin is armed with well-developed tooth-like serrations, basal strongest; beneath its apex is a tumid, yellowish, somewhat semi-egg-shaped protuberance; midway between the latter and base of process is a moderately stout, reddish apophysis, whose apex curves backwards; lamina light-brown, ovate, pointed, strongly convex, moderately hairy; genital bulb convex behind, deeply concave in front; anterior surface chocolate-brown, extends nearly to terminal third of lamina; posterior end yellowish-brown, pale within, somewhat membranous, prolonged forwards and inwards, on inner side, into a stout, moderately-curved process; most remarkable appendages within bulbus are three fine black apophyses, upper curves backwards from extremity of bulb; lower apophysis, basal half broad, membranous, curved forwards; third apophysis of similar form, springs from inner side of bulbus; directed forwards, above lower apophysis, is a broad, pale appendage drawn out on upper side into a black, strong, claw-like process, small tooth-like serrations; suspended in front of this organ is a broad, membranous, pale-yellowish process, apex emarginate.

Abdomen oviform; light yellow-brown, clouded with brown, dorsal band creamy colour, somewhat triangular-lanceolate.

Single specimen captured on Mount Egmont, *A. T. U.*

Gen. THERIDIUM, Walck.

Theridium punica-punctata, sp. nov.

Femina.—Ceph.-th., long, 1·4; wide, 1. Abd., long, 2·5; wide, 2. Legs, 1, 2, 4, 3 = 7·5, 5, 4·5, 3·2 mm.

Cephalothorax brownish-yellow, caput-grooves reddish; hairs sparse; pars cephalica convex, roundly truncated, lateral index equals half facial; *clypeus* projecting, indentation below eyes moderate, in height equal to two-thirds depth of ocular area; pars thoracica oval, convex; fovea oval, radial and caput striæ fairly well defined; profile-line somewhat level to posterior inclination, latter about 45°.

Eyes of tolerable and nearly equal size, on black spots; posterior row moderately procurved, median pair rather closer to each other—a space visibly exceeding an eye's breadth—than they are to laterals; anterior row recurved, curvature perceptibly stronger than posterior line; centrals dark, smaller than hind-pair, rather more distant from one another than they are from hind-centrals, an interval slightly exceeding their breadth; less than their diameter from side-eyes; hind-lateral eyes about equal to anterior centrals in size, fore-eyes smaller, posited obliquely on a common, lake-brown, tubercular eminence, contiguous.

Legs fulvous; hairs light, sparse; few slender black bristles; moderately strong.

Palpi colour and armature of legs; slender, rather shorter than cephalothorax.

Falces shade deeper than cephalothorax; sublinear, vertical; teeth form two rows on truncated apex, outer row 3 teeth, strongest projects from inferior angle of falx, inner composed of 5 small teeth.

Maxillæ strong, spathulate, inclined over *labium*, which is wider than long, rounded, somewhat flattened at apex, less than one-half length of maxillæ; organs light yellowish-brown.

Sternum greenish-yellow, metallic reflections; lozenge-shape, breadth equal to about three-fourths its length.

Abdomen oviform, convex; ground-colour stone-brown (possibly green tinge in fresh examples), dorsal band rather broad, widens somewhat in centre, composed of numerous confluent creamy-white flecks; median streak vein-like, stained with bright-yellow; in centre of dorsum are two large pinkish-lake patches, separated by their own breadth; inferior half of lateral margins spotted with creamy-coloured flecks. *Vulva* represents three equal-sized, closely-grouped foveæ, arranged in triangle; apical fovea above the rima genitalis represents a brown rimed orifice; hind-pair little more than brownish, purple-margined circular figures.

Captured in the forest near Stratford, *A. T. U.*

Theridium apiatum, sp. nov.

Female.—Ceph.-th., long, 2; broad, 1·8. Abd., long, 3·4; broad, 2·9. Legs, 1, 4, 2, 3 = 13·2, 9·3, 8, 7·3 mm.

Cephalothorax deep yellow-brown, median band marbled with chestnut-brown, tinge of lake; broad, as wide as eye-area at hind-row, divided to fovea by a narrow streak; lateral band broad, lake-brown; few coarse hairs on caput; rather flatly convex, roundly truncated, lateral index equals space from a side-eye to hind-central furthest from it; *clypeus* inclined moderately forwards, scarcely equal to one-half facial space; pars thoracica oval, fairly convex; fovea subcircular, deep; normal grooves somewhat slight; contour of profile rounded behind, angle about 40°, slope forwards moderate, visibly curved.

Eyes tolerably large, on dark rings; enclose an oval space; posterior row of equal size, divided from one another by an interval perceptibly surpassing an eye's breadth; median pair their diameter and a half from fore-centrals; median eyes of anterior row one-fourth smaller than posterior pair, separated by their breadth and one-half; form with hind-centrals a quadrilateral figure widest in front; visibly more than their diameter from side-eyes; laterals contiguous, fore-eye rather the smallest; placed obliquely on a common, strong tubercle: have the pearl-grey lustre of posterior centrals.

Legs straw-colour; femora, patellæ, and tibiae of first pair tinged with dark-orange; spotted—especially two first pairs—with lake; three brown-lake annuli on tibial + metatarsal joints of first and second; black-brown rings at extremity of three hind-pairs; first half of thigh of fourth pair black-brown; third and fourth have annuli on patellæ, and central and apical rings on tibial joints; similar but fainter annulations on metatarsi; hairs and bristles sparse.

Palpi pale-orange; hairs rather sparse; short bristles on cubital joint.

Falces fulvous, lake-coloured reflections at extremities; somewhat linear, vertical.

Maxillæ pale-yellow, suffused with orange; large, spathulate, tapering at extremities, inclined towards each other.

Labium yellowish, base greenish; nearly semicircular, somewhat truncated, less than half length of maxillæ.

Sternum pale greenish-yellow, metallic reflections, dark-lake flecks on side borders; triangular, about three-fourths as wide at base as long.

Abdomen oviform, convex; fore-third of folium without any determinate limits, gradually fades into ground-colour; centrally displays two pairs of crenatures, fore-pair twice as wide as hind; posterior third ovate; dull pale-brown (perhaps with an olive tinge in fresh examples), marbled with lake, border lake-black; median band broad, creamy-white on fore-third, centre part hastate, stained with lake and yellow; obliterated posteriorly; lateral margins shade lighter than folium, marbled with dull-purple; ventral region greenish-yellow, median band dull-lake; wide subtriangular mark of similar colour behind vulva. *Corpus vulvæ* black; oval, surrounded by two costæ rapidly widening in front, deeply cleft above the rima genitalis by a longitudinal, narrow-ovate, yellowish depression, on either side of depression is a broad-ovate fovea.

Stratford, *A. T. U.*

Theridium literatum, sp. nov.

Female.—Ceph.-th., long, 1·6; broad, 1·4. Abd., long, 3; broad, 2·3. Legs, 1, 2, 4, 3 = 8·2, 7, 6·4, 4·5 mm.

Cephalothorax amber-colour, median band on caput mahogany-brown, broad, somewhat crenate; marginal zone lightly pencilled with olive-brown, deeper tone on clypeus; few bristles; pars cephalica convex, roundly truncated, lateral index short; *clypeus* inclined rather forwards, height rather more than one-half facial space; pars thoracica broad-oval, convex; fovea elliptical, longitudinal; normal grooves fairly well defined; profile-line rises from thoracic junction at an angle of about 45°, slopes across caput with a slight curve.

Eyes large, on dark rings; posterior row nearly straight; centrals rather further from laterals than they are from each other, a space equal to three-fourths their diameter, removed from fore-centrals by about the former interval; anterior row moderately recurved; median eyes about one-fourth smaller than posterior pair, separated from one another by rather less than their diameter, and from side-eyes by an interval perceptibly shorter than their radius; laterals visibly larger than hind-centrals, have their pearl-grey lustre, contiguous, posited obliquely on moderately strong, dark, tubercular eminences.

Legs shade lighter than cephalothorax, lightly mottled, especially on thighs, with olive-green; two not strongly pronounced brown annuli on femoral, tibial, and metatarsal joints; basal rings on femora more or less obliterated; moderately slender; fairly furnished with hairs; few very slender spines; superior tarsal claws—first pair, 16 teeth, 14 rather even open comb-teeth, 2 basal small; free end moderately curved; inferior claw sharply bent, 2 points.

Palpi colour and armature of legs; humeral joint rather shorter than digital, and longer than genual and radial together; palpal claw 10 teeth, 7 strong, 3 basal smaller.

Falces amber-colour, fore-part mottled with olive-green, bare, semi-oval patch on base; conical, vertical, less than one-fourth shorter than digital joint of palpus, as stout as thighs of second pair of legs.

Maxillæ yellowish, large, oval, orange-brown patch in centre; stout, fore-half semi-elliptical, inclined towards lip.

Labium darker than maxillæ; semicircular.

Sternum yellow-brown, mottled with olive-green; clathrate; broad-cordate.

Abdomen oviform, depressed above, cone-shaped elevation on base; hairs moderately sparse, orange-red, spring from orange-red papillæ; integument greenish stone-colour; summit of cone whitish, fore and lateral margins clouded with olive-black; a large, somewhat W-shaped mark of same hue on posterior inclination above spinners, which have an orange colour; ventral surface normal colour; vulva yellowish, marbled with brown and olive-green; represents a large, somewhat quadrate projection; tapering forwards from basal angles is a moderately convex elevation—projecting rather beyond line of fore-angles, which are somewhat membranous—whose dark, obliquely-abscinded apex displays a heart-shaped fovea, apex of which is directed upwards.

Captured in the forest, Stratford, *A. T. U.*

ERYCINA, gen. nov.

Cephalothorax oval, lateral constriction at caput moderate, roundly truncated; profile-contour slopes forwards from limit of cephalic region, inclination more abrupt across ocular area, posterior incline moderately steep; *clypeus* slightly retreating, depth about equal to space between fore-centre eyes.

Eyes form two moderately-recurved rows, anterior strongest; posterior median pair and laterals of about equal size, posited on well-developed cup-shaped tubercular eminences; hind-centrals very perceptibly more distant from each other than they are from side-eyes; anterior centrals less than one-half size of laterals, seated obliquely on a low prominence, rather further from one another than they are from eyes next to them; laterals placed obliquely, interval between them perceptibly surpasses space dividing a fore-lateral from the hind-central nearest to it, an interval exceeding the distance between posterior median eyes.

Falces strong, second half divergent and somewhat attenuated, vertical, or slightly retreating.

Maxillæ rather longer than broad, taper to base, obtusely pointed.

Labium rather wider than long, margin very tumid, everted.

Sternum cordate; length scarcely exceeds the greater breadth.

Legs long, slender, 1, 2, 4, 3; hairs sparse; few fine bristle-like spines on the femoral, patellary, and tibial joints.

Palpi slender, digital joint longest.

Abdomen broad-oviform.

Erycina violacea, sp. nov. Plate XXI., figs. 4, 14, 17.

Mas.—Ceph.-th., long, 1·1. Abd., long, 1·7. Legs, 1, 2, 4, 3 = 6·9, 4·5, 4·2, 2·8 mm.

Cephalothorax pale yellowish-sienna; median band broad, olive-black, bifurcated on caput, limited by the hind-centre and lateral eyes; marginal zone rather wide, deeper shade; almost glabrous; clathrate; oval, lateral compression at caput slight; pars cephalica roundly truncated, convex, sides somewhat abrupt; *clypeus* perceptibly inclined towards falces, depth visibly exceeds space between fore-centre eyes; pars thoracica convex, indentation somewhat large and oval; caput and radial striæ faint; profile-line represents a slight curve across fore-end of caput, rises over a moderately prominent, rounded hump, from thence dips to thoracic junction at an angle of 60°.

Posterior median and lateral *eyes* of about equal size; hind-row moderately recurved, centrals seated on fair-sized tubercles, black oval spots; rather closer to side-eyes than they are to each other, an interval scarcely equal to an eye's breadth and a half, separated by about twice that distance from fore-centrals; anterior row more distinctly recurved; median pair rather smallest of eight, posited obliquely on a somewhat low elevation, their diameter and a half apart, less than that interval from side-eyes; laterals placed obliquely on cup-shaped tubercular prominences, space between them—which surpasses that dividing posterior centrals—rather exceeds the interval separating a fore-lateral eye from the hind-central nearest to it.

Falces light raw-sienna, slightly clouded; transversely rugulose; stouter than thighs of first pair of legs, somewhat linear, about twice as long as broad.

Maxillæ yellowish, green tinge, lightly clouded; length somewhat surpasses breadth, enlarged forwards, obtusely pointed, rather wide apart.

Labium fuscous; broader than long, margin very tumid, everted.

Sternum yellowish-brown, passing into brown about margins; broad-cordate, slight eminences opposite coxal joints.

Legs paler shade than cephalothorax, faint greenish annulations at apices of joints; hairs somewhat sparse; spines bristle-like, 3 or 4 on femoral + tibial joints; 1 on patellæ.

Palpi and legs concolorous; humeral joint somewhat incrassated forwards, rather exceeds in length cubital + radial joints together; pars cubitalis convex, perceptibly dilated in front; radial joint cup-shaped, slightly surpasses former article in length; pars digitalis large, lamina placed somewhat beneath bulb, fulvous, suffused with reddish-brown; hairs fine, sparse; broad-oval, basal half enlarged on inner side, projects about midway to apex a flattish process of its own colour, rather longer than wide, directed outwards and forwards; two similarly-directed processes spring from basal curve, inner linear, apex rounded, concave above, reddish margins, extends to anterior process; outer acute, less than half length of inner process; bulbus genitalis spiral (plane), basal curve pale brownish-yellow, superior surface brownish-amber, apical curve displays a conspicuous black beaded margin, free end rather wide, tapering, blackish; attached to centre of bulb by a wide, veined, membranous keel extending nearly its entire length.

Abdomen oviform; folium lyrate; violet-drab, margins dark-brown, broad fore-half displays a few somewhat silvery flecks; posterior half lightly suffused with a gamboge-brown, flecks yellow, metallic; constricted to about two-thirds width of fore-part, very acutely-crenate; superior streak on lateral margins broad, green tinged gamboge-brown, spotted with large silvery flecks; inferior streak widest, mottled with dark-brown, few metallic flecks; shield on ventral surface light chocolate-brown, bordered with a fine silvery line, three pale dots form a triangle near spinners.

Femina.—Ceph.-th., long, 1·5; broad, 1·2. Abd., long, 2·5; broad, 2·1. Legs, 1, 2, 4, 3 = 6, 4·8, 4, 2·5 mm.

Cephalothorax light raw-sienna colour, median band broad, olive-black, extends from fovea to hind-pairs of eyes, bifurcates on caput; side-border greener hue; few bristles; clathrate; broad-oval, fairly compressed forwards; pars cephalica convex, roundly truncated, sides rather abrupt, lateral index equals three-fourths facial, shows two circular indentations placed transversely nearly midway between frontal line and posterior limit; pars thoracica convex, indentation at posterior incline broad-oval, caput and radial striæ somewhat slight; profile-contour rises from thoracic junction at an angle of 45°, perceptibly curved over occiput, slopes moderately across ocular area; *clypeus* directed slightly inwards, depth scarcely equals space dividing fore-centre eyes.

Eyes on black oval spots; posterior row only moderately recurved, median eyes posited on strong cup-shaped tubercular eminences, rather more distant—twice an eye's diameter—from each other than they are from laterals; anterior row more distinctly recurved, centre pair less than one-half size of laterals, seated obliquely on a low prominence, about twice an eye's breadth apart, somewhat less than that interval from side-eyes, rather more than double their dividing-space from posterior median pair; laterals equal hind-centrals in size, seated obliquely on well-developed cup-shaped tubercles, rather more distant from each other than the fore-lateral eye is from the hind-central nearest to it.

Falces glossy, dark amber-colour, base clouded with olive-green; sub-conical, slightly retreating, second half somewhat divergent, nearly as stout as femoral joint of first leg, length slightly surpasses digital joint of palpus.

Maxillæ brownish-yellow, lightly clouded with olive-green; rather longer than wide, enlarged forwards, obtusely pointed, separated by an interval nearly equalling their own breadth.

Labium chocolate-brown; rather wider than long, margin tumid, everted.

Sternum yellow-brown, shading off to a deep-brown on margins; hairs sparse; cordate, length scarcely exceeds breadth between coxæ of fore- and hind-pairs of legs.

Legs colour of cephalothorax, femora faintly clouded and annulated with olive-green; two rings on tibiæ + metatarsi of a brownish hue; hairs sparse, outstanding; spines bristle-like; 3 or 4 on femora; patellary joints, 1; tibiæ of anterior pairs, 4; metatarsi, 1; tibiæ of hind-pairs, 2 spines; metatarsi, 1.

Palpi yellowish, clouded with olive-green; slender, rather shorter than cephalothorax; armature bristle-like hairs, few slender spines; palpal claw long, slender, slightly curved, free end more than half length of claw, 6 comb-teeth increasing in length.

Abdomen broad-oviform, projects over base of cephalothorax, viewed laterally somewhat reniform; ground-colour yellowish-drab, faintly suffused with purple-brown approximating to violet, flecked with more or less oval creamy-coloured spots, bordered with violet-brown; folium sublyrate, margins interrupted, brown, yellow outer border, fore-half nearly twice as broad as posterior; ventral field and inferior half of lateral margins greenish-black, figured with oblique marks and free and coalescing spots; shield lozenge-shape, broad, sides sinuating; yellowish, passing into pale-purple on margins, centre clouded with dark-olive.

Vulva yellow-brown, somewhat ⊥-shaped, moderately elevated, transversely rugulose; displays two small, reddish, elliptical foveæ, their greater diameter intersected by a septum whose breadth nearly equals their transverse diameter, septum bordered by dark costæ, which rapidly diverge round foveæ, extend outwardly above the rima genitalis, following somewhat the lower margin of two large, convex, oval, transverse depressions, contiguous to foveæ.

This species was not uncommon in the forest near Stratford, male examples by far the most numerous. *A. T. U.*

Gen. CORNICULARIA, Menge.

Cornicularia crinifrons, sp. nov. Plate XXI., fig. 3, 11.

Mas.—Ceph.-th., long, 1·4; broad, 1. Abd., long, 2·8; broad, 1. Legs, 1st pair missing, 2, 4, 3 = 10·6, 9, 5·5 mm.

Cephalothorax fulvous, eye-area red-mahogany colour, shaded with brown, sharply defined, connected by a wide streak with a brown-bordered lanceolate figure extending to fovea, latter reddish; marginal zone narrow, dark-brown; middle band represented by a series of dots on radial ridges; cephalic tubercle furnished with numerous strong hairs, directed outwards and forwards; pars cephalica elevated, laterally rounded, prolonged into a strong tubercle, apex rounded, rather more than one-third length of caput; *clypeus* directed moderately forwards, height nearly equals depth of ocular area; pars thoracica nearly circular, convex, border-hem wide, fovea circular, deep; radial striæ deeply grooved, caput striæ moderately; contour of profile slopes backwards from summit of caput to posterior limit at an angle of about 30°, with a visible curve, dome-shaped on thorax.

Eyes do not differ much in size, form a circlet on cephalic eminence; posterior eyes of about equal size, centrals closer to each other—a space less than twice an eye's breadth—than they are to laterals; anterior row equidistant, median pair dark, smallest of eight; laterals have the pearl-grey lustre of hind-median eyes, posited obliquely, contiguous.

Falces brownish-amber, glossy; subconical, anterior fourth divergent, directed somewhat forwards, moderately stout, length rather less than twice height of clypeus.

Maxillæ fulvous, pale about extremities; rather longer than broad, obtusely pointed, strongly developed at insertion of palpi, inclined over *labium*, latter organ fulvous, breadth somewhat surpasses length, apex pinched, lip-like, less than half length of maxillæ.

Sternum fulvous, broad, well-defined heart-shape.

Legs light brownish-yellow; femora of second, third, and fourth pairs have respectively 5, 3, and 4 light-brownish rings, tibiæ 4, 2, 2; legs very slender; hairs sparse, few fine bristles; superior tarsal claws—second pair, long, rather slender, moderately curved, 5 or 6 small teeth, 1 long, strong tooth, free end forms nearly half the claw, tip bent; inferior claw three-fourths length of superior, sharply bent, base stout; apparently small teeth.

Palpi colour of legs; humeral joint surpasses cubital + radial by one-fourth; contour of cubital joint has somewhat the form of an isosceles triangle; on apex—which projects above its articulation with penultimate article—is a stout, curved, black spine; two serrations on central third, anterior side;

moderately long bristle behind; radial joint linear, fully equals the greater length of former article; laminæ bulbi obovate, directed towards each other; hairs sparse; margin at base, outer side, turned up, forming an oval, deep depression above; bulbus genitalis dark amber-colour, well-developed, convoluted; convolutions terminate in two large well-defined apophyses directed downwards, of about equal length; inner apophysis lake-colour, dark margins, broad, rounded, outer face concave, projects laterally two small processes; backward-directed process black, horn-like; fore-process yellowish, curved forwards and upwards, apex tumid; outer apophysis spiral (single curve), base tumid, free end stout, acute, blackish.

Abdomen elongate-oviform; creamy-brown, somewhat mottled with brown-black; mottling composed of small elongate patches interspersed amongst free and confluent spots; dorsal region somewhat free from marks; ventral surface light-brown; spinners yellowish.

Single example, Stratford, *A. T. U.*

Fam. EPEIRIDÆ.

Gen. Epeira, Walck.

Epeira atri-apiata, sp. nov.

Mas.—Ceph.-th., long, 4·3; wide, 3·5. Abd., long, 5; wide, 3·5. Legs, 1, 2, 4, 3 = 15·5, 14, 10, 8 mm.

Cephalothorax rich mahogany-brown; glabrous, except few white hairs about clypeus; closely studded with small papillæ; sharply compressed forwards; pars cephalica depressed, central indentation, ocular elevation projects prominently over falces; depth of *clypeus* rather more than half facial space; pars thoracica strongly convex, median indentation oval, large, deep, discloses a cruciate groove within; radial and caput striæ more or less obliterated; contour of profile represents a low arch rising at eye-prominence.

Fore- and hind-row of *eyes* recurved; posterior median pair, on dark patches, about one-third smaller than anterior centrals, divided by an interval equalling twice their own diameter; fore-median pair separated from each other by an eye's breadth and a quarter, and from hind-centrals by fully their diameter; laterals one-third smaller than posterior median pair, posited obliquely on a dark common tubercle.

Falces fulvous, suffused with olive-brown, moderately stout and long, second half curved upwards and outwards.

Maxillæ rather longer than broad, roundly pointed, inclined towards *labium*, latter perceptibly wider than long, rounded, scarcely half length of maxillæ; organs olive-black, yellowish tips.

Sternum glossy black-brown; cordate.

Legs yellowish-brown; three-fourths of femoral joints of two first pairs, and basal half of hind-pairs, mahogany-colour; patellæ, central and apical rings on tibiæ + metatarsi, and second half of tarsi, similar shade; almost glabrous; spines brown, rather short, fairly numerous, irregular; coxæ of first pair armed with a curved process; tibial joints of first legs cylindrical, spines somewhat in rings; tibiæ of second stouter, enlarged on inner side at base and third quarter, spines strong, especially distal groups.

Palpi fulvous, olive-green tinge; hairs whitish; pars humeralis short, incrassated forwards; cubital joint one-third shorter than former article, broad-oval, projects a bristle from extremity; radial about as long as cubital, broad, cup-shaped, upper side emarginate; pars digitalis large, subglobose; lamina fulvous, clouded with olive-green; hairs fine, short, sparse; elongate-ovate, depressed, apices curved backwards; base tumid, centrally intersected by a dark groove; outwardly prolonged into a triangular area terminating in a moderately short, down-curved, lake-coloured apophysis; genital bulb viewed somewhat from front displays, including cap, five lobes; bulbus cap reddish-brown, golden reflections, partially encircled and indented by a conspicuous black apophysis; first lobe beneath cap narrow, encloses face and inner side of bulbus, yellow-orange metallic reflections, two transverse brown streaks; second lobe largest, side deeply emarginate, projecting from centre of this cavity is a short, slightly-curved, black process, directed backwards; transversely rugose, bright crimson-lake, passing into yellowish and black about the vertically-rugulose border; lower lobe light-brown, yellowish metallic reflections, rugose, wide margins transversely wrinkled, viewed beneath outer extremity reclinate; projecting from beneath former and contiguous to latter lobe is a broad sharply-backward-curved process, curvature at extremity of lobe, apex squarely truncated, light-brown, yellowish reflections, black-brown on outer side, lake band at curvature; beneath a yellow-brown, large, reniform lobe at base of bulb is a wide, backward-curved, yellowish-brown process, base tumid, apex rounded, revolute.

Abdomen oviform, subdepressed, humeral tubercles slight; three first and fifth tubercles very short; tubercle of second row prominent; stone-colour, lightly suffused with slate; folium stained with pale-brown, sparingly dappled with rather large slate-coloured lobate spots; margins acute-crenate, brownish, fore- and hind-extremities obliterated; four brown, conspicuous, impressed spots form a trapezoid narrowest in front; lateral margins flecked and figured with slate-colour; ventral region occupied by an olive-green shield, yellow transverse streak above.

Single specimen, contained in *Mr. H. Suter's* collection from Hastwell, Forty-mile Bush.

Epeira acincta, sp. nov.

Femina.—Ceph.-th., long, 4; broad, 3·3; facial index, 1·7. Abd., long, 6·4; broad, 5·3. Legs, 1, 2, 4, 3 = 15, 14, 12, 9 mm.

Cephalothorax brownish-orange, very lightly suffused with olive-green; hairs sparse, pale orange-yellow; slightly shorter than patella + tibia of first leg; cephalic part moderately convex, sides abrupt, eye-prominence rather low; lateral index equals space between fore-lateral eyes; *clypeus* inclined forwards, depth scarcely equals diameter of a fore-central eye; pars thoracica moderately convex, sides rounded; fovea somewhat oval, normal grooves rather faint; contour of profile rises with slight curve at an angle of nearly 40° from peduncle, moderately inclined forwards, dips rather abruptly across ocular prominence.

Eyes on dark rings; posterior row slightly recurved, hind-margin of centrals in line with fore-margin of laterals of same row; median pair visibly larger than fore-centrals, interval between them slightly exceeds an eye's breadth, less than their space and one-half from laterals; anterior row more distinctly recurved, centrals rather more distant from each other—an eye's diameter and a half—than they are from posterior centrals, perceptibly more than their space from side-eyes; laterals about one-third smaller than anterior centrals, posited obliquely on low tubercles, rather more than their radius apart.

Falces shade lighter than cephalothorax; conical, vertical, somewhat gibbous at base in front; one-fourth shorter than radial + digital joints of palpus, scarcely equal to femur of second leg in stoutness.

Maxillæ brown-yellow, base suffused with light-brown; nearly as wide as long, dilated forwards, obliquely truncated, inclined over *labium*, base of latter organ chocolate-brown, apex pale greenish-yellow; oval, length nearly equals breadth.

Sternum dark chocolate-brown, yellow, sublanceolate central mark; cordate, eminences opposite coxal joints.

Legs and cephalothorax concolorous; thighs of first pair lightly suffused with lake on second half; patellæ + tibiæ tinge of green; faint indications of greenish annuli on metatarsi + tarsi; femora of third legs visibly marked with two olive-green rings; patellar joints of hind-pairs greenish; faint annulations of same hue on other articles. Legs moderately strong, tibiæ as long as metatarsi; hairs sparse, yellowish; spines yellow, base dark; first pairs, about 15 on femora; few on patellæ; about 20 spines—equalling diameter of article in length—on tibiæ; 7 on metatarsi; 3rd + 4th femoral joints, 5; patellæ, 3; tibiæ of 3rd 7, of 4th 9 spines; metatarsal joints of third pair 3, of fourth pair 14; tarsal claws of first pair 8 teeth, 4 small, rest stout; inferior claw, 2 close teeth.

Palpi colour and armature of legs, green rings at apices of cubital + radial joints; moderately slender, equal cephalothorax in length; palpal claw, 8 teeth.

Abdomen triangular-oviform, depressed, humeral tubercles very slight; ground-colour dull pale-green, thickly dappled with stone-colour, resolved into oval spots on base; folium subtriangular, margins subcrenate; lightly suffused with pale-drab; margins evanescent, marked out by a series of five or six brown dots; basal end defined by procurved angular row of large dots; four dark impressed spots form a trapezoid narrowest in front. *Vulva* greenish amber-colour, shading off to dark-brown on side-margins; transversely wrinkled; tolerably convex, compressed rapidly into a large tapering scapus, whose length is about equal to the greater diameter of organ; stylus displays about two wrinkles, apex represents a broad conical cap, deep obtuse notch in upper margin, twice as wide as long, measured from apex of notch; scapus bordered by broad tumid costæ, showing three or more distinct grooves.

Captured at the base of Mount Egmont, on *Rubus australis*. This climbing shrub, which is generally to be met with about the skirts of forests, is much frequented by spiders, its close foliage and prickly armature offering the double advantage of protection to themselves and their prey from their mutual enemies, birds. This species belongs to a rather handsome group of *Epeira*, which is to be met with throughout New Zealand.

Epeira nigro-hastula, sp. nov. Plate XXI., fig. 13.

Mas.—Ceph.-th., long, 2·4; broad, 2. Abd., long, 3; broad, 2·2. Legs, 1, 2, 4, 3 = 10·5, 8·5, 7·8, 5 mm.

Cephalothorax fulvous, passing into green on caput, whose yellowish reflections disclose a somewhat intricate pattern; brown-black hastate figure within fovea, lance-head reaches limit of caput, somewhat removed from but forming a transverse line with its apex are two brown spots; hairs whitish, sparse; ovate, moderately compressed forwards; cephalic region flatly convex, ocular prominence fairly developed, lateral index fully equals facial; thoracic fovea oval, longitudinal; normal grooves moderately deep; profile-line represents a rounded arch, perceptible obtuse eminence on occiput.

Posterior row of *eyes* tolerably recurved, centrals equally distant from each other and fore-centrals, an interval equalling an eye's breadth and a half; rather less than their space from laterals; anterior row recurved; median pair one-third larger than hind-pair, an eye's diameter apart, scarcely that interval from side-eyes; laterals about one-third smaller than posterior median eyes, seated obliquely on brown, moderately prominent tubercular eminences, separated by half their radius.

Falces remarkably slender, yellowish, green shade; transversely rugulose; length fully equal to breadth of posterior row of eyes, scarcely as stout as tibia of second leg; inclined inwards, taper moderately, fore-third bent outwards and upwards; base shows a tumid collar; apices rest within concavity of maxillæ.

Maxillæ rather longer than wide, roundly pointed, directed inwards, prolonged beyond falces.

Labium longer than broad, triangular; organs pale greenish-yellow, base brownish.

Sternum green; cordate, slight eminences opposite coxal joints.

Legs pea-green, fuscous shade on superior surface of thighs, interrupted dark annuli beneath; moderately slender; coxæ of first legs project a curved process; tibiæ linear; hairs sparse; spines yellowish, brown apices; femora of first pair 5 spines on superior surface, cluster of 6 long spines beneath; patellæ, 5; tibiæ, 12 scattered spines; metatarsi, 3; spines of second pair shorter than first, of nearly equal number; spine armature of two hind-pairs does not differ greatly, more sparse than fore-pairs.

Palpi, humeral + cubital joints greenish, former short; cubital broad-ovate, projects two long reddish bristles; pars radialis duller green, shorter than cubital joint, prolonged on outer side into a large, semi-pellucid, subconical process, tumid on inner side, furnished with few bristles; laminæ bulbi yellowish, clouded with dark-green, moderately hairy; ovate, tapering, directed towards each other; base of lamina prolonged into a rather wide and long reddish process, directed outwards, apex curved; bulbus, viewed from somewhat behind and beneath, discloses several remarkable appendages; basal olive-brown, stout, subcylindrical, somewhat crescent-shaped, curved downwards; inner half tapering, apex cleft into two processes, outer broadly pointed, displays a series of short teeth; inner process longest, acute; outer extremity of lunulate process broad, apex fin-like, fore-margin furnished with a fringe of black, very acute projections, increasing in size upwards round apex; hind-angle prolonged, somewhat claw-like, projects a short tooth near its base; projecting forwards from margin of bulb is a wide, oblong, yellow-brown, hood-like membrane, with brown transverse stripes and reddish beaded margins; immediately beneath the latter is a paler projection of nearly equal length, its tumid fore-margin armed with three convergent rows of stout black teeth; directed downwards and forwards from centre of bulbus is a large olive-brown process, base constricted; base of the subtriangular fore-part somewhat spiral, apex membranous; curving inwards from front of genital bulb is an easily-perceptible, semi-pellucid, cylindrical apophysis, dilated at apex. Viewed from front, suspended beneath apex of lamina is a reddish, broad, membranous process, concave on outer side, fore-half constricted, inner angle drawn out, acute.

Abdomen oviform, moderately convex; somewhat sparse bristle-like hairs projecting from brown dots; folium sinuate, base semicircular, projects a short petiole; grey-green, margins green; enclosed within is a figure of similar form, pea-green, border deeper shade; the sublanceolate pale median mark projects backwards from the constriction at the almost circular basal end; lateral margins green, obliquely streaked with dark-green; ventral field brownish, shield shows two dark spots, border light flecks.

Femina.—Ceph.-th., long, 2·6; broad, 2·1. Abd., long, 4·9; broad, 4·3. Legs, 1, 2, 4, 3 = 10, 8·2, 8, 6 mm.

Cephalothorax pea-green, fading about thoracic region; yellowish pattern on caput, more conspicuous in spirit; black hastate figure in fovea; hairs pale straw-colour, mostly on cephalic part; pars cephalica tolerably convex, sides abrupt, lateral index equal to space occupied by a hind-lateral eye and the central furthest from it of same row; eye-eminence somewhat prominent; height of *clypeus* equal to diameter of a fore-median eye; pars thoracica ovate, convex; indentation rather deep, longitudinal; striæ tolerably well marked; contour of profile represents an angle of 50° on posterior slope, inclined moderately across occiput, abrupt dip at ocular area.

Posterior row of *eyes* moderately recurved, centrals posited somewhat obliquely, visibly more than an eye's breadth from each other and fore-centrals, nearly their space from laterals; anterior curvature rather stronger than posterior; median eyes about one-fourth larger than hind-pair, separated from one another by a distance perceptibly more than an eye's diameter, somewhat more than that interval from side-eyes; laterals about one-fourth smaller than hind-median, placed obliquely on dark tubercles, half their radius apart.

Falces yellowish-green; conical, moderately tumid at base in front, vertical, rather slighter than a thigh of second leg, length equals breadth of facial space.

Maxillæ rather longer than broad, pointed, base slender, tolerably inclined towards each other.

Labium scarcely as long as wide, roundly pointed, everted; organs brownish, apices greenish-yellow.

Sternum yellowish, green tinge; broad-cordate, eminences opposite coxal joints.

Legs yellowish-green, faint annulations; hairs sparse; spines yellowish, dark points, short; femora of first leg, 3 spines above, 5 beneath; patellary joint, 4; 10 on tibia, about equal to diameter of article in length; metatarsus, 3; spine armature of second leg about equal to first; femoral joints of hind-pairs have no spines on inferior surface, otherwise their spine armature nearly equals anterior pairs.

Palpi coloration of legs; hairs only; slender, nearly equal to cephalothorax in length.

Abdomen oviform, somewhat depressed, moderately clothed with bristle-like hairs; folium sinuate, base rounded, petiole short; closely flecked, pale grey-green, border green; encloses a similar figure of a deeper shade; median band wide, lighter tone; red-brown spots at root of hairs. *Vulva* represents a yellowish, transverse, broad-oval, depressed area, wrinkled in circles; free part or scapus sharply bent, more than half of area, projects somewhat over the rima genitalis, superior margin scalloped, lateral segments narrowest; displays in centre a rather large, lake-brown, rugose spot; side-margins of corpus involute; bordering the rima genitalis is a dark-lake narrow costa, extremities tumid, revolute, slightly surpasses centre segment in length.

Taken in the forest near Stratford, *A. T. U.*

Epeira atri-hastula, sp. nov. Plate XXI., fig. 7.

Femina.—Ceph.-th., long, 2·8; broad, 2·1; facial index, 1. Abd., long, 4·8; broad, 4·6. Legs, 1, 2, 4, 3 = 11·5, 10, 8·5, 6·5 mm.

Cephalothorax, caput green, fading off to a paler hue on thorax; cephalic part—especially after turning yellow in spirit—displays an intricate design; conspicuous brown-black hastate figure on thorax, transverse base-lines across fovea, lance-head intersects caput striæ, whose posterior halves are defined by brown streaks; somewhat removed from and in line with apex of lance-head are two dark spots; moderately furnished with light hairs on cephalic part; pars cephalica rather convex above, sides abrupt, roundly truncated, ocular eminence fairly prominent; lateral index nearly equals facial; depth of *clypeus* equals diameter of a fore-central eye; pars thoracica broad-oval, convex; fovea oval, longitudinal; normal grooves moderately strong; profile-contour rises at an angle of 40°, moderately inclined forwards, dips abruptly from hind-row of eyes.

Eyes on dark rings, subequal; posterior row visibly recurved, interval between median pair equal to rather more than an eye's breadth, visibly more than their space from laterals; anterior row more distinctly recurved, centrals perceptibly exceed hind-pair in size; rather further from each other than they are from posterior centrals, a space slightly surpassing an eye's diameter; laterals rather the smallest of eight, posited obliquely, half their radius apart, on low tubercles.

Legs yellowish-green, faint annuli; hairs pale-yellow, somewhat sparse; spines yellow, dark base; femoral joints have few short spines on superior surface; first pair has also a row of 4 on inferior side; second pair, 2; patellæ, 3 or 4; tibiæ of first, 9; three hind-pairs more sparsely spined; metatarsi, 3 or 4.

Palpi pale-green; cubital joint projects a bristle; fully equal to cephalothorax in length.

Falces yellowish-green; conical, moderately gibbous at base in front, fore-end somewhat divergent; length equals tarsus of a fore-leg, scarcely as stout as femur of second leg.

Maxillæ brown, apices pale-green; length somewhat surpasses breadth, roundly pointed, taper to base; moderately inclined towards each other.

Labium colour of maxillæ; rather wider than long, pointed.

Sternum greenish; broad-cordate, eminences opposite coxæ.

Abdomen broad-oviform, moderately convex above; hairs sparse; pale grey-green, closely flecked; folium undulating; deeper green, few red-brown spots; ventral shield lozenge-shaped; olive-brown, broad margin of creamy-coloured flecks. *Corpus vulvæ* olive-brown; strongly-wrinkled, transverse, oval eminence; tumid and longitudinally depressed above the rima genitalis; scapus green-tinged, bright reddish-amber; projects from tumid eminence, long, base broad, vermiform, flattened, curves forwards on abdomen for half its length, sharply bent backwards to little beyond posterior limit of corpus; apex semi-oval, somewhat calceolate.

Forest, Stratford, *A. T. U.*

Epeira galbana, sp. nov.

Femina.—Ceph.-th., long, 2·2; wide, 2. Abd., long, 4·1; wide, 3·4. Legs, 1, 2, 4, 3 = 9·4, 8·5, 7·1, 5·5 mm.

Cephalothorax brownish amber-colour, V-shaped yellowish mark at limit of caput; hairs whitish, soft, sparse; oval, moderately compressed forwards; pars cephalica convex, roundly truncated, ocular prominence fairly developed, lateral index scarcely equals facial; height of *clypeus* slightly exceeds diameter of a fore-centre eye; pars thoracica convex, fovea circular, deep, large; normal grooves somewhat slight; contour of profile represents an angle of 45° at posterior slope, visibly curved across caput.

Eyes moderately recurved, curvature of posterior row nearly as strong as anterior; median eyes of hind-row large, on dark oval spots, separated by an interval equal to their diameter and a quarter; three-fourths their space from laterals; fore-centrals on dark spots, nearly form a square with posterior median pair, scarcely equal to one-half their size, divided from them by a space less than their own breadth; closer to side-eyes than are hind-centrals; lateral eyes one-fourth smaller, than fore-median pair, posited obliquely on separate dark tubercular prominences, less than one-third their diameter apart.

Legs pale raw-sienna; femora + patellæ suffused with a deeper shade; two faint annuli on tibiæ + metatarsi; hairs sparse; rather slight black spines on all joints except tarsal; femora of first have 11; patellæ, 4; tibiæ, 14 somewhat irregular spines; metatarsi, 6; superior tarsal claws—first pair, 10 somewhat even comb-teeth; inferior claw rather sharply bent, 2 points; legs moderately slender.

Palpi, paler hue than legs; armature similar; equal cephalothorax in length; palpal claw straight, free end moderately curved; 8 rather even comb-teeth.

Falces and cephalothorax concolorous; conical, convex, vertical, perceptibly surpass cubital + radial joints of palpus in length, somewhat slighter than femur of a fore-leg.

Maxillæ yellow-brown, clouded; nearly as broad as long, taper moderately to base; inclined towards each other.

Labium yellowish-brown, base chocolate-brown; rather wider than long, pointed.

Sternum light-brown, centre stripe broad, undulating, yellow; cordate, eminences opposite coxal joints.

Abdomen oviform, base pointed, projects over cephalothorax; hairs fine, sparse; dorsal field pea-green, few scarlet dots; anterior pair of the four well-marked impressed spots olive-green, connected by a somewhat angular mark of a similar hue; almost in line with posterior pair is a semicircular olive-coloured figure, which throws off a series of nearly parallel yellowish vein-like lines, extending to spinners; lateral margins yellow, numerous brownish nearly vertical lines curve upwards from ventral surface; shield light chocolate-brown, margin defined by yellow flecks; on face of shield are two broken parallel yellow bars. *Vulva* yellow-brown, green tinge; corpus rapidly developed into a large, flatly convex triangular scapus, transversely wrinkled, rather wider than long; its rather broad beaded margins, which project upwards and outwards, are sharply bent inwards at their extremities; the confluent beading forms a semicircular wrinkle at base of broad stylus, which rather exceeds the dark-stained angular projections in length; base of stylus consists of two wrinkles; mouth of large ascidium-shaped apex inversely ovate; few coarse hairs.

Forest near Stratford, *A. T. U.*

Epeira venustula, sp. nov. Plate XXI., fig. 12.

Femina.—Ceph.-th., long, 2; wide, 1·8. Abd., long, 3·5; wide, 3. Legs, 1, 2, 4, 3 = 8, 6·3, 5·1, 3·6 mm.

Cephalothorax burnt-sienna colour, speckled in radiating lines with a deeper hue; triangular area, including facial space, of a gamboge-yellow, pale metallic reflections, extends to limit of caput; clathrate; hairs light-yellow, very sparse; length equal to patella + tibia of a leg of second pair; pars cephalica convex, lateral index nearly equals facial; eye-prominence moderate; *clypeus* retreating, height scarcely equal to radius of a fore-central eye; pars thoracica moderately convex, sides well rounded; fovea suboval, deep; caput and radial striæ fairly defined; contour of profile rises from thoracic junction at an angle of 40°, arched across cephalic part, dips rather abruptly at ocular area.

Eyes on dark spots, recurved, first rather the strongest curve; posterior row divided by an interval rather exceeding their diameter; scarcely more than their space from laterals; anterior centrals about an eye's breadth and a half from each other; their diameter from hind-pair, which they equal in size; separated from side-eyes by an interval equal to three-fourths their space; laterals about half size of centrals, posited obliquely, one-third their diameter from each other, on separate moderately strong tubercles.

Legs brownish creamy-colour; femoral joints have wide brown—dark-brown on hind-pairs—annuli on fore-half, passing into greenish-yellow at extremities; patellæ suffused with reddish-brown; tibiæ of first + second show two free, faint, reddish-brown rings; tibiæ of hind-pairs, and metatarsal joints of all, have central and apical annulations; legs somewhat slight; hairs sparse; few black spines.

Palpi yellowish, ring on extremity of radial and fore-half of digital joints red-brown; hairs sparse.

Falces fuscous, clouded with olive-green; conical, gibbous in front, vertical, stouter than thigh of a fourth leg, length equal to breadth of anterior row of eyes.

Maxillæ light greenish-brown, base chocolate-brown; about as wide as long, roundly pointed, taper to base, moderately inclined towards each other.

Labium greenish-black, apex greenish-yellow; somewhat triangular, rather wider than long.

Sternum chocolate-brown, median mark lanceolate, yellowish; cordate well-defined eminences opposite coxæ.

Abdomen broad-oviform, flatly convex above, projects well over base of cephalothorax; dorsal field covered by a large, acutely-sinuate, leaf-shaped figure; petiole formed by two ꜫ-shaped marks; ground-colour creamy-white, except basal end almost entirely suffused with yellowish-olive, spotted with numerous creamy-coloured, lake-margined flecks; forepart shows few lake and yellow spots; border stained with greenish-yellow; three pairs of blackish impressed spots, centre pair furthest apart, placed in deep indentations; folium tapers moderately to spinners, somewhat acute-crenate, truncated base intersects and extends beyond centre impressed spots, defined by a rather broad, procurved, soft brown-black band, intersected by posterior end of the somewhat diamond-shaped figure extending along its anterior margin; latter mark creamy-white, lake spots, yellowish-olive centre; border of folium pale greenish-yellow, crenatures brown-black; area is of the normal olive-green, and, like dorsal surface, shaded with a deeper hue, prettily marked with pale-yellow, creamy, and lake coloured sinuate lines and spots; lateral margins yellowish-olive, passing into a lightish-brown on ventral surface, marbled with deep greenish-black; shield somewhat oval, includes spinners; cinereous, flecked; above two large centre yellow spots are two lateral, blackish, ovate marks; border creamy, broken into four dots in line with spinners. *Vulva* yellowish amber-colour; represents an elliptical, centrally-compressed, smooth lobe; wrinkled, tumid margins somewhat ꜫ3-shaped, dark spot in short upper curve; scapus large, somewhat spoon-shaped, apex rather deep, curves over lobe, projects rather beyond.

Single example, taken in the forest near Stratford, *A. T. U.*

Epeira melania, sp. nov.

Femina.—Ceph.-th., long, 4·3; wide, 3·6; facial index, 1·9. Abd., long, 5·7; wide, 4·5. Legs, 1, 2, 4, 3 = 18, 16, 14·5, 9·5 mm.

Cephalothorax fulvous; hairs pale, sparse; length equals patella + tibia of a fourth leg; pars cephalica moderately convex, truncation perceptibly curved, ocular elevation slight; lateral index about equal to facial; depth of *clypeus* equals diameter of a fore-centre eye; slight lunulate procurved indentation behind posterior centre eyes; pars thoracica moderately convex, sides fairly rounded; transverse indentation on posterior inclination; caput and radial striæ tolerably strong;

profile-line rises from thoracic junction at an angle of 30°, slopes somewhat steeply with a slight curve to edge of occiput.

Eyes small; posterior row perceptibly recurved, median pair separated by an interval visibly surpassing their diameter, divided from laterals by their space and a half; anterior row recurved, centrals dark, black rings; largest of 8; removed from each other and hind-centrals by a distance scarcely equal to twice an eye's breadth; rather more than their space from side-eyes; laterals have the lake tinge and lake-brown rings of hind-centre eyes, placed obliquely on a low tubercle, their radius apart.

Legs fulvous, green tinge on thighs; dark patch beneath patellary joints of two first pairs; somewhat obscure brown annulations on metatarsi; hairs light, sparse; few light-yellowish spines on femora, cluster of strong spines on inner side of first pair; spines moderately strong and numerous on other joints; superior tarsal claws—first pair, 9 open teeth, increasing in length and strength; inferior claw, 2 close teeth.

Palpi pale brownish-yellow; armature of legs; moderately slender, length of cephalothorax; palpal claw moderately curved, 6 open teeth.

Falces shade paler than palpi, glossy, conical, gibbous in front, stouter than femur of first leg, length equal to digital joint of palpus.

Maxillæ light-brown, green tinge, margins paler; nearly as broad as long, roundly pointed, inclined over *labium*, latter organ shade darker; wider than long, subtriangular.

Sternum fulvous, marbled with green; cordate, eminences opposite coxæ.

Abdomen triangular-ovate, depressed above; folium subtriangular, acutely-crenate; two large, black, nearly contiguous spots on humeral angles; small black spot on either side of petiole, which is broad, curves round base of abdomen, black, white spot; ground-pattern consists of a series of creamy-coloured, purple-spotted, sinuous lines, converging upwards, resolved more or less into coalescing spots, intersected by purple streaks; lightly suffused with olive-brown; folium suffused with a deeper shade; crenatures on posterior end brown-black; ventral field purple, sides brown; shield quadrate, light olive-brown, border flecked. *Vulva* light greenish-brown, passing into olive-green on lateral margins, stylus yellowish amber-colour, side-lobes glossy brown-black; *corpus vulvæ* projects outwards, rather wider than long, strongly convex, transversely wrinkled; scapus large, about length of corpus, transversely rugose, sides developed into two very remarkable centrally-depressed discs, surpassing shaft of scape in length; deep sides of discs project outwards at an obtuse angle from corpus; stylus short, broad, rugose, apex large, well-formed semi-globose cup, with a conspicuous amber-brown beaded rim, latter in line with fore-margin of discs.

Stratford, *A. T. U.*

Epeira similaris, sp. nov.

Femina.—Ceph.-th., long, 4; broad, 3·1; facial index, 1·5. Abd., long, 7·5; broad, 6·5. Legs, 1, 2, 4, 3 = 14·4, 14, 11, 8 mm.

Cephalothorax dull raw-sienna, cephalic parts lightly clouded with olive-brown; hairs sparse, white and silky on thorax, mostly of an orange-yellow on caput; length equal to tibia of first pair; pars cephalica moderately convex; ocular eminence fairly prominent; lateral index nearly equals facial; sides of pars thoracica well-rounded; indentation moderately deep, caput and radial striæ not strongly defined; profile-line represents a not very strongly-curved arch; *clypeus* directed inwards, depth equals breadth of a fore-central eye.

Fore- and hind-row of *eyes* nearly equally recurved; anterior centrals perceptibly smaller than posterior pair, separated from each other by an interval equal to rather more than an eye's breadth, and from hind-pair by a space scarcely equalling the former; more than two-thirds their space from laterals; median pair of posterior row visibly more than their diameter apart; their space and a quarter from side-eyes of same row; laterals posited obliquely on separate, low, dark, tubercular eminences, perceptibly less than their radius from each other.

Legs, thighs of two first pairs brownish-yellow, faint indications of annuli; patellæ deeper shade; tibial, metatarsal, and tarsal joints greenish tinge passing into light-brown, especially towards extremities; femora of hind-pairs have a deeper hue; well-defined greenish rings on third pair; perceptible greenish and brownish annulations on their tibial and metatarsal joints; about 16 spines on femora of first pair; 9 or 10 on second; few spines on thighs of third pair; spines on patellary joints; spine armature of tibiæ and metatarsi somewhat sparse and irregular; rather sparsely furnished with lightish hairs.

Palpi and legs concolorous; green annulations on digital joint, which shades off to a brownish colour; hairs yellowish, bristle-like spines yellowish, base dark.

Falces light, glossy, yellow-brown; conical, vertical; equal pars digitalis of palpus in length, and femoral joint of a second leg in stoutness.

Maxillæ brownish-yellow, clouded with olive-brown; nearly as broad as long, roundly pointed, moderately inclined over *labium*, which is olive-brown, greenish-yellow margins; rather wider than long, roundly pointed.

Sternum chocolate-brown, well-defined yellowish lanceolate figure; cordate, moderately wide; eminences opposite coxæ prominent.

Abdomen somewhat depressed above, fore-part broad, rounded, tapers moderately to spinners; ground-colour dull-green, suffused with creamy, greenish-tinted, purple-spotted, lobate flecks, more or less confluent; margins of folium not sharply defined, acute-crenate, tips black, area lightly suffused with brown, except yellow streak on dorsal line, purple spots on flecks darker shade than marginal; a broad, undulating, creamy-coloured band, with dark-(Hooker's)-green margins, connects humeral prominences, curves somewhat round them, terminates with spots of its own colour; appended by a short petiole, springing from its strongly-constricted centre, is a small reniform mark of similar coloration; 4 impressed spots form a trapezoid narrowest in front; on base, which has a deeper-green shade, are two broken wreaths, composed of rather large, pale creamy-green, purple-margined flecks, enclosing a segment of a circle; greenish lateral borders pass into a purple spotted light-brown on ventral surface; shield greenish-brown, margins undulating, creamy-colour, purple spots. *Vulva* yellowish-brown, side-lobes of scapus dark-brown; corpus moderately convex, rapidly compressed into a large, wide, tapering, backward-curved scapus, whose length about equals the greater breadth of corpus vulvæ; whole field displays somewhat narrow transverse wrinkles; free end, or stylus, shows about two wrinkles of normal width, terminates with a conical membranous cap, about twice as broad as long; moderately-deep obtuse notch on upper margin; the broad, tumid margins of scapus show slight longitudinal convolutions.

Mas. — Ceph.-th., long, 3·2; wide, 2·5. Abd., long, 4; wide, 3. Legs, 1, 2, 4, 3 = 14·5, 13·5, 9, 7·3 mm.

Cephalothorax brownish-orange, clouded about caput and sides with lake-brown; hairs yellowish, somewhat sparse; broad-oval; cephalic part flatly convex, eye-eminence moderately prominent; *clypeus* scarcely equals diameter of a fore-central eye; pars thoracica convex, fovea longitudinal, deep; radial and caput striæ fairly defined.

Eyes on dark rings, fore- and hind-row recurved, posterior centrals perceptibly less than an eye's breadth from each other, removed by rather more than that interval from anterior median pair, more than their space from laterals; fore-centrals divided from each other and side-eyes by an interval equal to their diameter and a half; laterals rather more than half size of median eyes, posited obliquely, two-thirds their breadth apart, on low separate tubercular eminences.

Legs, femora of two first pairs, basal third brownish-yellow, fore-end orange-brown, clouded with lake-brown; a broad, broken, brown ring intersects the light and darker shade; patellar joints have the deeper colour of femora; tibiæ yellowish, green tinge, fore-third normal brown; metatarsi yellowish, faint, wide, greenish central and apical annuli; tarsi yellowish, passing into a darker hue; femora of hind-pairs have a deep red-mahogany shade; broken ring on third pair is separated from darker parts by a light streak; patellæ normal hue; tibial joints have two not well-defined reddish-brown annulations on fore-half; annuli on metatarsal joints reddish; legs moderately stout; hairs sparse, yellowish; femora of first and second pairs, 12 or 13 moderately strong black spines beneath, 8 or 9 above; 4 or 5 small spines on patellæ; tibial joints of first, about 13 irregular spines; second pair less; metatarsi about 7; femora of fourth pair, 5 or 6 beneath on fore-end; of third pair, one spine; spine armature of other joints does not differ greatly from first pairs.

Palpi, humeral joint yellowish; increases somewhat in width forwards, scarcely twice length of cubital + radial joints together; cubital joint yellowish, broad-oval, squarely truncated in front, projects two long bristles; radial similar tinge, short, convex on inner side, produced on outer into a long, broad process, acutely truncated on posterior side, few coarse hairs; lamina brownish-yellow, clouded; moderately hairy; placed rather beneath bulb, base developed into a stout conical projection, directed inwards, curving somewhat upwards, in length nearly equals distance from its own base to apex of lamina, more than half as broad as long; base of lamina prolonged on outer side into a large red-brown apophysis, directed backwards, curved forwards, concave in front; most remarkable appendages of genital bulb—suspended near base is a somewhat quadrate, dark membrane, concave in front, inner angle prolonged into a strong tapering apophysis, whose length about equals breadth of membrane at base; next to the latter appendage is a yellowish, oval, vertical organ, convex behind; directly in front, between two dark, backward-curved, stout processes, is a yellowish membrane, convex on anterior face, rapidly constricted into a fine apophysis curving backwards to the above-mentioned vertical organ.

Falces reddish-brown; conical, vertical, as stout as the femur of a fourth leg.

Maxillæ brownish-yellow, base clouded; nearly as broad as long, roundly pointed.

Labium, apex pale, base dark-brown; nearly as long as wide, somewhat pointed, transverse groove forms a collar-like base.

Sternum greenish-yellow, clouded with brown, centre mark; cordate, clathrate.

Abdomen triangular, base rounded, depressed above; integument pinkish creamy-colour, lightly suffused with dull-yellow, numerous small lake spots; creamy-white—border of band dark on posterior side—moderately wide band connects the slightly-developed humeral protuberances; superior surface of base has an olive-green tinge, clouded with black-brown; a broken, recurved wreath of lightish flecks connects apices of transverse band; folium olive-green tinge, extends from band to spinners, serrated, blackish marks on posterior side of serrations; blackish transverse patch below first serration; oblique brownish streaks on lateral margins; lake spots on ventral surface more pronounced, shield somewhat heart-shaped, olive-brown, margin dark.

Taken in the forest near Stratford, *A. T. U.*

Epeira lævigata, sp. nov. Plate XXI., fig. 6.

Femina.—Ceph.-th., long, 3; broad, 2. Abd., long, 5; broad, 4. Legs, 1, 2, 4, 3 = 10, 8·5, 8, 5·8 mm.

Cephalothorax yellowish, green tinge; hairs light, somewhat sparse; pars cephalica moderately convex, roundly truncated, eye-prominence low, lateral index equal to rather more than two-thirds facial; depth of *clypeus* equal to nearly the diameter of a fore-central eye; pars thoracica convex, sides tolerably rounded; fovea suboval, rather deep; normal grooves well defined; profile-contour rises from stalk at an angle of 40°, forward inclination slight.

Eyes on dark rings, hind-centrals lake-coloured; posterior only sensibly recurved, centre eyes largest of eight, rather more distant from each other than they are from fore-centrals, an interval scarcely equalling their diameter; about their space and one-fourth from laterals; anterior row recurved, median eyes dark, rather more than half size of hind-pair, separated by scarcely an eye's breadth and one-half; divided from side-eyes by an interval somewhat shorter than their space; laterals about one-third smaller than anterior centre eyes, posited obliquely, rather more than one-fourth an eye's breadth apart, on very low elevations.

Falces yellowish, suffused with green; conical, vertical, equal in length to digital joint of palpus, and in stoutness to the femur of a second leg.

Maxillæ yellowish, base clouded with olive-brown; dilated forwards, pointed, length somewhat surpasses breadth, inclined towards each other.

Labium greenish-yellow, base dark olive-brown; oval, rather wider than long; more than half length of maxillæ.

Sternum chocolate-brown, median stripe greenish-yellow, bisected by an interrupted yellow streak; cordate; eminences in front of coxal joints.

Legs yellowish, green tinge; faint reddish-brown central and apical annulations on tibiæ + metatarsi; indication of distal rings on femora; legs tolerably strong; hairs yellowish, somewhat sparse; spines black, tolerably strong and numerous, somewhat irregular.

Palpi greenish-yellow; hairs light; black bristle-like spines.

Abdomen ovate, depressedly convex; broad-conical hump projects over base of cephalothorax; very sparingly clothed with short hairs, few coarse black; bright pea-green, deepening in tone on lateral margins; dorsal mark yellowish; four dark impressed spots form a trapezoid, narrowest in front; interval between hind-pair and spinners occupied by a wide band of nearly uniform width, somewhat enlarged and rounded forwards; bordered by a narrow greenish-brown line; an arcuate line of similar colour limits the first quarter; median streak lighter shade, bifurcates at cross-line, enclosing a narrow streak to anus. Ventral shield greenish-brown, displays four yellow spots; elongate. *Corpus vulvæ* greenish-yellow; represents a large, transversely-wrinkled, subtriangular, curved scapus, rather wider at base than long; lateral margins not wrinkled, rather broad, beaded, project upwards and outwards; the dark tapering extremities are sharply bent backwards to base of stylus; latter organ stout, of uniform breadth, somewhat depressed or grooved above, scarcely one-half length of scapus vulvæ, projects nearly one-third its own length beyond lateral wings of scapus.

Single specimen, forest near Stratford, *A. T. U.*

Sub-Fam. TETRAGNATHINÆ.

Gen. Tetragnatha, Latr.

Tetragnatha arborea, sp. nov. Plate XXI., fig. 9.

Mas.—Ceph.-th., long, 4; broad, 3; facial index, 1·6. Abd., long, 5; broad, 3·4. Legs, 1, 2, 4, 3 = 32, 20, 14·5, 12 mm.

Cephalothorax pale brownish-yellow, red-mahogany colouring on ocular area shades off into a large lanceolate figure, marbled with brown; base of figure is somewhat sharply and roundly dilated, tapers moderately, compressed apex slopes into thoracic indentation; lateral margins of caput clouded with reddish-brown; hairs fine, sparse; pars cephalica somewhat flatly convex, roundly truncated, lateral index equals space of hind-row of eyes; pars thoracica convex, prominent above tapering extremity of caput, somewhat depressed behind, sides well rounded; fovea broad-oval, deep; radial striæ well defined; profile-contour rises from thoracic junction at an angle of 25°, slightly curved across cephalic part; *clypeus* perceptibly retreating, height equals two-thirds of a fore-central eye.

Eyes of fair size, seated on dark-brown oval spots; posterior row sensibly procurved, eyes about equidistant, centre pair rather more than their radius from each other; anterior row moderately recurved; median pair removed from one another by an interval slightly exceeding their radius, and from side-eyes by scarcely that space, form with hind-pair an oblong figure rather longer than wide in front; laterals about one-fourth the smallest of eight, posited obliquely, less than their radius apart, on low, dark, tubercular eminences.

Legs light-yellow, green tinge, shading off forwards, especially on fore-pairs, to an orange-yellow; coxæ of posterior pair marked with a large olive-brown spot; three more or less pronounced red-brown or olive-brown annuli on femora; patellary joints similar tinge; tibiæ three annulations, central and apical very broad, less so on hind-pairs; metatarsi of fore-pairs have the deep colour of annuli; central and terminal rings on metatarsal joints of hind-pairs; legs moderately slender; hairs fine, somewhat sparse; spines slender, 15 on femora of fore-legs, less on other pairs; patellæ project a strong spine; tibiæ of first, 9; of second, third, and fourth, about 7; metatarsal joints, about 5 spines.

Palpi light brownish-yellow; slender, length 6mm.; humeral joint rather shorter than cubital + radial together, perceptibly incrassated; pars cubitalis about one-half length of penultimate joint, strongly convex above; bristle rather short; pars radialis tapers moderately to base, projects a short process above, on inner side; two faint rings; digital joint scarcely as long as radial, bulbus genitalis complex; lamina light mahogany-brown; hairs fine, rather sparse; somewhat oval, obliquely truncated, projects rather beneath bulb; viewed from outer side, genital bulb displays at base a large, reddish-brown, linear, membranous process, twice as long as wide, apex truncated, emarginate, convex and hairy on outer side, directed forwards; above and attached to former process is a subreniform projection, apex acutely prolonged; bulb spiral (plane) yellow-mahogany colour; projecting from its truncated extremity is a remarkable yellowish, triangular, membranous process; curving forwards and upwards from beneath latter organ is a stout lake-black apophysis, which, viewed from front, shows a rather stout lateral process; perceptible above truncated apex of lamina, seen from inner side, is a low dark ridge, posterior end produced into an acute process; base of bulb, above lamina, shows an ovate depression; apex produced into a free, tapering, forward-directed appendage.

Falces red-mahogany colour; project at an angle of 20°, somewhat tumid at base in front, fore-third directed upwards and outwards, about equal in breadth to the femur, and in length to the tarsus of a leg of first pair; 3 teeth on outer row.

Maxillæ chocolate-brown, apices light; long, taper somewhat to base, obliquely truncated on inferior side, superior side rounded, moderately dilated, rather inclined over *labium*, which is subquadrate, perceptibly curved outwards, less than one-half length of maxillæ, transverse indentation; colour of maxillæ.

Sternum yellowish; few black hairs; cordate, eminences opposite coxæ.

Abdomen oviform, flatly convex above; hairs pale-yellow, somewhat sparse; ground-colour pale olive-green, suffused with moderate-sized, creamy-coloured, lake-spotted flecks; integument more or less stained with lake; folium lyrate, fore-half broad, margins undulating, dark-brown; posterior half tapers to spinners, compressed to about one-half width; of a slightly deeper shade and less flecked than lateral margins; between and projecting somewhat beyond the four reddish-lake impressed spots is a hastate figure, apex directed backwards, haft prolonged round base, free from flecks, creamy-white border; dorsal field displays 8 dark-brown, transverse marks, two anterior pairs subtriangular, placed on posterior side of last pair of impressed dots; second pair partially encloses apex of hastate figure; in centre of third bar—which, like the fourth and fifth, is drawn out, apices curved, to margin of folium—is a creamy spot; two or three posterior bars black-brown, or reddish, more or less obliterated in different examples; lateral margins longitudinally streaked with black-brown dashes; ventral shield defined—except at fore-end—by a broad margin of pale-yellow metallic flecks showing small lake spots; centre of shield displays few flecks and brown stains.

Femina.—Ceph.-th., long, 4; wide, 3. Abd., long, 6; wide, 5. Legs, 1, 2, 4, 3 = 20, 14, 13·2, 8 mm.

Cephalothorax reddish amber-colour, ocular area reddish dorsal figure mottled with brown at base, breadth of hind-row of eyes, fore-third incurved, tapers from end of curves, moderately to limit of caput, apex acute, dips into fovea; displays two large yellowish spots in line with its greater breadth; brownish stains on lateral margins of caput; hairs light, sparse; pars cephalica somewhat aplanate above, roundly truncated; lateral index equals breadth of hind-row of eyes, facial scarcely one-half width of thorax; *clypeus* moderately retreating, depth visibly shorter than breadth of a fore-central eye; pars thoracica broad-oval, prominent at limit of cephalic part; posterior incline depressed; fovea subcircular, deep; radial striæ ill-defined; profile-line rises at an angle of 40°, slopes with a slight curve across caput.

Eyes on dark oval spots, subequal, form an oval figure, anterior row more distinctly curved, centrals posited on slight tubercles, rather less than an eye's breadth from each other and laterals next to them; posterior row divided by nearly equal intervals, exceeding radius of a median eye; four centre eyes form an oblong figure rather longer than wide in front; laterals rather smallest of eight, seated obliquely on low tubercular eminences about their radius from one another.

Legs colour of cephalothorax, faint-green tinge; femora three more or less faint and broken annuli; basal half of patellar joint shaded; tibiæ of first pairs four annulations, hind-pairs three; two on metatarsi; moderately slender; armature sparse, fine outstanding hairs; few bristle-like spines on thighs; single spine near base of metatarsi; two spines beneath tibiæ of fourth; superior tarsal claws—first pair, base straight, evenly and moderately curved forwards, 18 short open teeth; inferior claw sharply bent, free end long, 2 close teeth.

Palpi colour and armature of legs; moderately slender, fully surpass cephalothorax in length; palpal claw moderately curved, free end more than one-half length of claw; 8 rather even comb-teeth.

Falces mahogany-brown; subconical, project at base in front, vertical, inclined outwards; 3 teeth in outer row.

Maxillæ light chocolate-brown, pale apices; about twice as long as broad, taper somewhat to base, inner side obtusely truncated, truncation perceptibly rounded; outer rather dilated.

Labium colour of maxillæ; oblong, nearly twice as wide as long; transversely grooved.

Sternum yellowish; cordate; eminences opposite coxal joints.

Abdomen oviform; ground-colour dark-stone, passing into a dull olive-green, irregularly suffused with lake; flecks numerous, yellow-stone dotted with lake; pattern closely resembles male's; ventral shield lighter shade, flecks golden; centrally marked with brown spots. *Corpus vulvæ* reddish-mahogany; triangular, flatly convex; rather beneath the roundly-truncated apex, which projects slightly over the rima genitalis, is a long narrow-oval orifice.

Male and female examples were rather numerous, more especially in the vicinity of watercourses. Stratford, Taranaki, *A. T. U.*

Tetragnatha multi-punctata, sp. nov.

Femina.—Ceph.-th., long, 2·8; broad, 1·8. Abd., long, 6; broad, 2·3. Legs, 1, 2, 4, 3 = 19·5, 13·5, 10·5, 5·5 mm.

Cephalothorax brownish-yellow, fovea and vein-like lines on caput brown; pars cephalica depressedly convex, roundly truncated, facial index surpasses lateral by one-fourth; depth of *clypeus* scarcely equals diameter of a fore-central eye; pars thoracica oval, depressed; fovea subovate, rather small and shallow; caput and radial striæ moderately defined; profile-line slopes moderately backwards from hind-row of eyes, slightly arched across thorax.

Fore and hind-row of *eyes* somewhat evenly recurved; posterior eyes nearly equidistant; median pair on black oval spots, further from one another than they are from anterior centrals, a space perceptibly exceeding an eye's breadth; fore-centrals posited on dark, lake-tinged rings, fully equal or slightly surpass hind-pair, with whom they form a quadrilateral figure broader than long, rather closer to each other than they are to side-eyes; laterals seated on strong black tubercles, rather less distant than are the fore- and hind-centre eyes; posterior eye exceeds anterior by about one-third.

Falces light amber-colour, fangs reddish; project at an angle of 45°, divergent; 6 teeth in outer row, 5 close, sixth tooth as far from fifth as it is from apex of falx; inner row, 7 teeth increasing in size and distance from one another.

Maxillæ reddish-brown; sublinear, fore-third divergent, superior angle dilated.

Labium shade darker; rather longer than broad, sides parallel, roundly pointed, transversely grooved.

Sternum yellowish-amber, sides clouded with brown; cordate.

Legs deep straw-colour, green tinge; slender; hairs sparse, fine, outstanding; few long, black, bristle-like spines on all joints except tarsal.

Palpi colour and armature of legs; slender, 3·5mm. long.

Abdomen cylindrical; deep-violet, passing into brown beneath, suffused with silvery lobate flecks; fore-half of dorsal line throws off a series of angular streaks, apices directed forwards, hind-pair straightest. *Corpus vulvæ* yellowish, moderately convex area, viewed from above somewhat campanulate, base contiguous to stigmata; truncated apex shows a long narrow orifice; a wide orange-red process projects from within beyond limit of corpus.

Single example, Taranaki, *A. T. U.*

Tetragnatha flavida, sp. nov.

Mas.—Ceph.-th., long, 3·1; broad, 2. Abd., long, 6; broad, 2. Legs 1, 2, 4, 3 = 20·5, 16, 15·5, 8 mm.

Cephalothorax light brownish-yellow, lateral margins and bifurcating band on caput faintly shaded with brown; posterior end of band and fovea more darkly pencilled; pars cephalica flatly convex, roundly truncated; facial index rather surpasses lateral; depth of *clypeus* equals interval between fore-centre eyes; pars thoracica oval, depressed, fovea deep, oval, longitudinal; normal grooves somewhat slight; profile-contour rather abrupt at posterior incline, somewhat level to limit of caput, occiput perceptibly curved, slope across eye-area.

Eyes on oval dark spots; posterior row moderately recurved, nearly equidistant, shortest interval between centrals, a space equal to nearly twice an eye's breadth; latter pair separated from fore-centrals by a somewhat shorter interval; anterior row more distinctly recurved, median pair rather smaller than hind-pair, and somewhat larger than posterior lateral eyes, divided from each other by nearly their diameter and a half, and from side-eyes by rather less than their space; laterals posited obliquely, interval between them about equal to space dividing centre pairs; fore-eye less than half size of posterior.

Falces brownish-yellow; project at an angle of 45°, moderately convex on inferior and concave on superior side, fore-half somewhat tumid, apex pointed, a strong curved tooth-like process projects above near apex; 8 teeth in outer row, 6 rather close teeth, increasing in length; 2, somewhat larger and more widely separated, on fore-half; inner row, 7 somewhat equidistant teeth.

Maxillæ brownish - yellow, clouded; long, sublinear, pointed, superior angle dilated.

Labium brown, light margins; oval, more than half length of maxillæ.

Sternum dull greenish-yellow, clouded with olive-brown; cordate, eminences opposite coxæ.

Legs deep straw-colour, lightly shaded with olive-brown; slender; hairs fine; few bristle-like spines on all joints except tarsal.

Palpi and legs concolorous; coxal joint as long as radial; pars humeralis enlarged forwards, arcuated, equals radial + digital joints together in length; pars cubitalis campanulate, lobed, about one-half length of penultimate article, projects a strong black bristle at apex; radial joint long, tapers to base, where there is a short blunt process on upper side; breadth at extremity nearly equal to half its own length; bilobate on inner side, upper lobe long, oval; armed with long black hairs; digital joint rather longer than radial; lamina narrow, sublinear, about twice length of bulb; hairs rather fine, short; first accessory lamina lies on superior surface of bulbus, reaches the fore-edge, elongate, extremity roundly truncated, tapers to base; second oval, terminates at base of bulb; genital bulb disciform, brownish-yellow, displays two brown rings; visible between accessory laminæ is a reddish, pointed, lip-shaped process projecting backwards from base of bulbus; on face of bulbus genitalis are two somewhat intricate spiral apophyses, extending to apex of lamina; outer blackish, narrow, tapering, convex on inner side; inner apophysis fulvous, membranous, semi-transparent, entwined and partially fused with second half of black apophysis, tapers moderately to apex, which is deeply cleft; projects a short process at first spiral curve.

Abdomen cylindrical; folium yellow stone-colour, suffused with light-yellow metallic flecks; dorsal line unflecked, throws off two pairs of oblique streaks; side-borders tinged with red-lake; lateral margins lightly suffused with brown, yellow flecks; ventral field displays three longitudinal bands, spots on side-bands bright golden-colour, centre band suffused with brown.

Femina.—Ceph.-th., long, 3·5; broad, 2. Abd., long, 7; broad, 2·5. Legs, 1, 2, 4, 3 = 21·2, 14, 13, 6·2 mm.

Cephalothorax light brownish-yellow, two brownish streaks radiate forwards from limit of caput; hairs light, sparse; pars cephalica depressedly convex, roundly truncated, one-half breadth of thorax; depth of *clypeus* equal to space dividing anterior central eyes from hind-pair; pars thoracica rather narrow-oval, depressed above, fovea subcircular, moderately deep; striæ somewhat shallow; caput striæ more deeply grooved beyond junction; profile-contour rises abruptly from thoracic junction, runs in a nearly level line to caput-indentation, visibly arched forwards, curved across eye-area.

Eyes on black spots, represent two somewhat evenly-recurved rows; hind-centrals rather larger than fore-centre eyes, latter pair somewhat exceed posterior laterals; fore-laterals less than half size of hind-pair; centrals of posterior row rather closer to one another than they are to laterals of same row, separated from fore-centre eyes by an interval slightly exceeding space between themselves; anterior median pair about an eye's breadth and a half apart, scarcely their space from side-eyes.

Falces light brownish-yellow; project at an angle of about 45°, somewhat straight on outer side, curved on inner; outer row of teeth, 5; inner, 7.

Maxillæ light brownish-yellow; length equal to width of sternum, sublinear, fore-third bent outwards, inferior angle rounded.

Labium chocolate-brown, pale margin; oval, one-third length of maxillæ.

Sternum greenish-fulvous, passing into brown on margins; broad-cordate.

Legs deep straw-colour, fore-half of articles shaded with reddish-brown; slender; hairs fine, very sparse; few bristle-like black spines on all joints except tarsal.

Palpi straw-colour; armature of legs; slender, length equal to tibia of a second leg.

Abdomen cylindrical; folium linear-oval; ground-colour olive-stone, suffused with pale-yellow flecks; dorsal band unflecked, tolerably wide on fore-half, reduced to a fine streak on posterior half, enlarged at anus, three strongly-arcuated lines on central third; broad band on lateral margins suffused with confluent silvery flecks, border red-brown, centre streak paler hue; ventral region olive-brown, closely spotted with yellow flecks, except on central band, which is of somewhat uniform width. *Vulva* yellowish, shaded with stone-brown; about as broad as long, convex, rather depressed above, somewhat truncated over the rima genitalis, longitudinal orifice.

A fine male example of this species was contained in *Mr. T. Kirk's* collection, captured at Belmont by *Miss Kirk*. Male and female specimens were taken by myself on rushes growing on the sand-hills near Hawera. Examples were taken in the forest near Stratford, and a female was captured on a bunch of rushes above the line of scrub on Mount Egmont. This group of *Tetragnatha* with cylindriform abdomens as a rule affect rushes, the position assumed by the spider, and its coloration, assimilating with its surroundings.

Fam. THOMISIDÆ.

Sub-Fam. PHILODROMINÆ.

Gen. PHILODROMUS.

Philodromus rubro-frontus, sp. nov.

Mas.—Ceph.-th., long, 2·6; broad, 2·3. Abd., long, 3·5; broad, 2·3. Legs, 1–2, 3–4 = 9·2, 5·5 mm.

Cephalothorax pea-green, facial region crimson-lake; almost glabrous; broad-oval; cephalic part flatly convex, somewhat squarely truncated; *clypeus* transversely rugose, visibly directed forwards, depth slightly exceeds space between fore-centre eyes; pars thoracica convex, posterior incline indented, normal grooves shallow; profile-line rises at an angle of 50°, moderately inclined across occiput, curved over eye-area.

Eyes small, of nearly equal size, form two somewhat evenly-recurved rows; posterior row nearly equidistant, centre pair slightly the furthest apart; anterior centrals rather closer to one another than they are to posterior median pair, an interval barely surpassing space between latter pair; laterals about one-third larger than centrals, posited on low tubercular eminences, separated by an interval somewhat shorter than that dividing fore- and hind-pairs.

Falces greenish-orange colour, suffused with lake; transversely rugulose; flatly convex, second half linear; slightly inclined forwards; bordered their entire length, outer side, by a dark costa; falx rather more than half as broad at base as long, equal to breadth of anterior row of eyes in length.

Maxillæ spathulate, superior side of second half dilated, directed towards each other.

Labium conoid, two-thirds length of maxillæ; organs yellowish-green, suffused with lake; transversely rugulose.

Sternum yellow-tinted pea-green; few hairs; cordate.

Legs yellowish pea-green, tinged with lake; two first and two hind-pairs of about equal length and strength; hairs, bristles, and spines sparse, latter only on femoral, tibial, and metatarsal joints.

Palpi greenish, suffused with lake; pars humeralis somewhat enlarged forwards, nearly twice length of cubital joint, latter article rather dilated, projects a strong bristle from extremity; radial joint deeply tinged with lake; lower margin developed into a rounded lobe; prolonged forwards on outer side into a black-tipped, pointed, ear-shaped process, nearly one-half length of lamina; digital joint rather longer than two former articles; lamina greenish, suffused with lake; ovate above genital bulb, latter yellowish-brown; subaplanate face displays a red-brown (plane) spiral apophysis, which follows margin of bulb, terminating in centre.

Abdomen oviform, depressedly convex; pea-green, pale flecks, chiefly on margins; four impressed spots form a trapezoid, narrowest in front.

Femina.—Ceph.-th., long, 2·8; wide, 2·8. Abd., long, 5; wide, 4. Legs, 1–2, 3–4 = 8·6, 5·6 mm.

Cephalothorax pea-green, lightly suffused with lake, eye-area lake; sparingly clothed with short whitish hairs, few coarse black on caput; broad-ovate, slightly constricted forwards; cephalic part flatly convex, perceptibly rounded; *clypeus* inclined forwards, height nearly equals interval dividing anterior centre eyes; pars thoracica convex; normal grooves faint; profile-contour rises from stalk somewhat abruptly, moderately inclined forwards across occiput, dips over eye-region.

Eyes on narrow yellow rings, form two evenly-recurved rows; posterior eyes of about equal size, centrals little more distant from each other than they are from side-eyes, form with fore-centre eyes a trapezoid widest behind; anterior median pair slightly exceed hind-centrals in size, rather smaller than fore-laterals, divided by an interval fully equal to that which separates them from hind-pair, scarcely half that space from side-eyes; laterals posited obliquely, hind-eye on a low tubercle, fore-eye slightly elevated, rather further from one another than a fore-eye is from the anterior central.

Falces pea-green; vertical, conical, well-developed costa along superior border, breadth equals width of hind-row of eyes, length equal to radial + digital joints of palpus.

Maxillæ greenish-yellow, lake-brown tinge, somewhat enlarged forwards, pointed, rounded on superior side.

Labium deeper tone; conical, more than one-half length of maxillæ.

Sternum greenish, ovate.

Legs greenish-yellow, lake tinge; first and second, third and fourth, of about equal strength; hairs fine, sparse; 3 or 4 bristle-like spines on femora of first pairs, 1 or 2 on hind-pairs; 1 bristle on patellæ; tibia of fore-leg 2 bristles above, 1, 2, 2, 2 spines; metatarsus, 2, 2, 2, 2 beneath, 1 side-spine; tibia of second leg, 2, 2, 2 on inferior aspect; metatarsus, 2, 1, 2, 2; hind-pairs few bristles above.

Palpi green, lake tinge; armature black bristles, white hairs.

Abdomen pea-green, closely dappled with a paler shade; spinners lake; hairs short, sparse; ovate; 4 impressed spots form a trapezoid narrowest in front; hind-pair deep. *Vulva* represents a not very observable elevation: when pressed below discloses the incision of the rima genitalis.

These specimens were captured in the vicinity of the "Hermitage," Mount Cook, by *Mr. H. Suter*. The species has somewhat close affinities to *P. sphæroides;* the male differing from the latter species in the greater breadth of the pars cephalica, the lateral eyes not being posited on rather prominent cup-shaped tubercles, and in the more ovate form of the abdomen. The absence of eye-prominences, and the more simple form of the vulva, are well-marked differences in the female form. I have given its natural coloration as a uniform pea-green, as being the most probable; but I have recently captured an immature example of *P. anbarus* with an amber-coloured cephalothorax, the normal colour being pea-green.

Fam. LYCOSIDÆ.

Gen. Lycosa, Latr.

Lycosa arenaria, sp. nov.

Femina.—Ceph.-th., long, 3·4; broad, 2·4. Abd., long, 3·5; broad, 2·9. Legs, 4–1, 2, 3 = 12, 9, 8·5 mm.

Cephalothorax stone-colour, tinged with olive-green, marked with greenish-black speckled transverse stripes, facial region deeper black; hairs whitish and yellowish, fine, short, adpressed, bristle-like on cephalic part; length fully equals the patellary + tibial joints of a fourth leg; ovate, slightly compressed forwards; pars cephalica convex, roundly truncated, lateral index equals two-thirds facial; height of *clypeus* slightly surpasses space between anterior centre eyes; pars thoracica convex, border-hem moderately prominent; indentation longitudinal; caput and radial striæ fairly well defined; contour of profile visibly curved across fore-end of caput, moderately inclined to fovea, dips more abruptly to thoracic junction.

First row of *eyes* slightly procurved, much the smallest of eight, centrals about one-third larger than laterals, separated from each other by an interval perceptibly exceeding their breadth, and from laterals by rather more than their radius; side-eyes rather closer to second row than they are to margin of clypeus; eyes of second row third larger than posterior pair, rather more distant from them than they are from one another, a space equalling an eye's diameter and a quarter; posterior eyes one-third further from each other than they are from second line.

Falces fulvous, lightly clouded; moderately armed with white hairs; conical, base gibbous in front, divergent, perceptibly inclined forwards, in length scarcely equal to radial + digital joints of palpus, stouter than the femur of first leg; double row of 3 close teeth.

Maxillæ fulvous, somewhat clouded; base slender, enlarged forwards, rounded slightly, inclined towards *labium*, latter organ olive-brown, margin pale; nearly as long as broad, rounded, apex truncated, about half length of maxillæ.

Sternum colour of coxæ; hairs white, sparse; suboval, broad.

Legs stone-colour, fuscous annulations; femoral joints, three rings more or less reduced to spots, especially on two first pairs; patellæ one ring; tibiæ, basal and central annulations; metatarsi have three somewhat obliterated rings; moderately clothed with outstanding white and black hairs; spines tolerably numerous on all joints except tarsal.

Palpi colour and armature of legs; pars humeralis fully equals cubital + radial joints together in length; digital joint one-fourth shorter than two latter articles.

Abdomen oviform; stone-colour, spotted with black-brown; thickly clothed with white and yellowish hairs, representing, with dark spots, a well-defined tabby pattern; ventral region light-brown, hairs white, thick. *Corpus vulvæ*, posterior part fuscous, lighter tone in front; represents a large transverse oval orifice, dark lateral margins connected on superior side by a fulvous, brown-bordered, membranous costa; within orifice is a semicircular fulvous lobe, convexity directed towards and connected by a moderately prominent ridge with inferior margin.

Mr. T. Kirk, F.L.S., to whom I am indebted for the specimens, says that these little spiders are hardly visible when at rest on the sand amongst small stones.

Fam. CTENIDÆ.

Gen. Cycloctenus, Koch.

Cycloctenus pulcher, sp. nov.

Femina.—Ceph.-th., long, 4·5; broad, 4. Abd., long, 6; broad, 4. Legs, of equal length, 15·5 mm.

Cephalothorax brownish-yellow, approximating to drab about margins, ocular area and markings fuscous; two streaks on either side of cephalic region; thoracic radii lighter tone, somewhat confluent, limited by the submarginal band; wedge-shaped contiguous figures round border-hem; hairs yellowish, short, sparse; cephalothorax slightly longer than tibial joint; pars cephalica depressedly convex, sides abrupt, roundly truncated, breadth equal to one-half of thorax; *clypeus* scarcely equals space dividing fore-central eyes; pars thoracica somewhat dome-shaped, rises very perceptibly above plane of occiput; thoracic groove reddish, longitudinal; striæ somewhat shallow; contour of profile rises from the stalk at an angle of 45°, rounded above thorax, slopes slightly across caput to second row of eyes, dips abruptly to margin of clypeus.

Eyes light-brown, except small laterals, which have a pearl-grey lustre; first row straight, eyes about one-half size of centrals of second line, rather more distant from latter pair than they are from each other, an interval about equal to their diameter; second row perceptibly procurved; median pair slightly elevated, an eye's breadth apart, rather less than their radius from laterals, which have a broad-oval form, much the smallest of eight, posited at base of tubercles, little more distant from posterior eyes than they are from centrals of their own row; hind-pair of eyes do not differ perceptibly in size from median pair of second line, seated obliquely—directed somewhat backwards—on well-developed tubercular eminences, separated by an interval surpassing space between centre pair of next row by one-third.

Legs shade lighter than cephalothorax, fuscous markings; femora approach to drab, spotted, annulations somewhat crenate, interrupted; single ring on patellæ; broken central and distal annuli on tibial + metatarsal joints; hairs somewhat sparse; short spines on superior aspect of femora; 1 spine on patellary joints; tibiæ, 2, 2, 2, 2, 2 beneath, 2 lateral spines; metatarsi, 2, 2, 2, 2 on inferior side; spines on hind pairs nearly as numerous, somewhat irregular.

Palpi deeper tone than legs, annuli well-defined; length, 5·5 mm.; sparingly armed with hairs; long spines on pars digitalis.

Falces rich red-mahogany colour; transversely rugulose; strong fringe along outer margin of groove, otherwise sparingly furnished with hairs; conical, somewhat gibbous at base in front, divergent, directed moderately forwards; stout, length equal to digital joint of palpus; 4 small teeth in superior row, increasing in strength; interspace between fore-tooth and fang rather exceeds length of row; inner side shows 2 somewhat stronger teeth in advance of outer row.

Maxillæ yellowish-brown, clouded; about half as wide at base as long, superior side of second half roundly dilated; inferior margin perceptibly curved, apices emarginate; superior angle displays a dense fringe of hairs; inclined towards *labium*, which has a deeper shade; conical, apex abscinded, concave, three-fourths length of maxillæ.

Sternum deep-fulvous, fuscous clouds round margins; broad-cordate.

Abdomen oviform, margins wrinkled; moderately clothed with short, adpressed, deep-yellowish hairs; brownish-yellow, passing into black-brown on lateral margins and posterior third; fore-part of yellowish region somewhat quadrate, border sinuating, encloses a light blackish-brown oval figure dilated laterally in front; posterior part spotted. Ventral region displays a chestnut-brown lozenge-shaped shield, margins approximating to orange-brown. *Corpus vulvæ* lake-black, passing into a more pronounced lake on margins; large, transverse, broad-oval, moderately convex, superior border shortly prolonged over the rima genitalis, bounded by ridge-shaped costæ terminating abruptly close to the tumid, elliptical, bright-lake-coloured apex.

Wellington, *T. Kirk, F.L.S.*

Fam. ATTIDÆ.

Gen. Attus, Walck.

Attus montinus, sp. nov.

Femina.—Ceph.-th., long, 2; wide, 1·5. Abd., long, 3; wide, 2. Legs, 4, 1, 2, 3. Leg of 4th pair, 4·1 mm.

Cephalothorax reddish-mahogany, passing into dark mahogany-brown on margins; eyes on black spots; hairs yellowish, short, sparse, chiefly about frontal region, moderate fringe on clypeus; pars cephalica plano-convex, perceptibly rounded, sides abrupt, limited by an indentation; height of *clypeus* equals space dividing centre eyes; thoracic part one-third longer than cephalic, convex, sides slightly dilated; contour of profile rises at an angle of 45°, level to posterior eyes, moderately inclined across ocular area.

Anterior row of *eyes* slightly curved, nearly equidistant, laterals one-third size of centrals, separated from them by about their radius; posterior eyes do not differ perceptibly in size from fore-laterals, posited a little closer to one another, divided by a somewhat greater interval than that which separates them from lateral border; eyes of second row equidistant; ocular area about one-third broader than long.

Falces red-mahogany colour, transversely rugulose, vertical, moderately strong, length slightly surpasses the pars digitalis of palpus.

Maxillæ fulvous, suffused with reddish-brown; nearly twice as long as wide, second half dilated, rounded.

Labium darker; enlarged at extremity, apex somewhat rounded, rather less than one-half length of maxillæ.

Sternum chocolate-brown; oval.

Legs, thighs of two first pairs chocolate-brown; patellæ yellowish-brown; tibiæ chestnut-brown; metatarsi + tarsi yellow-brown, second half of former articles dark-brown; posterior pairs fulvous, fuscous basal and distal annulations on femoral + tibial joints, fore-half of metatarsi similar shade. First and second legs of nearly equal length, moderately strong; tibia slightly exceeds patellary joint in length; metatarsus and tarsus equal; hairs sparse; spine armature normal.

Palpi bright straw-colour, humeral joint clouded; hairs whitish, somewhat sparse.

Abdomen oviform, moderately convex above; sparingly clothed with short whitish and orange-red hairs; ground-colour drab, perhaps approximating to pale olive-brown; dorsal band ovoid, earthy-brown, without any determinate limits, fading away into ground-colour; ill-defined oblique brown bands on lateral margins; ventral region light-brown. *Corpus vulvæ* bright yellow-mahogany colour, two red-brown wide pointed marks encroach from above across to foveæ; corpus represents a rather large subcircular, convex, centrally-depressed area, superior half projects rather outwards over the rima genitalis, roundly emarginate; within central depression are two circular foveæ, divided by a narrow septum; fuscous outer margins of foveæ produced into well-defined triangular processes projecting towards centre of foveæ.

Single specimen, Mount Cook, *H. Suter*.

Attus monticolus, sp. nov.

Femina.—Ceph.-th., long, 2; wide, 1·2. Abd., long, 2·5; wide, 1·6. Legs, 4, 1, 2, 3. Leg of 4th pair, 3·8 mm.

Cephalothorax yellowish mahogany-colour, lateral borders chocolate-brown, deepening in tone round eyes; dorsum marked with a brownish, ill-defined, broad hastate figure, whose apex intersects posterior eyes; hairs whitish and orange-red, chiefly on lateral margins of caput, increasing in length on clypeus; irides of centre pair of eyes orange-red; elevated; cephalic region plano-convex, widening slightly in front, sides subvertical; rather prominent behind posterior eyes; limited by a somewhat obovate depression; height of *clypeus* equal to nearly twice diameter of a lateral eye; sides of thoracic part very slightly dilated; profile-contour inclined forwards, with a perceptible curve, across ocular area, rises slightly and shortly behind posterior eyes, dips at an angle of 45° to thoracic junction.

Anterior row of *eyes* sensibly recurved, centre pair subtouching; laterals about one-third size of former pair, separated by an interval equalling one-fourth their breadth; posterior pair trifle smaller than fore-laterals, posited rather closer to each other; rather less than one-fourth further from one another than they are from frontal margin; eyes of second row somewhat nearer to fore-laterals than they are to dorsal eyes; ocular area scarcely one-fourth wider in front than long.

Falces brownish-orange; somewhat sparse white hairs; subconical, vertical, rather slight; scarcely as long as the radial + digital joints of palpus.

Maxillæ lighter shade than falces; arcuated on inferior side, dilated and rounded at extremity on superior side; directed visibly outwards.

Labium light greenish-brown; conical, somewhat abscinded, less than one-fourth length of maxillæ.

Sternum light-brown; oval.

Legs brownish-yellow, annulations on femoral, tibial, and metatarsal joints; reddish and faint on two first pairs, darker shade on hind-pairs; distal rings on metatarsi chocolate-brown; first and second pairs do not differ much in length or strength, moderately strong; tibiæ cylindrical, slightly surpass genuæ in length; metatarsal and tarsal joints of about equal length; hairs sparse, whitish; slender spines on femora; tibial and metatarsal spines strong.

Palpi straw-colour; hairs white; bristles sparse, fine, black; palpus rather stout.

Abdomen elongate-oviform; hairs short, very sparse, white and orange-red; deep stone-colour, closely dappled with a paler tone, and few brown dots; dorsum displays on basal fourth a conduplicate mark—apices directed backwards—of a soft black-brown hue; near centre is a wide, procurved, arcuate bar of a deeper shade, intersected by a light-brown sagittate figure, apex directed forwards; posterior fourth shows a dark angular mark with revolute ends; projecting from it towards spinners is a short, somewhat lanceolate figure; inferior half of lateral margins marked with light earthy-brown, close, oblique streaks; ventral region normal colour, border narrow, serrate, interrupted. *Vulva* reddish-brown, approximating to yellow-brown on margins; large, transverse oval eminence, emarginate over the rima genitalis; area occupied by two circular foveæ, intersected by a moderately broad)(-shaped septum; foveæ exhibit within a dark, wide, tapering, revolute membrane.

Captured by *H. Suter*, Mount Cook.

Attus valentulus, sp. nov.

Femina.—Ceph.-th., long, 1·8; wide, 1·8. Abd., long, 3; wide, 2·5. Legs, 4, 3, 1, 2 = 4·1, 4, 3·8, 2·5 mm.

Cephalothorax brown-black; moderately clothed with white and yellow adpressed hairs and erect black; irides orange; elevated; cephalic part aplanate, frontal region slightly rounded, sides abrupt; depth of *clypeus* less than radius of a fore-centre eye; fringe of white hairs; thoracic and cephalic parts of about equal length, sides rounded; profile-line rises somewhat abruptly from thoracic junction, slightly curved to dorsal eyes, moderately inclined forwards across ocular area.

Anterior row of *eyes* sensibly recurved; laterals about one-fourth size of centrals, separated by intervals exceeding radius of a side-eye; dorsal eyes perceptibly larger than laterals, project from moderate prominences, near margin of hind-slope; space between them exceeds interval dividing laterals by nearly one-third; more distant by one-third from each other than they are from frontal margin; eyes of second row posited rather closer to fore-laterals than they are to hind-pair; ocular area one-third broader behind than long.

Falces lake-brown, hairs white; flat, scarcely as long as the pars digitalis of palpus; breadth equals space occupied by fore-centre eyes.

Maxillæ light chocolate-brown, pale apices; enlarged forwards, rounded, inclined over *labium*, latter organ deeper shade than maxillæ, rather more than half their length; oval.

Sternum lake-black; white hairs; small, oval.

Legs brownish-yellow, suffused—except tarsi—with lake-brown; fore-pair darkest; two hind-pairs of about equal strength; anterior legs stoutest; thighs compressed; patellæ + tibiæ stout, latter articles cylindrical, about one-fifth longer than patellar joints; metatarsi + tarsi rather slender, latter articles shortest by one-fourth; white and erect black hairs; 1 short spine on fore-end of femora; tibia of first leg, 2, 2, 2; metatarsus, 2, 2; second leg, tibia, 2, 2; metatarsus, 2; tibial joint of third leg, 2 spines at fore-end; metatarsal joints of hind-pairs, ring of 5 spines; superior tarsal claws—first pair, basal two-thirds straight, fore-third sharply curved, outer claw no teeth, inner about 12 or more short close teeth, claw-tuft strong.

Palpi brown-yellow; sparingly haired; cubital, radial, and digital joints of about equal length.

Abdomen oviform, moderately convex; brown-black; fairly clothed with short adpressed yellowish hairs; on basal half is a bare patch of a lanceolate form, apex directed forwards; spot of white hairs on lance-head; similar spot on base of haft, between the latter spot and spinners are three smaller spots, latter flanked by bare spaces enclosing patches of white and yellowish hairs; ventral region brownish, hairs moderately thick. *Vulva* represents two large, yellowish, ovate foveæ, bordered by brownish beaded costæ, separated by a space nearly equalling their transverse diameter.

Single example, North Shore, Auckland, *A. T. U.*

Gen. Marpissa, C. Koch.

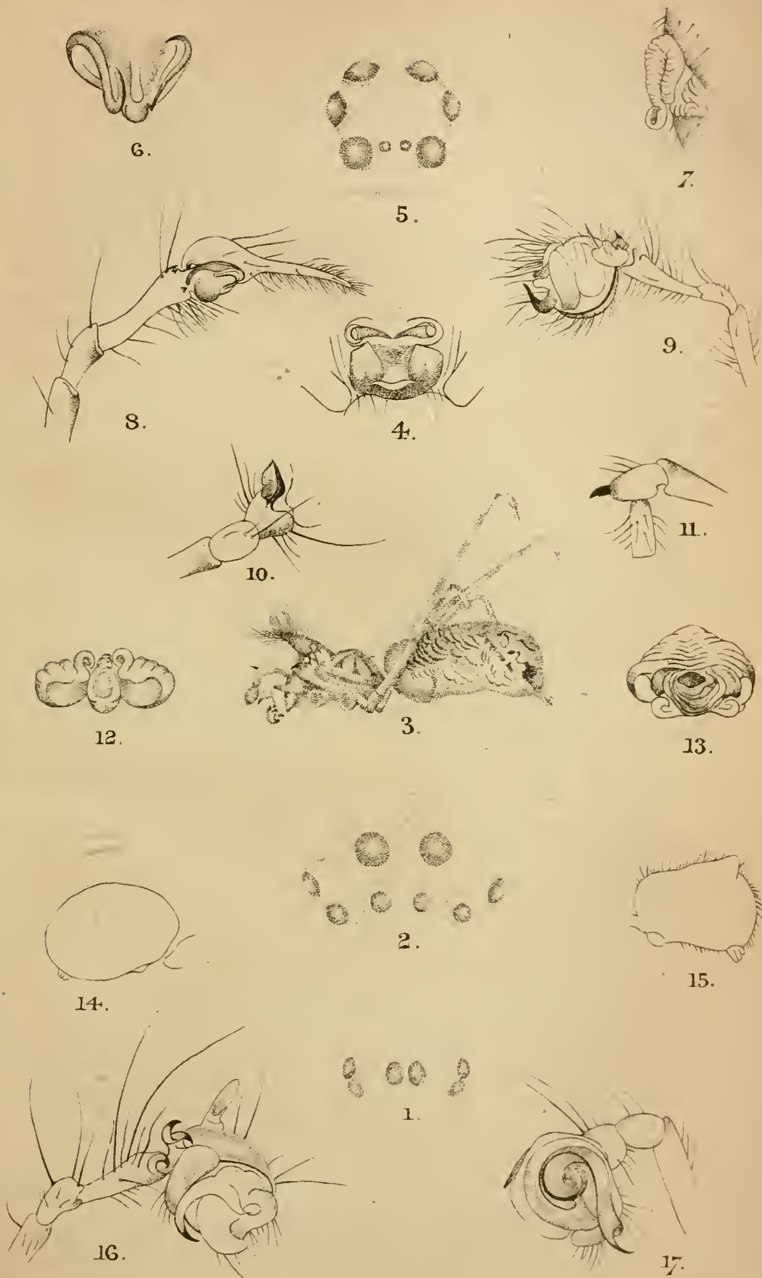
Marpissa cineracea, sp. nov.

Femina.—Ceph.-th., long, 2; broad, 1·2. Abd., long, 2·8; broad, 1·8. Legs, 1, 4, 2, 3. First leg, length 6 mm.

Cephalothorax red-mahogany, passing into olive-brown about margins, blue-black stains; hairs white and golden, tolerably thick, adpressed, black erect hairs; irides golden; clypeus fringe white, long; elongate, cephalic part aplanate, limited by a transverse indentation; height of *clypeus* equal to radius of a lateral eye; pars thoracica slightly dilated, rather more than one-third longer than cephalic part; contour of profile rises from thoracic junction at an angle of 60°, moderately inclined forwards.

Anterior row of *eyes* visibly recurved, centrals much the largest, rather nearer to each other than they are to laterals, a space equal to radius of latter eyes; posterior eyes about equal to fore-laterals in size, perceptibly closer to them than they are to each other; eyes of second row posited somewhat nearer to anterior laterals; ocular area one-third wider than long.

Falces olive-brown; few white hairs; short, about as long as radial + digital joints of palpus together, breadth scarcely



A.T.U. del. NEW ZEALAND SPIDERS. C.H.P. lith.

surpasses interval occupied by fore-centre eyes: inwardly inclined.

Maxillæ fulvous; dilated and roundly truncated at extremity, directed towards each other.

Labium dark-brown, pale tumid margin, broad-oval, less than half length of maxillæ.

Sternum dull olive-brown; oval.

Legs pale olive-brown, semi-pellucid, faint annulations at articulation of joints; hairs somewhat sparse, white, and outstanding black; spines on tibiæ + metatarsi, terminal rings of 5 on metatarsal joints of two hind-pairs; first and fourth legs of nearly equal length; femora of first and second pair stout, compressed; patellæ + tibiæ cylindrical, of nearly equal length, metatarsi + tarsi shorter and more slender than former articles.

Palpi shade paler than legs; hairs white, few black hairs.

Abdomen elongate-oviform, base truncated, rather depressed above; moderately clothed with white adpressed hairs; pale-drab, markings dark-brown; spotted somewhat in lines; basal third displays a conduplicate figure, convexity directed forwards, extremities rapidly compressed, revolute; in centre of dorsal field are two somewhat crescent-shaped figures, inner horns prolonged forwards, nearly confluent; following the latter is an angular mark, thickening at basal extremities. *Corpus vulvæ* colour of abdomen, foveæ brown; area occupied by two large, broad-oval, rugose foveæ, divided by a narrow)(-shaped septum.

Stratford, *A. T. U.*

EXPLANATION OF PLATE XXI.

Fig. 1. *Oonops septem-cincta*, sp. nov.: Eyes.
Fig. 2. *Habronestes celeripes*, sp. nov.: Eyes.
Fig. 3. *Cornicularia crinifrons*, sp. nov.: Male, eight times natural size.
Fig. 4. *Erycina violacea*, sp. nov.: Maxillæ and lip of female.
Fig. 5. *Habronestes scitula*, sp. nov.: Eyes.
Fig. 6. *Epeira lævigata*, sp. nov.: Vulva.
Fig. 7. *Epeira atri-hastula*, sp. nov.: Vulva.
Fig. 8. *Tegenaria arboricola*, sp. nov.: Palpus.
Fig. 9. *Tetragnatha arborea*, sp. nov.: Palpus.
Fig. 10. *Linyphia pellos*, sp. nov.: Patella and radial joints of palpus.
Fig. 11. *Cornicularia crinifrons*, sp. nov: Patella and radial joints of palpus.
Fig. 12. *Epeira venustula*, sp. nov.: Vulva.
Fig. 13. *Epeira nigro-hastula*, sp. nov.: Vulva.
Fig. 14. *Erycina violacea*, sp. nov.: Profile of female.
Fig. 15. *Linyphia sennio*, sp. nov.: Profile of female.
Fig. 16. *Linyphia sennio*, sp. nov.: Palpus.
Fig. 17. *Erycina violacea*, sp. nov.: Palpus.

Art. XX.—*Notes on* Sceloglaux albifacies, *the Laughing Owl of New Zealand.*

By R. I. Kingsley.

[*Read before the Nelson Philosophical Society, 1st September, 1890.*]

The specimen of this rare New Zealand bird now exhibited is the first one, as far as I have been able to learn, that has ever been seen or captured in this neighbourhood.

It belongs to a species endemic to New Zealand, and is the sole representative of its genus; and also, unfortunately, it is amongst the number of those interesting forms of life which from a variety of causes appear to be fast approaching extinction. There is no doubt that one chief factor in their disappearance is the increasing scarcity of their natural food. This, as well as a change in the condition of their environment, the outcome of civilization, would of necessity cause their numbers to diminish.

The bird in question was captured in the Tadmor Valley, in this province, by a man who stated that he saw it walking on an unfrequented bush-road. It did not appear shy, but was easily captured alive, and brought into town to Jacobs, our local taxidermist, who, after keeping it alive a short time, during which period it freely took food from the hand, destroyed it in order to secure the skin for preserving, as there was a danger of the feathers being more or less injured in confinement. Jacobs unfortunately omitted to notice the sex: I am therefore at present unable to state whether it is male or female, although I am inclined to think it is a male.

From comparison with the description given in Buller's new book on New Zealand birds I find some slight differences, which I think it well to mention.

The whole of the forehead does not appear to be covered with the greyish-white feathers, but only the front margin; the white only extends to the upper part of the sides of the neck, and not the whole as described by Buller. The remaining portion of the forehead, upper parts, crown, nape, and lower part of sides of neck are dark-brown—the broad yellowish-brown margin being only on the sides of the feathers, the black-brown streak being continued through to the tip. The feathers on the lower part of the fore-neck and breast are not narrowly but *broadly* margined with light-fulvous or yellowish-brown. The claws are not black, but of a dark horn-colour.

I notice in vol. xviii. of the "Transactions" that Mr. A. Reischek states he "never saw this bird in the North Island,

and in the South it is extremely rare." We are therefore fortunate in having secured it for our Museum. Too often in the past anything a little uncommon has, as a rule, been sent away to enrich other museums, to the disparagement of our collection; but I trust that the public generally will in future endeavour to preserve any future acquisitions for our institution.

For the benefit of those who may not have had an opportunity of reading up the subject of *Sceloglaux albifacies*, I give a few notes collected from Buller's work.

The bird was first described by Mr. J. R. Gray, in the "Voyage of the 'Erebus' and 'Terror,'" under the name of *Athene albifacies*. Dr. Kaup afterwards made it the type of the genus *Sceloglaux*, of which it still remains the sole representative. Gould points out that its prominent bill, swollen nostrils, and small head, are characters as much accipitrine as strigine, and that its short and feeble wings indicate that its powers of flight are limited, while its lengthened tarsi and shortened toes would appear to have been given to afford a compensating increase of facility of progression over the ground.

There is no doubt that in former times the bird was more plentiful, especially when New Zealand was overrun with a frugivorous rat, which was its chief food; but, with the disappearance of the natural food, as a matter of course the bird would either be compelled to find other subsistence or perish.

There are three specimens in the British Museum, two in Wellington, two in Christchurch, one in Dunedin, and now one in Nelson.

We are indebted to Mr. W. W. Smith, of Ashburton, for nearly all the knowledge we possess of these interesting birds. When he lived near Timaru he discovered indications of them in crevices among some rocks, and by means of smoke forced them out and captured several. Some he kept in captivity to study their habits, and some specimens he forwarded to Sir Walter Buller. Mr. Smith succeeded in getting them to pair and deposit eggs, and made sundry interesting notes of their habits. They are not so active as the morepork in seizing their prey. The male bird (as all males should be) is very attentive to the wants of the female, keeping guard over her during incubation and receiving food and carrying it to her.

They deposit two eggs. Their food, judging from the composition of the pellets or castings, consists principally of beetles and other large insects.

The name "laughing owl" is applied from the sound they make, which is a kind of ridiculous laugh in a descending scale.

Art. XXI.—*Description of a Remarkable Variation in the Colour of* Platycercus auriceps.

By R. I. Kingsley.

[Read before the Nelson Philosophical Society, 11th November, 1890.]

This beautiful bird, exhibited by Mr. W. Martin, was shot near the reservoir in Brook Street, Nelson, during the month of September.

In general appearance it somewhat resembles the splendid specimen now in the Colonial Museum, Wellington, referred to in Sir Walter Buller's work on the birds of New Zealand (p. 143), as shot in Eve's Valley, Waimea, by Mr. Fabian. But it differs in the following respect: There is very little, if any, indication of the normal colouring—*i.e.*, green—on the quill- and tail-feathers.

The following is a description of the present specimen:—

General plumage beautiful vivid canary-yellow; narrow band of crimson across forehead; on each side of rump the uropygial spot of rich crimson. Quills very pale yellowish-white, slightly mottled with brownish-grey; secondaries yellowish-white; larger wing-coverts very dark brown, with slightly-bluish green reflection; lesser wing-coverts rich canary-yellow, slightly shaded with grey at the tips. Tail-feathers canary-yellow, the quills being white. Bill bluish-white; legs and feet flesh-white.

Length, 10·4in.; tail, 4·3in.; culmen, 0·6in.

Wing-flexure, 6·1in.

Art. XXII.—*On the Occurrence of* Danais plexippus *and* Sphinx convolvuli (?) *in Nelson.*

By R. I. Kingsley.

[Read before the Nelson Philosophical Society, 11th November, 1890.]

On October 26th I received from a resident near Bishopdale, Nelson, a fine specimen of *Danais plexippus*. It was unknown to me at the time by name, although I had in my possession a damaged specimen of one taken about the year 1879. In the course of the following week I heard of some six or seven others being captured in the vicinity of the town, and since that date several more have been observed.

On referring to Mr. Enys's Catalogue of the Butterflies of New Zealand, I find there a coloured drawing and a reference to it under the name of *Danais archippus*. It appears to have been first recorded as a New Zealand insect by R. W. Fereday in a paper printed in vol. vi. of the Transactions, and named by him *D. berenice*.

In vol. xi. Mr. F. W. Sturm states he saw it in Hawke's Bay in 1840 or 1841, and again in 1861. It would thus appear to occur periodically at intervals of several years.

Mr. G. V. Hudson has two specimens taken in 1879 and two taken in 1881, but from inquiries made I can find no evidence of their having been seen in Nelson since that date until the present time. And it is scarcely probable that so large and prominent an insect could escape observation.

This occasional appearance is a subject which deserves investigation. There may be several surmises by way of explanation, all more or less reasonable, and yet not satisfactory because void of proof. It may be that their usual habitat is "far from the haunts of men" on some of the back ranges or secluded mountain-gullies, from which a succession of strong winds similar to those we have lately experienced has driven them; or, as is the case with some insects in England, the larva may require some four or five years to mature.

Whatever may be the cause, it is well from time to time to notice their presence, in order to assist in unravelling the tangled web of their life-history. There is no description, as far as I am aware, in the Transactions, but I have, through the kindness of Mr. G. V. Hudson, received the following copy of Boisduval's description:—

Danais plexippus, Linn. *Danais archippus*, *D. berenice* (in Transactions), *Anosia plexippus*.

The four wings somewhat sinuate, fulvous above, with a rather brilliant reflection; all the wings entirely margined with deep-black, having in fresh specimens a bluish reflection; nervures same colour. The summit of the primaries has three oblong fulvous spots, preceded by eight or ten smaller white or yellowish-white, extending to the middle of the upper edge, two rows of white spots on the outer borders of all the wings; occasionally the inner row is ferruginous. The fourth nervure of the secondaries has a large black spot or tubercle. The under side presents the same markings as the upper, but the points of the posterior edge are larger and all white. The ground-colour of the secondaries is nankin-yellow, with the nervures slightly bordered with whitish. The emarginations of all the wings white. Body black, with yellowish points on the thorax and breast.

The ♀ has wider nervures, and is destitute of the black tuberculous spot on the secondaries.

Expanse of wings, 4½in.

I have also to exhibit two fine specimens of a moth which Mr. Hudson identifies as *Sphinx convolvuli*. They were captured in Nelson during the past week. Mr. Meyrick, in vol. xxii. of the Transactions, describes it, and mentions it as being found in Taranaki and Napier, and that the larvæ feed upon the wild convolvuli of the sea-shore.

From a description of the larva, I should say it is identical with the one that I am informed has been seen for several years feeding on the convolvuli in Blind Bay district.

I also have to record the occurrence of the somewhat rare and beautiful moth, *Elvia glaucata*, in Nelson, but, unfortunately, my specimen was destroyed. Mr. Meyrick mentions it as found in Christchurch from December to February, but I captured it early in the month of October.

Art. XXIII.—*On Rats and Mice.*

By Taylor White.

[*Read before the Hawke's Bay Philosophical Institute, 11th November, 1890.*]

Plate XXII.

Owing to my pastoral occupation I have mostly lived on the outskirts of civilisation, residing in districts formerly little known and sparsely populated. This was eminently favourable for the observation of the indigenous fauna, and of the gradual spread of imported animals. In this paper I will endeavour to set before you my experience on the subject of rats and mice.

Coming to the Province of Canterbury at the commencement of the year 1855, I at once went into what is now known as the Oxford district, and assisted in starting the Warren Station. We had shipped a brace of pointers to use on shooting-excursions after the New Zealand quail; but even in those early days quail were becoming very scarce in that part of the country — possibly owing to burning off the native grasses to cause green feed to spring. Having no game to work the pointers to, they were utilised in hunting minor game—rats, for instance. We would take a spade, and walk out on the plains, which were like a great sea, whose limit was the horizon, or, on the west, the apparently endless ranges of mountains, clothed at their base with dark-coloured evergreen forest, while above the timber-line were Veronicas and areas of yellow-brown covered with tall snow-grass, tangled together by thick masses of their former growth, bending downward, dead and grey, never having been burnt by the Maoris for centuries probably; crowned with grey peaks where the jagged rocks and their broken fragments pointed to the sky. These ranges were then considered an "Ultima Thule." Looking far away to the east were the dark rough outlines of the Port Hills, and near by Burnt Hill, standing alone like an island surrounded by an endless sea of yellow tussock (*Poa australis*). On favourable occasions a wonderful mirage would be seen, when the silver line of the waters of the Waimakariri would be distinctly seen pictured above the edge of the horizon, a glistening, winding, silver band with its fringe of small kowhai-trees clearly defined. In looking for my flock of sheep I have seen them like rows of trees, when, in reality, they were hidden in lower ground some two miles away, and were not to be seen looking from half the distance with the aid of a telescope. A telescope was an essential part of a shepherd's outfit in those days. On the occurrence of a mirage the day would be hot, and the evaporation, when closely noticed, could be seen ascending with a quivering, tremulous motion some 6ft. upwards from the heated ground. Taking a spade and the pointers, we would beat around, and the dogs would presently come to a stand. Going up, an area of some 10ft. would be noticed of a nice bright-green colour among the prevailing brown, being free from tussock, and covered by a small flattish-leaved grass, whose leaves had their points curved or bent towards the ground. At distances apart in this green patch were numerous rat-holes. We would commence to dig, and the dogs stood ready to field the rats—of which there was generally quite a small community—as they bolted. One day a laughable scene occurred: a dog had just nabbed a rat, when another rushed out. Bravo opened his mouth automatically, as it were, and the rat, in his hurry, jumped straight in. The dog then, with two rats hidden in his capacious mouth, looked round in a dazed and helpless manner, as if asking advice what to do under these strange conditions. At other times a rat would spring at a dog, and hang to its nose or pendulous upper lip like a veritable bull-dog.

This same green grass, I think, was similar to a kind seen since in Hawke's Bay. If so, it has a large seed, which might have been collected as food and stored by the rats, some of which being dropped would grow around their dwellings. Yet I do not remember finding any stored, but only nests of dry grass. Or the ground being manured and made fertile by the rats may have induced this particular grass to grow and establish itself.

I did not at that time consider these rats as anything out of the way, being fully prepared to find things upside down at the Antipodes. From recollection, they were reddish-brown, and perhaps white underneath, of a fair size, and not unlike the Norway Rat (*Mus decumanus*). Still I feel certain they could not be the Norway rat, but a distinct species of a more social disposition, for full-grown ones lived together to the number of eight to fourteen, and were not a family of young rats. The tradition at that time among the Canterbury settlers was that the Maori rat was of a red colour. I never remember any one noticing these rat-warrens or speaking of their occupants as the Maori rat. To show how little likely unscientific persons are to notice small peculiarities in rats, I may say that as a boy I was constantly killing rats in England adjoining a large piece of water, and never found out that the water-rat was in any way different from the other; yet I understand naturalists class them separately, though their colours must be similar.

While living at the Warren there was not a mouse to be seen for a whole twelvemonth or more. Then some one reported seeing a mouse among the tussocks; in a few days more were noticed; then numbers all about, in the grass and in every corner of the house.

After this I had nearly a year's experience at gold-digging on our first goldfields near Collingwood, Nelson. Here in the camps were both rats and mice, although the country was mostly covered by the virgin forest. On my return to Canterbury Province I found my way to the back of the first range of westward mountains previously mentioned, and started a small sheep-run, bounded by the rivers Waimakariri, Poulter, and Esk, there being other large mountains still to the westward, in fact all around. Here the rats acted differently, though I had no suspicion they were a different kind. These came in crowds around the dwelling, so much so that, having stored the flour—which was very precious owing to the difficulty of packing it in—on beams overhead, I made myself a lance by lashing a large packing-needle to a long stick, and, when lying in bed, having the light burning, would spear the rats as they frolicked about, scattering the flour-dust over me. One starlight night I went outside and was standing near a small native-birch tree. On looking towards the clear frosty sky the boughs of the tree were well defined; but the whole tree was thickly covered with apples. I rubbed my eyes and looked again: they still were there—quite a plentiful supply of fruit. I got a long pole which was near by and gently touched one of the apples, when it gave a squeak, and all the fruit vanished in a twinkling. I rushed to get my dog, but all had cleared out. There were several sheepskins hanging in the lower boughs of the tree, and the rats, busy eating them, on hearing me coming had run aloft and tucked themselves up on the smaller boughs. I candidly confess that it was a case of complete mystification, and instead of hitting hard and making sure of one they were all allowed to escape.

Here, as before, were no mice for months, when they suddenly appeared, having crossed large rivers of ice-cold water or mountain-ranges, and were in thousands. The rats cleared away, and we were now pestered with legions of mice. I have heard farm-labourers, when taking down a wheat-stack for threshing, say if many mice were found in the upper part of the stack there would be few or no rats found in the foundation, being driven out by the mice, or not liking their company.

Again I moved, still further into the wilds, going to the head of the New River (Oreti) and the shores of Lake Wakatipu, Otago. Here were rats which lived under the dead leaves of the prickly "Spaniard," and possibly fed on the roots. The Spaniard leaves forked into stiff upright fingers about 1in. wide, ending in an exceedingly stiff pricking point. In places where no fire had passed the dry old leaves turned over towards the ground, overlapping each other, making a miniature bell-tent round the parent stem: these were beautiful dry houses for the rats and lizards. Rats were very numerous; and during my first winter here, being snowed in with a short supply of provisions, I was driven to various devices to keep things going. One was to walk out on the snow with my sheep-dog and set him to find one of these natural tents beneath the snow tenanted by a fat rat, which I would poke out with my stick for the dog to catch, continuing this till a good stock of these small deer were collected. I would then go home, make a bright fire, singe and scrape them, and roast slowly on the ashes. When cooked they gave an appetising odour resembling cooked rabbit. After they had cooled down and had been minced up by a tomahawk, they were given to the poultry. By this means I saved my hens alive and kept them nice and fat. One thing I noticed in cutting up the rats: the paunch or stomach was full of a tanglement of what seemed to be white worms of a pin-wire look, and, perhaps, ¾in. long. I never found out the meaning of this, but considered them a parasite, for the rat masticates its food and would not swallow it whole. These worms had certainly not been bitten. Of course, heating would make them swell and become more apparent. They could hardly be shreds of the Spaniard root. All the rats were similarly affected. The curious part is that I seem to have noticed no food of any kind in the stomach round which the worms might have been wrapped. This would be about the year 1861.

If I remember rightly it was some three years before the first mouse came. This place was ninety-odd miles from the east coast, from which direction they would probably come. They came just in the same manner as before described. I have now given three undoubted cases of the migration of large bodies of mice, and there is little doubt their natural instinct caused them to travel immense distances, even putting aside comparison with their diminutive bodies. How they avoided or crossed large rivers I do not understand, for I have caused a rat to swim in an ice- or snow-fed river, and the coldness of the water caused it to drown. If the migration occurred in the autumn the water in the rivers would be both lower and much warmer. Up to the time of the migration not a mouse had been seen. Then one was reported as seen in the grass, next day a few more, and then plenty all over the place. The plan of these migrations is not carried out after the manner of troops, marching shoulder to shoulder, but each little beast is dodging along from cover to cover, after the manner of sharp-shooters in advance or on the wings of an advancing army.

These periodic migrations of animals have no doubt been the means by which large continents became stocked over their whole area in those parts suitable to the particular animal occupying them. What influences them, and how they communicate with each other to appoint a day for a general move, is a problem as yet unsolved. Things may occur round about us which have no special significance to our understanding, unless by accident, as it were, the proper key is placed before us.

Rats in this district came into the house—whether the same as those living under the Spaniards I do not know. At the house of one of my neighbours living near Lake Te Anau, some thirty miles away—for people then were few and far between—they killed and salted a lot of beef for winter use, and then hung the pieces by flax-strips to the round battens of the thatched roof. When visiting there I was shown this large array of joints, and told to examine them well. There seemed nothing unusual about them, but on a piece being taken down it proved to be only a shell of outer crust, the whole centre having been eaten away by rats, who proved too cunning to cut away the string by which the meat was suspended. After the advent of mice the rats became less numerous, as was the result in other cases; they must have moved westward into the alpine ranges, before the army of mice.

Recently there has been a plague of rats in Lincolnshire, England, and some have said the cause was owing to shipments of weasels to New Zealand. From their being in such numbers (one farmer poisoning thirteen hundred in his yard during one night), it is evident that it is not from natural increase, but the result of an ordinary migration.

I lived in the South Island over twenty years and never found a Black Rat (*Mus rattus*), but, on coming to Hawke's Bay, I soon noticed them; as also the common Norway Rat (*Mus decumanus*), which is said formerly to have found its way, by ship, to England, and to have superseded the black rat or destroyed it, which was the rat indigenous to Britain. The black rat seems never to come into buildings or stacks, but to live in the fields or bush. I have taken specimens having a yellow-brown mark or line leading from the angle of the jaw down the breast to each fore-leg. On reading Mr. Rutland's paper, giving an account of the so-called Maori Rat (*Mus maorium*) in the north of the South Island, I set to work to try and find the same rat in the forests here where I am located—Wimbledon, Hawke's Bay. The grey or brown rats had so great a variety of shades of colour and size that this was no easy matter; and a collection of skins had to be made, which varied so much that, for a time, I could come to no decision. Now, I feel sure we also have *Mus maorium*, and very likely a second native rat, or, rather, third, counting *M. rattus*. But as yet I have proved nothing certain about No. 2. There may be various stages of hybridism among these rats with *Mus decumanus*, which would make a difficulty in fixing on the originals. My new rat, in description, seems to agree somewhat with the *M. maorium* in Mr. Rutland's paper. For some time, owing to its small size, I thought it the young of the larger species. In colour it is brownish-grey mixed with black hairs; black hairs plentiful from forehead to nose, which is pinkish-skinned; belly dirty-white, also light slate-colour, very dark fur underneath; yellowish-brown stripe down breast-bone (not always); coloured on legs down to claws, which are pink with white hairs; ears are often or always jimped as with small excrescences on edges from disease, but this seems a distinct peculiarity of the species; face broad, outline Roman, possibly from hair standing outward naturally; ridge of bone between ears, on back of head, very prominent, sometimes with patches of black colour on inside of skin; hair on back beautifully iridescent in sunbeam when looked at from a certain angle, giving a bright delicate colour of light-green—in fact, the whole surface of the back looks a beautiful green. It is possible this may also be seen on the coats of ordinary rats; I have not yet put it to the proof. If so, it is worth any one's while to see this wonderful effect—an ordinary grey animal changed to a delicate shade of green by arrangement of angle of sun-rays and the line of sight. Here is another description from my notes: Male, ears jimped with fighting (?), reddish-brown, with black hairs slightly longer. Short black hairs on head, giving a stand-up look to the coat, as of an animal very cold or sick. (This may be taken as a distinct characteristic of the variety.) Nose and mouth pink. Under-jaw, belly, inside fore-legs, blue-white, with dark under-down. Faint bar of reddish down breast. Darker-brown colour down front of fore-legs. Dark reddish ring of colour round to inside hind-legs at the hock in the lowest of the long body-hair. Top of back darker than sides. Tail smooth; hardly any short hairs. Toes white; hind-toes with patch of dark colour on middle knuckles. Forehead or front of face looking to project, or rounded by hairs standing out. Whiskers black.

Unfortunately I get no opportunity to observe the habits of these rats, for it is from the dead bodies brought home by the cat that my information is derived. I have seen the heaps of hinau seeds with the minute perforation and covered in saw-dust or chippings as described by Mr. Rutland; but any of the rats might have this habit. These rats have not the black hairs of the back projecting twice the length of the other hairs, which I take to be a distinctive feature of *M. decumanus*, especially the male.

A curious fact is observable in rats and mice: you will see how closely the feet resemble the human hand (as indicated in their scientific name—*M. decumanus*); but the thumb on each fore-foot is wanting in the top joint and nail.

In England there are several distinct species of mouse; but how few people see or know them one from another! The ordinary mouse, *M. musculus*—probably imported; the long- and the short-tailed field-mice; the dormouse, sometimes kept as a pet, but sleeping most of its time, as its name indicates; an exceedingly small species, the harvest-mouse, which builds a covered nest of grasses among the cornstalks or bushes: and two kinds of shrew-mouse—these have noses peculiarly long and sharp-pointed, to facilitate their search after the small insects on which they feed; cats are said never to eat them, although they may kill one by mistake. All but the first-mentioned live in the fields, and do not enter buildings. There are also the black rat, said to be extinct; a grey water-rat, and the Norway rat. There are, thus, ten distinct species inhabiting the one country.

Mr. A. R. Wallace writes, "The Black Rat (*Mus rattus*), was the common rat of Europe till, in the beginning of the eighteenth century, the large Brown Rat (*M. decumanus*), appeared on the lower Volga, and there spread more or less rapidly, till it overran Europe and generally drove out the

Black Rat, which in most parts is now comparatively rare, or quite extinct. This invading rat has now been carried by commerce all over the world, and in New Zealand has completely exterminated a native rat, which the Maoris allege they brought with them in their canoes from their home in the Pacific." The following measurements have been taken roughly in inches:—

—	Maori Rat.				Black Rat.	
	Male.		Female.		Male.	
	No. 1.	No. 2.	No. 1.	No. 2.	No. 1.	No. 2.
Snout to root of tail...	$6\frac{4}{16}$	$5\frac{1}{8}$	4	$5\frac{3}{8}$	$7\frac{12}{16}$	$7\frac{3}{8}$
Length of tail ...	$5\frac{11}{16}$	$5\frac{1}{8}$	$4\frac{6}{8}$	$5\frac{3}{8}$	8	$7\frac{1}{2}$
	$11\frac{15}{16}$	$10\frac{2}{8}$	$8\frac{6}{8}$	$10\frac{6}{8}$	$15\frac{12}{16}$	$14\frac{7}{8}$

The head of Maori Rat $1\frac{1}{2}$in., *M. decumanus* and *rattus* 2in., from point of nose to top of head. Hind-leg of Maori Rat, 1in.; of the other two species, $1\frac{1}{2}$in. These are not measurements of the bone, but outside the hair—*i.e.*, from tip of nose to terminal hairs for length of body—this makes the tail shorter than would show in the bone-measurement.

[Note.—I have, since writing, taken seven worms from paunch of Black Rat, over 2in. long, stiff and wiry. The sheen of Black Rat is dark-purple.]

Art. XXIV.—*On Rabbits, Weasels, and Sparrows.*

By Taylor White.

[*Read before the Hawke's Bay Philosophical Institute, 13th October, 1890.*]

I am sorry to see from newspaper report that the members of the Hawke's Bay Rabbit Board have decided against the importation of weasels. As this subject is sure to be considered again, sooner or later, it may be worth while to say a few words in favour of the weasel and its introduction to our lands. So far as I understand, the objection brought forward may be called a fear that "the balance of nature" should be upset—*i.e.*, What are the weasels to do when the rabbits are killed? Very well, so far. But let me put several questions which may throw light on the matter. How far back in the history of Britain can we trace both the rabbit and the weasel Was either beast introduced by man to that same island, or may we suppose both rabbit and weasel lived side by side in Britain when men were few and far between, and dressed themselves in skins, or coloured their naked bodies with woad —at which time the most of Britain would be covered with dense forests and swamps? Under such conditions, could man be a valuable agent to check the undue increase of either animal race? The rabbit, as an article of food, would be taken by man. But for what reason should primitive man check the undue increase of the weasel? If the weasel was left unchecked to increase at will, why did it not exterminate the rabbit, then the game-birds, then the sheep, then cattle and horses, till at last man had finally to succumb before this energetic little blood-sucker? Seeing that rabbits were hunted by man, how was it the rabbit did not speedily become extinct, having man, dog, wolf, fox, weasel, and others constantly killing it? What is there remarkable about New Zealand, as compared with the Britain of the past, which gives the idea that weasels would in this country be endowed with extra vitality? Does not man aid in keeping "the balance of power" among the animal kingdom? Where rabbits are scarce may he not destroy weasels and protect the rabbit, and *vice versâ*, and so play one against the other?

I come from a district famed in English history, the old forest of Sherwood, and have stood under the shadow of Robin Hood's oak, an aged giant among trees, under which Robin and his men in green, the bold foresters of "Merrie Sherwood," held their tryst. Now, why did not the law speedily check these freebooters, who slew, with bow and arrow, the king's deer, and feasted thereon, not forgetting the tax they levied on the purse of the wealthy traveller? They were able to hide successfully in the trackless forest and escape the king's soldiers. There were formerly many local ballads recounting the various exploits and encounters of Robin Hood and his merry men, which were very popular. Most of these would seem to be now lost. Sir Walter Scott introduces some of these erstwhile heroes in "Ivanhoe:" Robin Hood, under the disguise of Locksley, the archer, as also the "sturdy clerk of Copmanhurst," otherwise known as Friar Tuck, who has a bout at fisticuffs with King Richard himself. For even some in holy orders were fain to join in this free and jovial life. "The Miller of the Dee" was another celebrated character; also "Maid Marian," Robin's wife, and "Little John," his lieutenant, who, notwithstanding his nickname, was considerably over 6ft. in height. Robin is sometimes thought to have been the exiled Earl of

Huntingdon. I give part of a modern song, in vogue some thirty years ago :—

The monks of old famed stories told
  Of knights of chivalrous arms,
When the guerdon of the warrior bold
  Was the maiden's peerless charms,
When bold Robin Hood and his foresters good
  Were merry as merry could be,
When the forester's life was free from strife,
  And his home was the trysting tree.

CHORUS.

Then, hurrah, hurrah, for bold Robin Hood :
  Hurrah for the olden times,
And one cheer more for each forester good,
  Who lives in the olden rhymes.

This wilderness of forest was harbour for rabbits and weasels equal to any of our New Zealand wilds. Cultivation and population, both, have largely increased in historic times, and we must not consider the Britain of the past as similar to the Britain of the present.

Some people point to the wonderful increase of the house-sparrow in its new home, and say, "Look at that; who'd ha' thought it!" Now, I can show they might have known what the result would be by looking back on this bird's history, provided they could do so as I can myself. Nearly fifty years ago, when New Zealand was a very small place, and I myself also small, I can well remember that public payments were made in England to induce the boys to destroy the house-sparrow. When a very little fellow I used to make a practice of catching these birds, and saving their heads, which had a market value. When a good necklace of heads was collected I would go to the workshop of the village carpenter, who also must have collected rates or taxes, or in some way had the authority to disburse certain moneys. His name I remember well—Chadwick; he would count the heads, and then give me a few of the large pennies current in those days. So you see, some fifty years ago, at Cuckney, in Nottinghamshire, England, it had been found necessary to devise means to check the undue increase of the house-sparrow, and it is every way possible that the same verdict had been passed against the sparrow a hundred years previous to the date mentioned. The hedge-sparrow is of quite a different character, and must not be classed with the other. I think it has been found impossible to bring so delicate a bird the long voyage to New Zealand. This matter of head-money for the destruction of the sparrow, if disputed, can most likely easily be proved by referring to the rate-books of that date in the district mentioned, or probably in most other parts of England.

Here is a cutting from the *Otago Witness*, of the 3rd July, page 7, which accurately describes one of the traps used fifty years ago, and also advocates the importance of waging continual war with the sparrow of to-day in England, as was the case many years ago: "Speaking of the sparrow nuisance, a correspondent of the *Field* says, 'In consequence of a note in your columns I have lately tried one of Wyatt's (of Bristol) sparrow-traps, which in shape is like a large spittoon made of wickerwork, and find it most successful. It is placed where the poultry are fed, and six to eight sparrows are caught daily. I generally leave one hen-sparrow in the trap as a decoy. When one considers that a single pair of sparrows will rear from eight to ten young ones during the next three months, these traps seem to deserve a trial wherever sparrows are numerous.'" The writer omits to mention a small door in the side of the trap to collect the captured birds from, which find entrance under the centre of the downward sloping top, and seldom or never think of returning by the same way. This little extract shows that the war with the sparrow has been kept up all these years, and that they still hold their own in spite of everything.

Now an argument is founded by persons ignorant of the above fact. They say, "See how the sparrows have increased in New Zealand. If we are foolish enough to introduce weasels they are sure to do the same." I know of no proof, historical or otherwise, that weasels ever increased unduly in England; and, if it were not for the special eagerness with which game is preserved in certain places, the weasels would mostly be left unmolested, as they are in other districts where game is not the particular object. In New Zealand "the balance of nature" is at present upset by the undue increase of the rabbit, so man requires to place the weasel in the opposite scale and hold the balance in his hand.

Since writing the above, I have received my copy of vol. xxii. of the Transactions, and have read Mr. Coleman Phillips's paper on rabbit-disease. Although advocating the spreading of fluke through the agency of dogs, he allows the necessity of using natural enemies as aids in destruction also. A letter from Mr. W. Brodie, President of the Toronto Natural History Society, is included in the same paper, which shows that the wolf, fox, lynx, fisher (*Mustela pennantii*), marten (*M. americana*), and horned owl (*Bubo virginiana*) are in that district the rabbit-destroyers. All these are dangerous animals to introduce into New Zealand. The three first are sure to destroy sheep and lambs. The fisher and marten are tree-climbers. As Mr. Brodie remarks, "They are good tree-climbers, thus easily eluding the pursuit of dogs." It is a well-understood fact that it is of vital importance to the agriculturist that the number of insectivorous birds should be increased rather than diminished. So these tree-climbing *Mustelidæ* are not admissible, for they take not only the nests of eggs, but the birds also when at roost in the trees. I notice Sir James Hector, in his letter to the Minister of Mines,* remarks that he is of opinion they would in New Zealand leave the open country and take to the forest. This is decided evidence against them. Sir James continues, "the British martens have even a worse reputation than the polecat as destroyers of lambs." I take exception to this. First, I am of opinion that there are no British martens, properly so-called, for martens are tree-climbers; and I maintain that the killing of lambs, and even assaults by companies of weasels on man himself, are old fables and not properly authenticated. Of the polecat I have no certain knowledge, other than that it is almost or entirely extinct in Britain.

The horned owl is a deadly enemy to all game-birds, and extends its depredations even within the Polar regions, where it plays havoc with the ptarmigan, a species of grouse. From this it is evident that the less we have to do with importations of such Canadian animals the safer it will be.

Mr. A. R. Wallace, in "Darwinism," says, "the sable (*Mustela zibellina*), unlike other animals and birds, when resident within the polar circle, is not in the habit of assuming the white coat, but retains its rich brown fur throughout the Siberian winter, for owing to its tree-climbing proclivities it finds a harbour from pursuit among the trees, with the bark of which its colour assimilates, and not only feeds partially on *fruits and seeds*, but is able to catch birds among the fir-trees." This is a remarkable habit, and causes the sable to feed occasionably on the same food and copy some of the actions of the squirrel, which is of the family *Rodentia* and a congener of the rabbit.

Why the marsupial native cats of Australia (*Dasyuridæ*) are not spoken of as a check on the rabbits in that country is curious, for they are decidedly carnivorous, and I have known one take a full-grown laughing-jackass (*Dacelo gigantea*) which was crippled in the wing, and was so kept within the paling-fence of a garden. This occurred at night; and the cries of the bird, when being dragged under the house, during the small hours, were weird and startling.

To all who will take the evidence of persons living in rabbit-infested districts in New Zealand and Australia it is clearly proved that trapping, poisoning, or hunting are a continual drain on time and money, without any permanent

* Trans. N.Z. Inst., vol. xxii., p. 320.

result, for the whole series have to be constantly gone over again and again. So the already depleted profits from the land are further lessened by costs of fines and expenses incurred, by maintenance of a large staff of men and dogs, purchase of poisoned grain, fencing, &c. If the weasel is not speedily imported to Hawke's Bay, a large proportion of our settlers, who are now barely making a living, will have to throw up their holdings.

The Mount Nicholas Station, Otago, consisting of 75,000 acres of mountain-pasture, when in my occupation, easily carried twenty thousand well-fed sheep. Within some four years after the first rabbit was killed the then owners were practically ruined by rabbits. I saw in the newspapers some two years ago that the run only carried two thousand sheep, and the occupier, Mr. Nichols, was so harassed by fines inflicted on account of rabbits that he petitioned to be relieved from the lease of the land, which was not granted, and in despair, I believe, he cleared out to some other country.

In regard to spreading bladder-fluke by the aid of dogs, to me it seems just as probable that ultimately sheep might be affected, though perhaps not by that special disease itself, but one kindred to it as it were, in a different guise, for these low forms of organism appear to change their character according to what host they occupy; though how scientists can with certainty trace them in their various phases and transmigrations as they alternately occupy animals, snails, earthworms, other animals, and so on, I am at a loss to understand. Surely it can be only guesswork at the best. Years ago a relative, a medical man in large practice, wrote to me: "I do not know the disease—scab—you speak of in your sheep, but you should be careful of your dogs, for the tapeworm from the dog will cause fluke amongst sheep."

The fluke in Australia, though perhaps not the form he alluded to, is generally the result of wet pastures. Formerly we in New Zealand bought imported merino ewes from Australia. I had some at Mount Nicholas, which had lived on those dry hills some four years after leaving Sydney. Some of these, when fat, were occasionally killed for mutton. Speaking one day to a shearer who had knowledge of the fluke, he, to my surprise, said, "I will show you some." As luck would have it, one of these Sydney ewes was being killed at the time. The man cut open a main gall-duct on the liver, pressed his finger along the duct, when, floating in the juice of the gall, came veritable flukes of different sizes, the largest fully three-fourths of an inch long, and resembling greatly in shape an ordinary flounder or flatfish. Here was evidence of the parasitic cause of the disease continuing to inhabit its host apparently for years, and propagate its kind without leaving; but, the surroundings not being favourable, the increase of the parasite was on so small a scale that the sheep themselves were perfectly healthy; and some of this importation of sheep must have lived to the age of twelve years or more. This surely is good proof that the fluke-parasite procreated its kind without ever leaving its host, which is contrary to what science teaches; for, if it or its eggs had once left its host, the dry nature of the pasture would have proved unfavourable to further development, and they would have lost their vitality. Such an incident as this should be of great interest, and its correctness may be fully relied on. I never tried or saw this experiment performed on sheep bred in New Zealand.

My conclusions are that the weasel and stoat should be the only enemies introduced, unless the black-footed ferret of the prairies, mentioned by Sir James Hector,* is devoid of the knowledge of tree-climbing, which presumably it would be, as those regions are mostly almost without timber. It is possible this may be the small hardy, dark-coloured ferret I used in England when a boy, which I was told was a cross between the ferret and polecat, and which was obtainable in England some forty years ago.

[Since this paper was written I have turned up the following in a book, "The Oxonian in Norway," written by the Rev. Frederick Metcalf, M.A., second edition, published 1857, page 87. After remarking on $3 being paid in Norway for each pair of the claws of the golden eagle, he says, "Surely this is a more sensible arrangement than that of those numskull churchwardens of ———, who pay for sparrows' heads out of the church-rates, although a pair of them, while feeding their young, destroy, according to Buffon, four thousand caterpillars weekly." Mr. Metcalf and Buffon side with the sparrow; but I certainly agree with the churchwardens. There are plenty of real insectivorous birds; so there is no need to rely on the doubtful aid of the sparrow.]

Art. XXV.—*Further Notes on Coloured Sheep.*†

By Taylor White.

[Read before the Hawke's Bay Philosophical Society, 11th August, 1890.

Plate XXIIa.

The sheep-breeder may say, "To what good purpose is the consideration of peculiar or out-of-the-way forms of sheep,

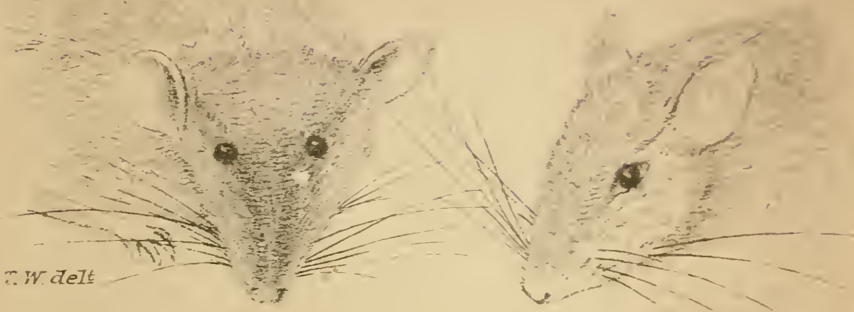
* Trans. N.Z. Inst., vol. xxii., p. 321.
† See vol. xxi., art. liii.

which are not likely to produce commercial products?" This shows a want of knowledge of such things as are beyond their immediate range of vision; for in the Bradford wool-market considerable quantities of coloured wools are sold—black, brown, grey, and yellow—imported from the south of Russia and other places. We here only see the wool-circulars referring to our own products or those competing with them.

Suppose we can find a distinct breed of sheep, having such characteristics as lead to the conclusion that they are direct descendants of the original sheep first domesticated. This at once brings us a link in evidence nearer to the sheep's four-toed fossil ancestor, from which all our domestic animals having double hoofs are considered to have descended. The two immature hoofs at the back of the shank-bone of the sheep, cow, and goat are taken to be rudiments of other two claws or hoofs, which have shrunk to their present diminutive size by generations of disuse, proving of no material service to the animal under changed conditions of life: for instance, when the surface of the earth, or their place of habitation, became more solid to travel over, and so required less spread of foot.

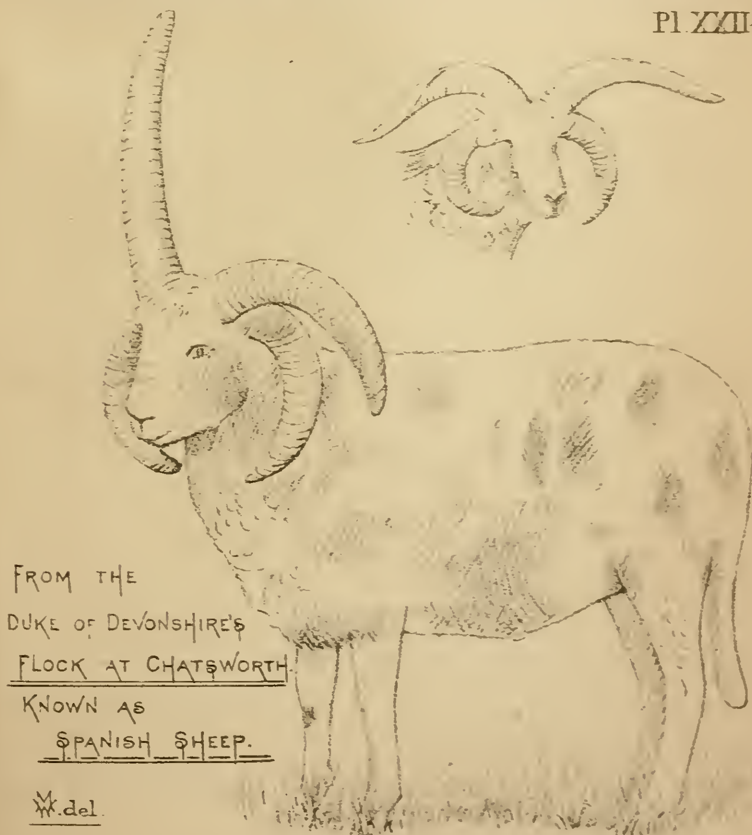
Fossil remains of animal life give evidence that reptiles, and after them animals, all had five toes—at least, on their front feet: one toe after another being gradually lost, in the course of ages, from disuse; the blood, or nourishing agent, flowing naturally by preference to those toes in greater use, thereby the useless members became smaller and gradually lost. In the horse only one toe remains; signs of two others are in the splint-bones at either side of the cannon-bone, hidden beneath the skin. This gives a curious instance of variation working by two different plans to effect the same result: in the horse the atrophy commencing at the hoof, or free end of the claw, and leaving the splints, which are the remnants of the second and fourth supplementary cannon-bones; but in the cow, &c., the atrophy commencing from the reverse end, there remain no splint-bones, but two diminutive hoofs, which are of no practical use to the animal. You will the more readily understand this by remembering these bones correspond with those in the human hand between the wrist and knuckle-joints—the two middle fingers agreeing with the bones contained in the two hoofs.

There are six or more animals in a natural state which are classed as sheep, but writers have been unable as yet to trace the descent of the domestic sheep from any one of these wild species: the argali and mufflon in Europe, thär and burrell in the Himalayas, ammon and poli in Asiatic Tartary—this latter named after its discoverer, Marco Polo, one of the earliest travellers who have left fairly reliable records of their



Small Maori Rat ♀. *Maori Rat. nat size.*

Pl. XXIIA.



To illustrate Papers by T. White.

adventures. The bighorn, or Rocky Mountain sheep, of North America, the musk-ox and the yak of Thibet—these two, inhabiting districts right apart, but living close to the regions of perpetual snows, seem connecting-links between the ox and sheep.

In *Scribner's Magazine* of February, 1889, is a picture, said to be taken from an instantaneous photograph, of the bighorn in their native wilds. In this photograph of a ram and two ewes the ram has a wonderful resemblance to a picture in an illustrated paper of a live specimen of the burrell presented to the Prince of Wales when visiting India some years ago. "The bighorn is in colour a dusky-brown, too nearly resembling that of the rocks through which they move to secure clearness of outline in a picture taken at a long distance." Unfortunately the tails of all three figures are hidden from view. The ears are broad and rounded at the tip, somewhat resembling those of a calf. The horns of the ram are very thick at the base, inclined slightly outward and backward, with one gradual curve only. The ewes have small upright horns, with the tips slightly turned backward, much the same as those seen in the chamois. The ibex and chamois are by many considered the originals of our domestic goats, or a link between the goat and the deer. Here would come a question whether they shed their horns annually, as do the true deer, or retain them for life.

Of domestic sheep the Wallachian is worthy of remark. It has a pair of upright spiral horns of considerable length, which, when viewed in a direct line, give the animal a great resemblance to the fabulous unicorn. Like the Cashmir goat, this sheep is covered with long, straight hair, having an undercoat of extremely fine wool. This latter is greatly valued.

Here is a lady's description of sheep used in packing goods in the Himalayan mountains, in India, an extract from *Chambers's Journal*, 2nd November, 1889: "A long string of sheep passes us on their way to the plains, each with its little pack on its back. They have come all the way from Bhotan, across the highest passes of the Himalayas. They carry down borax and salt, and take rice and other grain on the return journey, being altogether about three months on the road." Perhaps if they grow any wool they will leave that behind also.

This extract from "The Mule-track on the Mountains" gives a good sample of word-painting: "But it is not only still life on my mule-path. Suddenly, perhaps, round a turn in the road, a little flock of sheep comes hurrying down. They are very small gentle creatures, with long soft hair (it can hardly be called wool), dark-brown or cream-white. Their wild-looking shepherd, with his dark Italian face, has a word of greeting for the stranger as he passes by. One day one of these flocks was led by a tiny child, with cropped head, a frock down to his heels, and a branch of mimosa in his hand. He walked first among the sheep, their little faces crowding and pushing softly round him. He might have been David, leading his father's sheep for the first time out of Bethlehem. Then there are women in bright handkerchiefs, picking up olives under the tree; and one often meets a mule or large ass, the rightful owner of the path, stepping down with a gingerly grace over the stones. He bears on his back an immense load of sticks and grass, or a little barrel of wine slung on each side. He probably has one ear set forward, the other back, to show that no advantage must be taken of his good-nature, and he looks at the stranger with a doubtful, intelligent eye, while his master or mistress gives a friendly nod and '*Bon jour.*'" This is very well described, you will allow, and must be by a lady also, I should think.

The report of Consul-General Playfair upon the commerce and agriculture of Algeria, last year, contains very much interesting information relating to wool and sheep. The following is his description of the wool produced in Algeria: "Algerian wool may be divided into two categories, Arab and Berber. The former is generally of a short fibre, sometimes moderately, rarely, if ever, very long, and regulated by the climatic influence of the localities where the sheep are reared. It is always short on the high plateaux, and becomes longer as the sheep descend into more fertile and better-watered regions, but in both instances it is fine wool of a fine quality, and without any hairy appearance—the relic, it may be, of the now lost Merino stock, supposed to have been introduced by the Romans, and subsequently perfected by the Moors of Venice, who certainly drew their original supplies of wool and of sheep from North Africa. The Kabyle or Berber wool, on the other hand, is entirely different: it is hard, coarse, inelastic, and almost resembles goats' hair. Algerian wool has been much discredited by fraudulent practices to increase its weight; nevertheless it is good in quality, and readily purchased, while the sheep themselves are eagerly sought for in France, where from three to four millions are sent every year. No doubt, neither Algerian wool nor Algerian sheep are of the first quality, but the latter possess qualities which might possibly disappear were the race modified to any appreciable extent. They can resist the greatest extremes of heat and cold, of abundant and deficient pasturage, absolute want of care, and the long fatiguing marches necessary to send them to the port of embarkation."

A Russian writer says of the Caucasian wool: "It may be divided into four classes. First, fine wool, which has hitherto been disposed of in Moscow, as it is unsuitable for other markets, being too short in the staple for combing. Secondly, the wool known as Pschawa Touches, and Touchivi: this description is cleaner than the other kinds, and only comprises 5 per cent. of black and grey; the second clip is more sought after, as being cleaner. Thirdly, Tarakamas wool, which is produced in the Tartar districts, and yields 30 per cent. of white, the rest being black and coarse. This description is mostly bought for America, though a considerable portion of the second clip is retained in the country for making carpets. Fourthly, the intermediary description, more or less white, and comprising less grey than the Tarakamas. Besides those named are the Elisabethpol, which yields about 40 per cent. white; and the Chakcheran, giving 60 per cent. white."

In the New South Wales Court, at the Dunedin and South Seas Exhibition, held this year, samples of Bagdad brown wool were on exhibit with other wools.

"One of the most striking breeds in the show [Paris Exhibition] was the Solognot, a small, light, and rather leggy sheep, with a long thin tail, and face and legs of a rich red. A pen of Swiss two-shear ewes, jet-black all over, attract attention, mainly by the elongation of the neck and legs."—*Live-stock Journal*, 19th July, 1889.

A Five-horned Ram.—"The most interesting thing about the premises of the London Docks on a Wednesday lately was a remarkable ram hidden away in a corner on the deck of a ship. What was strange about the ram was his horns. He had five of them—two gracefully curling from the points which horns usually select as most convenient, immediately below them were two more, and below these one formed a kind of rung which led up to the rest. The ram looked proud of these horns. He held his head aloft, and seemed anxious to have them duly noticed. He was as playful as a kitten, and, according to one of the sailors in charge, takes to rum as readily and as naturally as any one of the crew. He then displays a number of antics altogether out of keeping with his general decorum. He is twelve months old, and comes from the Persian Gulf; he is remarkably small, with wool of exceedingly dirty yellow, and his legs are brown."—*Newspaper cutting.*

St. Kilda Sheep.—"In the report of the sheep classes at Windsor, in the new number of the Journal of the Royal Agricultural Society of England, page 699, is an account by Lord Moreton of the St. Kilda four-horned sheep. He writes: 'They are said to be descendants of sheep which got ashore from an Armada ship wrecked on the island. Although my sheep have been bred for several generations in England, they are still inclined to be wild. I find the mutton excellent, though the joints are small. I get from 3lb. to

4lb of wool of good quality. As a matter of fact, although called black sheep, they are really brown. . . . But it does not seem to be remembered that these sheep have a peculiar habit of feeding freely on seaweed, so maintaining themselves in the winter time. The Armada legend is brought to account for every variation of horse, cattle, or sheep. But there seems little doubt that the St. Kilda sheep represent a descent from the wild *Ovis*, and therefore may have some capacity for crossing purposes.'"—Signed "G.," *Live-stock Journal*, 20th December, 1889.

I therefore wrote to Lord Moreton for further particulars, and he very courteously replied as follows:—

"Sarsden House, Chipping Norton, Oxon,
"12th May, 1890.

"Dear Sir,—A few days ago I received your letter about St. Kilda sheep, and will now answer it. St. Kilda is an island some distance from the coast of Scotland, and is, I believe, very rocky. I obtained my sheep at the sale that took place on the death of Mr. Staniforth, of Storrs, Windermere, a well-known shorthorn breeder. He had quite a flock of these sheep, and, being, as I said, dispersed at his death, they got scattered over England. They are small sheep. Although spoken of as black, in reality they are of a very dark brown. I am unable to say what the value of their wool is, as I never sell any, but have it made up for my own wearing. The sheep generally have four horns, sometimes only two; at present I own a ram with seven horns. I have never heard of one with so many as this. The pictures you sent me are very like St. Kildas, especially about the head. I regret that I am unable to send you a photograph of my sheep. I have often tried to photograph them—without success, however, as they are too wild. "Yours truly,

"Moreton."

The pictures sent to Lord Moreton were taken from photographs of the Chatsworth spotted four-horned sheep, described in my former paper,* and which I claim as descendants of the original British sheep.

From the inherent wildness of the St. Kilda sheep, and from the Canons Ashby spotted sheep (described previously),* when crossed with a white breed, producing black lambs, we have evidence of affinity between these two breeds, and this leaves little doubt but that they are remnants of the original or first introduced sheep of Britain.

I had laid plans to communicate with Professor Boyd Dawkins to inquire if any fossil remains of British sheep had been found showing that the possession of four horns was

* Trans. N.Z. Inst., vol. xxi., p. 402.

customary. Unfortunately, my communication is delayed or gone astray. I particularly reverence Professor Dawkins as the man who, long years after I had gone to New Zealand, dug up bones of the sabre-toothed lion, cave-bear, hyena, and others in an overhanging-rock cave, where, when I was a child, an old man used to stable his donkey. This was at Cresswell Craigs, on the boundary of Notts and Derbyshire.

Some twelve months ago a very good picture appeared in the *Town and Country Journal*, Sydney, page 541, of African sheep at the Zoological Gardens, Berlin. Three animals are represented. One is of uniform black, or dark colour, and seems to have no tail—possibly it has been cut off; fair-sized horns, bending backwards close to the head, short hair, and well-defined mane of long hairs, and long hair hanging down between the brisket and the throat. I am uncertain of the sex; it is either a ewe or wether. The ears appear to droop. The buck is dark-coloured from the top of the rump to the fore part of the shoulder; neck and thighs white; a smooth tail, white, nearly reaching to the hocks; ears white, standing out at right angles; horns as previously described; a thick rough mane and long fringe under the neck; rest of body smooth. The third (evidently a half-grown lamb) has dark and white patches of smooth hair all over, white tail, ears slightly inclined downwards, no horns; and is lying at rest. Part of the description given is as follows: "The colour of these sheep is always black-and-white, the white forming the groundwork for the black round spots which are found upon the nose, eyes, ears, and just above the hoofs. The shape of the specimens here illustrated is rather small and graceful; the profile is straight; the finely-shaped ears stand out horizontally from the head; the line of the back is even; and the tail is of medium length. The body is curved; the limbs are slender, very similar to those of a deer. The hair is short and even, except on the buck, and even then it grows long only on the under-side of the neck. The large coloured spots which are distributed over the body are essentially black, and characteristic. The Cameroon sheep are only useful as food; but they are considered of great importance among the black population on account of their easy-fattening qualities." Now, the only spot I detect is one black spot round the eye of the buck. One animal is entirely black, the other two have black and white in large areas, not at all to be called spots. The picture is very well done, and must give a faithful resemblance of the originals.

The African fat-tailed sheep are remarkable: the tail alone is described as weighing from 20lb. to 30lb., being equal in weight to the animal's body, and was considered a great delicacy, having the flavour of marrow. They are seldom met with now. I was making inquiries through a southern paper, asking for information about hybrids between sheep and goats, when a gentleman wrote me of these sheep, saying that they were a cross between the old Dutch goat and the sheep. He sent me a sample cut from a rug made from their skins by the blacks at a mission-station. This piece of skin was covered with short, shining, white hairs, with a few very slight fibres slightly curled, requiring close inspection to detect. This resembled greatly the skin of the Angora when in summer coat. The gentleman had never seen the sheep themselves, as they were mostly superseded by the merino; but his description of the tail, and flavour of the same when cooked, though gained by hearsay, was quite correct.

I will now make a few remarks on peculiarities I have noticed among domestic sheep:—

In black and coloured crossbred and long-wool sheep a small white spot below the eye is rarely absent; but I believe that black merinos never show these two spots. Can these spots be inherited from a wild ancestor? If wanting in merinos it would point to two different wild forms or species from which these two breeds are separately descended.

It is a singular thing that we have no breed of domestic sheep with rudimentary tails, considering that man has for many generations been in the habit of excising that member, and that their near allies the goat and deer rejoice in short upturned tails like a rabbit. We have both cats and dogs naturally with short tails.

Here are two instances of inheritance which have been observed by myself. When assisting at the annual ear-marking of lambs at my neighbour's (Mr. Low, of Von River, Lake Wakatipu) I found a lamb with both ears so small that it was impossible to place the proper ear-mark thereon. On looking carefully through the sheep in the same pen I saw the mother, having the same extremely small ears as in the case of the lamb. At another ear-marking years afterwards, on the Glengarrie Station, Hawke's Bay, we were unable to ear-mark a lamb, for the one ear was wanting entirely, nor was there any orifice leading to the organ of sound within the head. Remembering my former experience, I soon found the mother, possessing a like defect.

From the Eyre Mountains, Otago, I once mustered in a mob of merinos and their produce which had been lost for some years. Among them was a young four-tooth ram, unear-marked, having small horns little larger than those of a ewe, and without convolutions or roughness. The wool was very white, having no yolk, fine, also straight, having no curl or spiral in the fibre. Unfortunately, this sheep was lost soon afterwards. From such a sheep the celebrated Mauchamp merino, of France, is said to have originated. In the same district I found lambs with their hoofs bitten off, supposed to be done by rats. One in particular surprised me. As I was walking on the hill, doing shepherd's duty, the little thing came walking towards me with such a smooth and peculiar action that I was transfixed with wonder. On looking closely I found that it was walking on the two fore or front legs only, the body being balanced by projecting the hind legs forward on each side of the front ones. In most cases, the hoofs after a time grew into perfect form again. But whether this particular lamb survived or not I cannot say.

On the Canterbury Plains in the early days, when all the runs were unfenced for many years, we used to find cabbage-tree or hermit sheep. These were merino sheep living alone, and having a cabbage-tree or flax-bush for a mate or companion; and they could not be made to leave, always keeping within a certain radius of that special tree, which they considered their especial friend. They would be without ear-mark, having long tails and several years' wool, mostly reaching to the ground. They could never be made to associate with flock sheep, and, being very fat when found, were generally carted home and killed.

Now comes a most extraordinary account of a wether sheep suckling and rearing a lamb. Mr. Robert Wiffin, my first informant, said, "It brought it up, and well, too." Several in the district speak to this as a fact. Mr. Mark Franklin and others examined the sheep when it was in for shearing. This was at Mr. John Roberts's Tautane Station, when Mr. Pillans was temporary manager.

So, wonderful things are seen and lost, for in our life-struggle we have to attend to more immediate wants, and in most cases lose sight of the rare and curious freaks which occur at long intervals among our surroundings.

The accompanying drawing (Plate XXIIa.) was copied from the photograph of a Chatsworth sheep by my friend and correspondent, Mr. E. Mervyn Wrench, and is some of his last work, he having since "passed through the valley of the shadow of great darkness to that better land." It is identical with the picture remarked on by Lord Moreton as a fair resemblance to a St. Kilda sheep.

P.S.—The following letter has since been received from Professor Boyd Dawkins:—

"Woodhurst, Fallowfield, Manchester,
"28th June, 1890.

"Dear Sir,—In answer to your question, forwarded to me by Miss White, as to ancient British sheep, I cannot say more than that I have never seen any four-horned sheep of the

Neolithic or Bronze Ages in Britain. I have, however, seen several four-horned skulls from refuse-heaps belonging to the Middle Ages. There were two distinct breeds in Britain from the Neolithic Age to the close of the Roman occupation—one small and like the Hebridean sheep, and another much coarser and thicker in the legs. Both these were two-horned.

"I am, &c.,

"W. Boyd Dawkins."

As animals in a state of nature are seldom or never equipped with useless duplicate pairs of horns, the extra horns on these animals are probably the result of variation under domestication.

The party of Algerian Arabs now on exhibition in London in place of Buffalo Bill's Wild West Show, have brought with them goats having four horns. These are the first of the kind I have heard of; and, the sheep and goat being very closely allied, such an incident is worthy of notice in this paper. From the remains of four-horned sheep appearing about the time of the Middle Ages, perhaps they were brought to England by the Saxon or Danish colonists. It would be interesting to know if signs of such sheep are found in the Danish middens.

A previous remark about the St. Kilda sheep eating sea-weed is probably an error, for I fancy St. Kilda is difficult of approach, having no beach. Likely this would be a habit of the Hebridean sheep. A native of those parts once told me that it is customary to feed horses on potatoes during the severe winter season which is experienced in those exposed islands.

Art. XXVI.—*On the Birds of the Kermadec Islands.*

By T. F. Cheeseman, F.L.S., F.Z.S., Curator of the Auckland Museum.

[*Read before the Auckland Institute, 4th August, 1890.*]

At the close of a paper on the flora of the Kermadec Islands, printed in vol. xx. of the "Transactions of the New Zealand Institute," I have given a list of the birds observed during my visit to the group in August, 1887. Since then, through the kindness of Mr. Bell, the well-known resident on Sunday Island, I have obtained much additional information and many specimens. I am also much indebted to Captain Fairchild for bringing me living birds from the group on the occasion of his annual trips in the "Hinemoa," and for information respecting them. I have also received similar assistance from Mr. Alexander, Mr. Stratford, and Mr. Bethune. So much interest is now taken in the natural history of isolated groups like the Kermadec Islands that I feel no apology is due for placing this additional information before the notice of the Institute. My previous catalogue contained the names of twenty-two species. I am now enabled to add eighteen more, making a total of forty.

It is unnecessary to preface my paper with a sketch of the physical features of the Kermadec Islands, a full description being given in Mr. Percy Smith's official report, published by the Government Printing Press, and in my account of the botany, quoted above. There are, however, several noticeable features connected with the ornithology of the group that deserve brief mention. The first, and perhaps the most remarkable, is the fact that there are no species peculiar to the group. So far as is at present known, all the birds are found elsewhere. The land-birds, without exception, are natives of New Zealand; and the sea-birds are either found in our waters, or are common on the coasts of Australia or Polynesia. Considering that both Norfolk Island and Lord Howe's Island, which are in the same latitude as the Kermadec Islands, and are of very similar size and physical structure, possess endemic species of land-birds, it is certainly surprising that there are no species confined to the Kermadec Islands. The fact is a most significant one, and certainly lends much support to the view that I have advanced, in my previous paper, of the origin of the flora and fauna of the group.

Another peculiarity is the paucity of resident species—that is, of birds that live permanently on or about the islands—and the great number of sea-birds (petrels, terns, &c.) which make yearly visits for breeding purposes. Out of the forty species mentioned in the following catalogue, not more than twelve or fifteen are permanent residents. The remainder make their appearance in the spring, many of them in enormous numbers, use the islands as a nesting-place, and disappear in the autumn as soon as their young have attained sufficient age. And I have no doubt that the proportion which the visitors bear to the residents will be increased as the ornithology of the group is studied. Every traveller bears witness to the vast number of birds present during the breeding-season, and many kinds not yet collected are sure to be obtained.

My own visit to the islands was too early in the season to obtain much information respecting the breeding-habits of the birds; but at my request Mr. Bell has especially attended to this point, forwarding me many notes and specimens of the eggs. Where the identifications are certain (in some cases I have not obtained skins of the species whose eggs he has forwarded) I have incorporated the information thus obtained with my catalogue.

1. Common Harrier (*Circus gouldi*, Bonap.).

This I saw several times on Sunday Island, and a pair was also noticed on Macaulay Island. Mr. Bell states that it is not a permanent resident, but disappears each year in the month of September, returning in the following January. According to him, it is driven from the islands by the Wide-awake Tern (*Sterna fuliginosa*), which yearly visits the islands in enormous numbers for breeding purposes. On the arrival of the *Sterna* it is quite common to see parties of six or eight, or even more, pursuing a hawk and chasing it from place to place; and this goes on until the hawks disappear. Mr. Bell is confident that they migrate to New Zealand—a distance of over six hundred miles.

2. Kingfisher (*Halcyon vagans*, Less.).

Common on Sunday Island, but not seen on Macaulay Island. Breeds in holes in the cliffs.

3. Tui (*Prosthemadera novæ-zealandiæ*, Gml.).

Plentiful on Sunday Island, although its numbers, according to Mr. Bell, have been much thinned by the wild cats. It usually builds its nest among the branches of the pohutukawa (*Metrosideros polymorpha*), and its breeding-season extends from September to January. I am indebted to Mr. Bell for some eggs, which are precisely similar to New Zealand specimens. Both Mr. Percy Smith and myself remarked that its note slightly differed from that of our bird.

4. White-eye (*Zosterops cærulescens*, Lath.).

I met with this species several times in the bush on Sunday Island, and a few individuals were noticed in a clump of stunted Carumbium bushes in the crater of Macaulay Island. Mr. Bell tells me that it is only an occasional visitant, and that he has never known it to breed on the island.

5. Ground-lark (*Anthus novæ-zealandiæ*, Gml.).

Apparently not uncommon on Macaulay Island, the flat grassy surface of which is a very suitable habitat for it. I did not see it on Sunday Island, but Mr. Bell states that he occasionally notices it, usually in pairs, but has never found it breeding as yet.

6. Red-fronted Parrakeet (*Platycercus novæ-zealandiæ*, Sparrm.).

Very plentiful on Macaulay Island, where it was seen hopping about on the short grass in flocks of from twenty to fifty, apparently feeding on the seeds of *Gnaphalium* and *Erigeron*. So tame were they, and so unused to man's presence, that it was quite easy to walk within a yard or two of them without disturbing the flock, which went on feeding as usual. I caught several alive by moving up to them quietly and steadily and then suddenly putting my hat over them before they could fly up; and more were caught by the sailors of the "Stella" in the same way. On Sunday Island they are seldom seen; but on Meyer Island, a small islet a few miles distant, they are numerous, flitting about among the stunted *Metrosideros* and ngaio which cover the top of the islet. In this locality they are frequently snared by the members of the Bell family, who use a slender rod with a running noose of twine at the end. According to Mr. Bell, they generally breed in holes in the cliffs, but sometimes in hollow trees. All my specimens are slightly larger than New Zealand ones, but I cannot see any other difference.

7. LONG-TAILED CUCKOO (*Eudynamis taitensis*, Sparrm.).

This species I did not see, but Mr. Bell showed me the tail of a specimen shot not long before the time of my visit. According to him, it is a permanent resident, although by no means common. Miss Bell, who is familiar with the birds of the island, and who is a good observer, tells me that she has repeatedly seen the old birds feeding the young, and she considers that they build their own nest and bring up the young themselves.

8. SHINING CUCKOO (*Chrysococcyx lucidus*, Gml.).

This also I insert on the authority of Mr. Bell, who assures me that occasionally a few visit the island, but never remain more than a few days.

9. PIGEON (*Carpophaga novæ-zealandiæ*, Gml.?).

The earlier settlers on Sunday Island found a large fruit-pigeon very abundant on their first arrival; but its numbers were gradually thinned, and it was finally exterminated, partly by the settlers themselves and partly by the wild cats introduced by them. A Mr. Johnson, who resided on the island about fifteen years ago, states that it exactly resembled the New Zealand species in size and colour, and he has no hesitation in considering it to be the same.

10. MEGAPODIUS sp. (?).

The same Mr. Johnson states that when he lived on Sunday Island, which was prior to the eruption of 1876, a bird inhabited the floor of the large crater which made mounds of sand and decayed leaves 2ft. or 3ft. high, laying its eggs in the mounds. He was in the habit of visiting the mounds for the sake of the eggs and young birds, and has frequently taken five or six of the latter from the same nest at one time. The eruption of 1876 covered the floor of the crater with a deposit of mud very similar to that thrown out by the eruption of Tarawera, and apparently killed out the species, for it has not been seen since. The evidence, such as it is, seems to point to the former existence of a species of *Megapodius*. It is worth mention that in the crater-basin of Niuafou, one of the Tongan Islands, and which is not further removed from Sunday Island than the mainland of New Zealand, a species of *Megapodius* has long been known to exist. (See Finsch and Hartlaub, "Ornithology of Central Polynesia," p. 153; and the Rev. S. W. Baker's notes published in the Trans. N.Z. Inst., xvii., p. 452.)

11. Golden Plover (*Charadrius fulvus*, Gml.).

According to Mr. Bell, this species sometimes visits Sunday Island. As it is frequently seen in many parts of Polynesia, and occasionally reaches our own shores, it is by no means improbable that his identification is correct; but I have seen no specimens.

12. Blue Heron (*Ardea sacra*, Gml.).

This also I include on the authority of Mr. Bell, who informs me that it is occasionally seen in the group. It is common in many parts of Polynesia, including the Tongan Islands, the group nearest the Kermadec Islands, and whence a few individuals might easily emigrate.

13. Godwit, or Curlew (*Limosa novæ-zealandiæ*, Gray).

A few individuals of this species are seen on the shore of Sunday Island every spring and autumn—very possibly some of the emigrants to and from New Zealand.

14. Striped Rail (*Rallus philippensis*, L.).

Sunday Island, vicinity of the lagoon in Denham Bay, but by no means common.

15. Swamp Rail (*Ortygometra tabuensis*).

I am indebted to Mr. Bell for a skin of this species, obtained on Meyer Island. He also tells me that it occurs, with the preceding, near the lagoon in Denham Bay. It is common on many of the Polynesian islands, but its occurrence on Sunday Island is certainly very remarkable, considering its feeble powers of flight.

16. Pukeko (*Porphyrio melanotus*, Gould).

During my visit in 1877, I saw a single individual near the lagoon in Denham Bay. Mr. Bell tells me that it is decidedly scarce.

17. GREY DUCK (*Anas superciliosa*, Gml.).

I did not see this, and insert it in my list on the authority of Mr. Bell, who states that it exists on the crater-lakes, but has been very scarce since the eruption of 1876. He is confident that it is the same as the New Zealand species. Mr. Stratford informs me that it is so rare that the total number found on the island does not exceed seven. A single specimen of a smaller species is reported to have been seen on one occasion.

18. WIDEAWAKE TERN (*Sterna fuliginosa*, Gml.).

This species arrives at the end of August, and remains until the end of December or middle of January. According to Mr. Bell, it is one of the commonest sea-birds on the islands during this period, although very rarely seen during the winter months. It is active and noisy, and, as mentioned at the commencement of these notes, its first act on arriving on the island is to drive off the few hawks which are present. It is gregarious, breeding in immense colonies both on the main island and the adjoining rocks, one of the largest breeding-places being on the sandy beach of Denham Bay. Its nest is a slight hollow scooped out of the bare sand, and it only lays a single egg. The eggs seem to vary in size, but the average of six sent by Mr. Bell is 2·1in. by 1·5in. The colour is a pale buffy-white, copiously marked with blotches of reddish-brown. I am indebted to Mr. Bell for several skins, and to Captain Fairchild for living specimens taken from Curtis Island. It is somewhat singular that no stray specimens of this bird have been observed on the New Zealand coast, seeing that it breeds in such immense numbers in two localities so near to us as Sunday Island and Norfolk Island. It appears to be spread all round the world in tropical and subtropical seas.

19. CASPIAN TERN (*Sterna caspia*, Pall.).

Inserted on the authority of Mr. Bell. I have seen no specimens from the group.

20. WHITECAP NODDY (*Anous melanogenys*, G. R. Gray).

I have received two skins and several eggs of this handsome species from Mr. Bell. He states that it is tolerably common during the spring and summer months, but disappears at the commencement of autumn. So far as he knows, it only breeds on Meyer Island. It makes a slightly-hollowed nest of sea-weed mixed with leaves, which it cements to the branches of trees a short distance from the ground. Usually it selects a closely-branched *Pisonia* for this purpose, but the ngaio and pohutukawa are also made use of. Only one egg is laid. Those sent to me measure 1·80in. by 1·25in. The ground-colour is creamy-white, and on it are numerous rather small spots of reddish-brown. The silvery-grey patch on the top of the head of this species contrasts very vividly with the sooty-black of the rest of the plumage. It seems to be not uncommon about Norfolk Island, where it also breeds, but it has not been previously recorded from the limits of the Colony of New Zealand.

21. Little Noddy (*Anous cinereus*, Gould).

This was one of the commonest sea-birds at the time of my visit in 1887, and was especially plentiful on the outlying rocks. During our stay we landed two or three times on Meyer Island, so often mentioned in these notes, and on each occasion almost every ledge on the cliffs near the landing-place was occupied by these birds, which watched our proceedings with the greatest curiosity. Small flocks of them would every now and then leave their resting-places, fly backwards and forwards over our heads, noisily screaming all the time, and then return to their quarters, to be quickly imitated by another party. They were quite tame, allowing us to approach within a few feet. On discharging a gun clouds of them rose in the air, circling and wheeling about in the utmost confusion, but they soon quieted down. They were also plentiful on Macaulay Island; and it was pretty to look from the cliff at the extreme western point of the island, which is almost 700ft. in height, and see large colonies of them quietly basking in the sun on inaccessible ledges hundreds of feet below the spectator. According to Mr. Bell, they breed in October and November, selecting ledges on the faces of the cliffs. No nest whatever is made, the single egg being deposited in a slight natural hollow. One sent to me measures 1·7in. by 1·1in. In colour it resembles the preceding species, but is slightly darker, and the spots are much smaller and more numerous.

The common Noddy (*Anous stolidus*, L.) also probably breeds in the group, as it is common in Norfolk Island, the Tongan Islands, and elsewhere in Polynesia.

22. Little White Tern (*Gygis candida*, Gould).

In vol. xxi. of the "Transactions of the New Zealand Institute," p. 122, I have mentioned this species as regularly breeding on Sunday Island, and have given particulars of its nesting-habits as observed by Mr. Bell. Since then I have received several skins and some more eggs; but I have no particulars of importance to add to the account then given.

23. FRIGATE BIRD (*Tachypetes aquilus*, L.).

This species is inserted on the authority of Mr. Bell, who states that it frequently visits the group during summer, but is not a permanent resident.

24. MASKED GANNET (*Sula cyanops*, Sund.).

This handsome bird is not uncommon all through the Kermadec Group, breeding on Curtis Island, on Haszard Island (a rock off the eastern side of Macaulay Island), and on Meyer Island. I have no information additional to that given in my paper printed in vol. xxi. of the Transactions, p. 121, where its occurrence in the group was first recorded. Dr. Crowfoot, in a paper on the sea-birds frequenting Norfolk Island, printed in the "Ibis" for 1885, states that it usually lays two eggs; and Mr. Bell, speaking to me of its breeding-station on Meyer Island, made the same statement. But Captain Fairchild, who has brought me several fine specimens from Curtis Island, found only one egg in each nest.

25. COMMON GANNET (*Sula serrator*, Bp.).

In addition to the previous species, Mr. Bell states that another gannet not unfrequently visits Sunday Island. He is confident that it is identical with the New Zealand *Sula serrator*, and I therefore include it in the list on his authority.

26. TROPIC BIRD (*Phaeton rubricauda*, Bodd.).

Visits Sunday Island in great numbers for breeding purposes, arriving about the end of October or beginning of November, and leaving again in June or July. I am indebted to Mr. Bell for several roughly-prepared skins and for eggs. I have also to thank Mr. Alexander for a beautifully-prepared skin in full plumage, which is now set up in the Museum. Mr. Bell informs me that it breeds in holes on the edges of the cliffs, depositing its single egg on the bare floor of the hole. The eggs have a ground-colour of pale reddish-brown, which is thickly covered over with blotches and specks of dark red-brown. The average measurements of four were, length, 2·75in.; breadth, 1·92in. Captain Fairchild has also found it breeding still more abundantly on Macaulay Island. On one of his visits he brought back with him two young birds, barely one-third grown. They were most quaint and comical-looking objects, being densely covered with long white down, with a pink flush, and with heads and beaks altogether out of proportion to the size of the body. Their appetite for fish was truly enormous, and it was most amusing to see them swallow with the greatest ease sprats and herrings almost as large as themselves, and yet always be ready for more.

27. Wandering Albatros (*Diomedea exulans*, L.).

I noticed several individuals from the deck of the "Stella" during my voyage to and from the islands in 1887, and Mr. Bell informs me that it breeds on the Chanter Islands, a group of small rocks on the eastern side of Sunday Island.

28. Mollymawk (*Diomedea melanophrys*, Boie).

This was plentiful at sea everywhere in the vicinity of the islands, and no doubt breeds on some of the isolated rocks.

29. Sooty Albatros (*Diomedea fuliginosa*, Gml.).

I noticed a single specimen at sea between Sunday and Macaulay Islands. Other species of this genus no doubt visit the group, but it is difficult to secure specimens, and it is not easy to identify them on the wing.

30. Cape Pigeon (*Daption capensis*, L.).

Plentiful at sea all round the group—in fact, one of the commonest petrels at the time of my visit in August, 1887. However, Mr. Bell is of opinion that it does not breed on any of the islands.

31. Cook's Petrel (*Œstrelata cookii*, Gray).

Not uncommon during the summer months, arriving about the beginning of November, and leaving again at the end of April. It breeds on Meyer Island, and more sparingly on Sunday Island, generally in company with *Puffinus assimilis*. It constructs a burrow sometimes over a yard in length, depositing a single pure-white egg at the extremity. Three of these sent to me by Mr. Bell measured 2·0in. in length by 1·5in. in breadth.

32. Œstrelata sp.

I am indebted to Mr. Bell for several specimens (most of them immature) of a handsome species of this genus which I am unable to identify. The forehead, back of the neck, and all the under-surface are pure-white; crown of the head black; primaries and secondaries black on their outer edges, becoming much paler towards the inner part of the webs; shoulders and back brownish, each feather tipped with pale-grey; tail-feathers greyish-brown. Total length, 18·75in.; wing from flexure, 12·3in.; bill, along the curve of the upper mandible, 1·65in.; lower mandible, 1·75in.; tail, 5in.; middle toe and claw, 2in.; tarsus, 1·5in. Bill black, feet with the claws and end of the webs black, lower part and tarsi yellowish. Evidently closely allied to *Œ. lessonii*, but differing in the dark colour of the head and in the darker back. Its measurements are very close to those of *Œ. les-*

sonii. Mr. Bell informs me that it is by no means common. It arrives about the end of September, and remains until the end of June, being one of the last petrels to leave the island. It is solitary in its habits, and very seldom can two nests be found in the same locality. Its breeding-place is usually near the mountain-top, in some dark gully filled with palms and fern-trees, and generally its burrow is made at the roots of the latter. It is purely nocturnal in its habits, and rarely leaves its burrow during the daytime. An egg sent to me by Mr. Bell measured 2·5in. in length by 1·9in. in breadth, and is pure-white in colour.

33. Kermadec Mutton-bird (*Œstrelata mollis*, Gould).

This species, which Sir W. L. Buller informs me is the same as *Œ. mollis*, is the "mutton-bird" of the Kermadec settlers, also sometimes called "piakoia" in imitation of its cry. It arrives in immense numbers at the end of August or early in September, and breeds all over the island, but most abundantly towards the tops of the hills. Unlike most of the other petrels, it makes no burrow, but lays its single egg in a hollow at the root of a tree, or even anywhere on the bare ground. During the middle of the breeding-season they are present in extraordinary numbers, many parts of the island being converted into vast breeding-grounds. The young birds are used for food, being taken just when they commence to lose their down. They are salted and smoked, or pickled in brine. During the spring of 1889 the settlers on Sunday Island, including the Bell family and those occupying Denham Bay, collected and preserved for winter use over twelve thousand of these birds.

34. Winter Mutton-bird (*Œstrelata* sp.).

Mr. Bell distinguishes between this bird and the preceding one. According to him, the winter mutton-bird breeds only on Meyer Island and other outlying rocks — never on the main island; and its breeding-season is during the winter months, the young birds being nearly ready to depart when the true mutton-bird arrives. I find but little difference between the two species, save that this has a more distinct dark band across the breast. At the time of my visit (August, 1887) the slopes of Meyer Island were crowded with nearly full-grown fledglings, sitting at the roots of the trees. At our approach they uttered hoarse cries, and endeavoured to escape by rolling down the hill, the old birds circling about among the trees above our heads.

35. Œstrelata neglecta, Schl. (?)

This petrel is assigned to the Kermadec Islands in the late Mr. G. R. Gray's hand-list of birds. I mention it here because

Mr. Bell has given me notes of a species which must be closely allied to it, if not the same, and which breeds on Sunday Island in the months from October to January. I have seen no specimens.

36. Puffinus carneipes, Gould.

I am not quite certain whether this species is correctly identified, all my specimens being fledglings that have not yet lost their down. Mr. Bell gives it the name of the "black burrower," and states that it arrives in the month of October in each year, often in very large numbers. It digs out burrows, often several feet in length, on the edges of the cliffs, or on the margins of inland terraces. In some places the burrows are so numerous as to prove serious impediments to the traveller, the soft ground above them yielding to his weight, and allowing him to drop through up to his knees. The eggs are pure-white, and measure 2·75in. in length, by 1·7in. in breadth.

37. Puffinus chlororhynchus, Less.

I have received a single specimen of this species from Mr. Bell, collected somewhere on Sunday Island, but unaccompanied with any information.

38. Puffinus assimilis, Gould.

This species was collected in the Kermadec Islands by Mr. McGillivray, naturalist to H.M.S. "Herald," as far back as 1854. At the time of my visit to the group great numbers were breeding on Meyer Island, and I secured several specimens, together with eggs. These last average 2·11in. in length by 1·4in. in breadth, and are pure-white when freshly laid. The bird digs out burrows for its nest, often of considerable length.

39. Puffinus sp.

I have the dried head of a species of *Puffinus*, which may be *P. obscurus*, Gml.

40. Stormy Petrel (*Pelagodroma marina*).

This was common at sea all round the islands at the time of my visit. Mr. Bell informs me that it breeds on Meyer Island and on other outlying rocks.

In addition to the above, Mr. Bell has furnished me with notes of the plumage, &c., of at least five other petrels, but until specimens are obtained it is not possible to identify the species.

Art. XXVII.—*A New Parasitic Copepod.*

By George M. Thomson, F.L.S.

[*Read before the Otago Institute, 14th October, 1890.*]

Plate XXIII.

As far back as May, 1889, Mr. J. F. Erecson sent me a tube containing numerous specimens of a small parasite taken from the bodies of Mokis (*Latris ciliaris*). In my paper on parasitic *Copepoda*, read last year,* I inadvertently omitted to include this very distinct form. It belongs to the genus *Lepeophtheirus*, and I have much pleasure in naming it after its discoverer, to whom I am indebted for many valuable observations on our fish-fauna, and for numerous specimens illustrative of their food-supply, their parasites, &c. The following is a description of the species :—

Lepeophtheirus erecsoni. Plate XXIII., figs. 1–11.

Male (fig. 2).—Body very flat. Cephalothorax semi-orbicular; hind-margin nearly square, outer margin rounded posteriorly, and finely fringed with extremely numerous delicate setæ. This fringe is more like a border of transparent tissue than a flange of setæ. Frontal lobe extending across only a small portion of the front of the cephalothorax (about one-fourth of its breadth), slightly notched in the middle, separated at the sides from the cephalothorax only by a slight indentation. Hind portion of thorax barely half as long as cephalothorax, and not more than one-fourth as wide. Fourth segment quite destitute of dorsal lamellæ, very short and broad. Genital segment rather longer than broad, its lateral margins shorter than on the median line, ending in somewhat rounded lobes tipped with 3 or 4 setæ; hind-margin nearly square. Abdomen extremely short, indistinctly 2-jointed. Caudal lamellæ very short, terminating in a few (3 or 4) short setæ.

Length of whole animal, barely 3mm.; breadth of carapace, about 2mm.

Female (fig. 1).—Cephalothorax orbicular, rounded behind; outer margin as in the male. Frontal lobe rather more arcuate than in male. Hind portion of thorax half as long as cephalothorax, and nearly half as wide. Fourth segment very short. Genital segment much longer, subquadrate, produced backwards on each side into rounded lobes. Abdomen very

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* Trans. N.Z. Inst., vol. xxii., p. 353.

short (fig. 11), rounded at the end, and considerably exceeded by the caudal lamellæ.

Oviferous tubes stout, more than half as long as the whole body, very distinctly annulated. The length is to the breadth in the ratio of 6 to 1. The number of rows of eggs or of annulations is treated as a matter of specific importance by some authors. In two specimens (taken at random) of this species the annulations are respectively 23 and 38.

Length of body, 4mm.; length to end of oviferous tubes, 5½mm.; breadth of cephalothorax, 3mm.

The *first antennæ* (fig. 3) have the 1st joint plate-like, and presenting from above the appearance of a lateral continuation of the frontal lamella, but fringed on the inner (front) margin with a row of setæ; 2nd joint very small, subquadrate, also flattened, and with about 10 setæ arranged around its extremity.

The *second antennæ* (fig. 4) are very stout; the basal joint bears at its extremity a short flat obtuse lobe, striated in a comb-like manner. I cannot suggest the function of this appendage. The 2nd joint is in the form of a blunt hook, and bears on its inner margin a single small seta.

The *mouth-sucker* (fig. 5) is short, thick, and blunt.

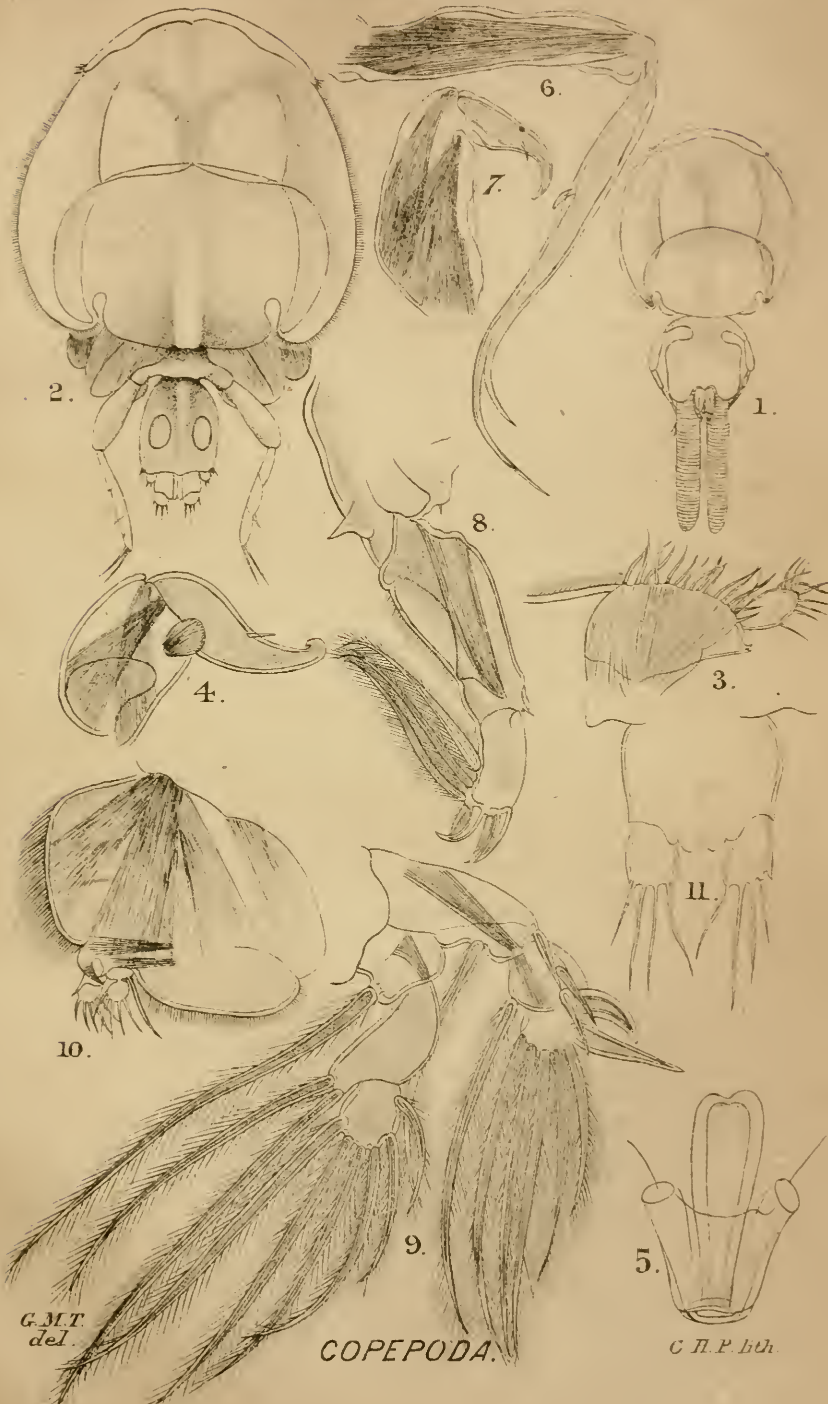
The *first foot-jaws* (fig. 6) are slender and weak, more elongated than in *L. huttoni,* and bear on the outside of the terminal joint a very small short jointed appendage or seta.

The *second foot-jaws* (fig. 7) are strong and 2-jointed, as in *L. huttoni,* and hooked at the end.

The *legs of the first pair* (fig. 8) are 1-branched; basal joint of branch with a spine on its inner side; terminal joint with 3 strong claws, and a very short plumose seta at the extremity, and on the inner margin 3 long plumose setæ, directed inwards.

The *legs of the second pair* (fig. 9) are 2-branched; outer branch 3-jointed, and placed as in *L. huttoni*;* 1st joint extending laterally from the side of the sternum, and bearing a long plumose seta on its inner and a straight short spine on its outer margin; 2nd joint with a long plumose seta on the inner and two straight spines on the outer margin, which also has a finely-plumose fringe; 3rd joint with one stout curved spine and one strong straight plumose spine on its

* In describing this species (Trans., vol. xxii., p. 355). I have said, "Outer branch 2-jointed and in a continuous line with the basal joint, stretching transversely across the body of the animal." This "basal joint" is really the 1st joint of the outer branch, but its junction with the sternum is not always very clearly defined.



G. M. T. del.

COPEPODA.

C. R. P. lith.

outer margin, and 5 plumose setæ—increasing in length inwards—at the extremity.

The *legs of the third pair* (fig. 10) are 2-branched, and each branch is 3-jointed. Basal plate very large and wide, and having a strong spine just above the insertion of the very small branches. Outer branch having 5 or 6 short setæ at the end of the rounded terminal joint. Inner branch with a long plumose seta on the inner side of the 1st joint, and 6 plumose setæ on the outer joint.

The *legs of the fourth pair* are very long and slender, and 1-branched, with the basal joint slightly dilated. Branch 3-jointed: 1st and 2nd joints oblique at the ends, and each bearing a small spine on the outer extremity; terminal joint with 3 slender spines, inner much the longest, outer the shortest.

This is a very small species—not more than one-fourth the length of *L. huttoni*. It is just possible that it belongs rather to Heller's genus *Anuretes* than to *Lepeophtheirus;* but in the absence of the complete literature of the subject I cannot be certain of this. The structure of the limbs is in several respects remarkably similar in this species and in *L. huttoni*.

EXPLANATION OF PLATE XXIII.

LEPEOPHTHEIRUS ERECSONI.

Fig. 1. Female (dorsal aspect) ×.
Fig. 2. Male „ × 25.
Fig. 3. Antennæ of 1st pair, × 56.
Fig. 4. „ 2nd „ × 56.
Fig. 5. Mouth-sucker, × 56.
Fig. 6. Foot-jaw of 1st pair, × 56.
Fig. 7. „ 2nd „ × 56.
Fig. 8. Foot of 1st pair, × 56.
Fig. 9. „ 2nd „ × 56.
Fig. 10. „ 3rd „ × 40.
Fig. 11. Abdomen and caudal setæ, × 56.

Art. XXVIII.—*On the Wandering Albatros; with an Exhibition of Specimens, and the Determination of a New Species* (Diomedea regia).

By Sir Walter L. Buller, K.C.M.G., F.R.S.

[*Read before the Wellington Philosophical Society, 13th February, 1891.*]

As far back as the 13th February, 1885, I exhibited, at one of the meetings of this Society, a series of specimens of the so-called Wandering Albatros, and expressed my belief that there were two species confounded under the common name of *Diomedea exulans*, one of them being highly variable in plumage, and the other distinguishable by its larger size and by the constancy of its white head and neck (see Trans. N.Z. Inst., vol. xvii., p. 450). But, although that was the conviction on my mind, I did not feel justified in setting up the new species and giving it a distinctive name till I could produce incontestable evidence of its existence.

I have recently had an opportunity of examining sixteen beautiful examples, of both sexes and of all ages, and I have no hesitation now in giving this new species the rank to which it is entitled. It is undoubtedly the noblest member of this group, both as to size and beauty, and I have therefore named it *Diomedea regia*. Of the sixteen examples mentioned above, two (an adult female and a full-grown fledgling) came from Campbell Island, one was brought alive from the Auckland Islands, and the remaining thirteen (most of which were female birds) were taken by fishermen off the New Zealand coast, in the vicinity of Port Chalmers.

In my "Birds of New Zealand" (second edition) I treated this bird as the mature condition of *Diomedea exulans;* but that I still had my doubts on the subject will appear from the following paragraph on page 192 (vol. ii.): "We cannot suppose that the Albatros is first pure-white, then dark-brown, and, after passing through several intermediate states, pure-white again in extreme old age. Nor would it be altogether safe, from the materials at present before us, to construct a new species. I am inclined rather to account for the differences I have mentioned on the supposition of the existence of dimorphic phases of plumage, as in some other oceanic birds."

In the plate facing page 188 I have given the two forms, the swimming figure representing the fully adult condition of *Diomedea exulans,* and the standing one being the bird now described as new, which is thus referred to in the text

(p. 192): "Shortly before leaving the Colony, I saw, at Waikanae, a fresh specimen, which had been cast ashore on the coast during a severe gale. It was of small size and evidently a young bird. The whole of the plumage was pure-white without any markings, excepting only the wings, which were black on their upper surface, largely dappled with white, especially towards the humeral flexure; legs and feet flesh-grey. The skin of this bird afterwards came into the possession of Mr. S. W. Silver, of Letcomb Manor, and, with his permission, I have introduced its likeness into my plate of this species, as the back figure standing on a rock."

The two species having been confounded, it may be as well to explain, before proceeding further, that the description given on page 192 of "The Birds of New Zealand" of a "perfectly mature example," received at the Canterbury Museum in 1874, relates to *Diomedea regia*, as do also the notes contained in the last three paragraphs of descriptive matter on page 193. The description of the young on page 190, and of the ten successive states of plumage in the progress of the bird towards maturity (*l.c.*, pp. 190–192), relate, of course, to the old-established species, *Diomedea exulans*.

As to the specific distinctness of the two birds there can no longer be any reasonable doubt.

I have much pleasure in submitting to the meeting a series of both species. On one side we have three specimens of the common Wandering Albatros (*D. exulans*). No. 1 is in the grey plumage of immaturity, with a well-defined white face; No. 2 is in a transitional or progressive state of plumage; and No. 3 represents the fully adult state, with the white plumage prettily speckled and vermiculated on the back and sides. On the other hand we have three specimens of my new species, No. 1 being a full-grown fledgling, with remnants of white down still adhering to the plumage; and Nos. 2 and 3 representing the adult male and female. The latter, I may state, were both taken by fishermen off the Otago coast, whilst the young bird was brought last season from Campbell Island, where it was captured on the nest.

It will be observed at once that the two birds are readily distinguishable. *Diomedea regia* is appreciably larger than the common species, with a far more powerful bill, which differs further in having a broad black line along the cutting-edge of the upper mandible. In *Diomedea exulans* even the adult birds are more or less marked or mottled with brown on the crown; in *Diomedea regia* the head and neck are pure-white from the nest. In *Diomedea exulans* the bare eyelids are greenish-purple; in *Diomedea regia* the eyelids from youth to maturity are jet-black. In all other superficial respects the two species are alike; but they keep quite apart on their breeding-grounds, and do not commingle except when sailing and soaring over the mighty deep, where a community of interest and a common pursuit bring many members of this great family together. So far as I am aware, their breeding-habits are the same; but I am glad to be able to exhibit this evening an egg of *Diomedea regia*, from Campbell Island, alongside of the egg of *Diomedea exulans*, from the Auckland Islands. There is a manifest difference in size, as might have been expected. I do not, however, attach any special importance to this, knowing how variable the eggs of the Albatros are as to size. Nor, indeed, can we look for anything very remarkable in the habits of this bird to distinguish it from the common species. There can be no doubt, however, that this royal Albatros is the one singled out for special mention in the following passage in my "Birds of New Zealand" (vol. ii., p. 195): "On my last voyage from the Antipodes, by direct steamer by way of Cape Horn, I made careful observations on the albatroses that followed us. During the first few days from the New Zealand coast (middle of March), and in lat. 56° S., some twenty or more of *D. exulans* were in daily attendance. Nearly the whole of these were in the dark plumage characteristic of the young birds, the foreneck, breast, and upper parts of the body being of various shades of chocolate-brown, and the face, throat, and abdomen pure-white. In some the brown on the breast was very pale, and in one or more of them was reduced to a mere cloud of speckled markings. One bird, however, and the only one in the white body-plumage mentioned above, was conspicuous among the group. It had the head, neck, back, and all the under-parts of the purest white; and the upper surface of the wings blackish-brown, with a broad white patch at the humeral flexure. It was a bird of considerable size—larger, indeed, than any of the others—and seemed to take much wider sweeps over the ocean, and often approached so near to the stern of our ship that I could detect the pinky flesh-colour of the beak. Its tail was white, with what appeared to be a terminal band of black. In long. 126°, the weather being bitterly cold, all the albatroses had left us. But three days later, lat. 56° 22′ S., long. 107° 9′ W., a pair of young birds (in brown plumage) came up to us about noon; and on the following day (March 21), with a stiff gale blowing, an old one appeared in the midst of a flock of petrels, but did not remain very long. The last appearance of this species was on the 22nd March, lat. 56°, long. 88°, when two birds (one of them in the young plumage) joined us about noon and followed our ship till dark. At this time we were steaming before the wind at a great rate, our log having registered a run of 320 miles for the previous twenty-four hours."

Captain Fairchild, of the "Hinemoa," who has for some years past made a close study of the Albatros on its breeding-grounds, has long maintained that there are two species. Till very recently he was of opinion that the large white-headed form was only to be found breeding on Campbell Island and other places to the south of the Auckland Islands. Until his last cruise, indeed, he had never found it breeding anywhere but on Campbell Island, whilst the common species appeared to have exclusive possession of the Auckland Islands, Antipodes Island, and the other islands to the north; and he had always found this species nesting four or five weeks earlier than the other—that is to say, the Campbell Island bird commenced to lay about the end of December, and the Auckland Island bird about the first week in February: in other words, *Diomedea exulans* was commencing to lay in the Auckland Islands just when the larger species was hatching out its young further south. On his recent visit, however, to the last-named group, Captain Fairchild found a colony of *Diomedea regia* nesting there, but occupying a separate locality, and quite apart from *Diomedea exulans*. Here, too, in the Auckland Islands, the same difference in the breeding-time was observable, for, whilst the nests of *Diomedea regia* contained young birds, the other species was only just preparing to lay. On the 7th February a nest of the latter was discovered containing two eggs (a most unusual occurrence), but all the other nests were empty, or occupied by the young bird of the former season. Marvellous as it may appear, it is perfectly true that the young birds never leave the breeding-ground till their parents return to refit their nests for another brood. This is the account of it, amply authenticated, given by Mr. Harris, as quoted by Professor Hutton: "At a certain time of the year between February and June—Mr. Harris cannot exactly say when—the old birds leave their young and go to sea, and do not return until the next October, when they arrive in large numbers. Each pair goes at once to its old nest, and, after a little fondling of the young one, which has remained in or near the nest the whole time, they turn it out and prepare the nest for the next brood. The deserted young ones are in good condition and very lively, frequently being seen off their nests exercising their wings. When the old birds return and take possession of their nest, the young one often remains outside and nibbles at the head of the old one until the feathers between the beak and the eye are removed and the skin made quite sore. The young birds do not go far from land until the following year, when they accompany the old ones to sea." The fact is that when the young are left in the nest at the close of the breeding-season they are so immensely fat that they can subsist for months without food of any kind. Professor Hutton attempted to account for the good condition of the young birds by suggesting that they may be nocturnal in their habits (although the old ones are strictly diurnal) and "go down to the sea at night, returning to their nests in the morning;" but Mr. Harris rejected that theory on the ground that the young birds are incapable of flight, and that the situations occupied by many of them make it impossible to get to the water except by that means.

Captain Fairchild has described to me from personal observation the coming-home of the Wandering Albatros after its long absence from its island sanctuary, and the peremptory manner in which the young bird in possession is ordered to quit the nest, so as to make room for its successor. The ease with which the old birds find their way to their own particular nest among so many is not the least wonderful thing in this marvellous romance of island life. And when I ponder on these strange facts I can only ask, as I have done before,* "What is that divinely-implanted faculty which enables this bird, after wanderings that defy calculation, and perhaps encircle the globe, to find her way back at the right moment, across the pathless deep, to that little speck of rock in mid-ocean where she had cradled her young the season before? Doubtless the same mysterious unerring instinct that guides the swallow in its annual pilgrimage—that leads the pipit, without landmark of any kind, straight to her little nest in the grass, amidst miles of waving tussock — that enables the nesting sea-bird, when she comes back from fishing, to pick out her two painted eggs from amongst the thousands that lie upon the barren rock."

Diomedea regia, sp. nov.

Ad.—Albus: tectricibus alarum nigris vix brunnescentibus, majoribus interioribus plus minusve albis, margine carpali albo et brunneo vario: remigibus brunnescenti-nigris, apicem versus pallidioribus, scapis flavicanti-albidis: scapularibus albis, ad apicem nigris: supracaudalibus caudâque albis, hac nigro apicata, rectricibus exterioribus basaliter brunneo irregulariter marmoratis: subtus pure albus: rostro albido, carnoso vix tincto, ad apicem flavicanti-corneo: pedibus corneo-albicantibus: iride saturate brunneâ: annulo ophthalmico nigro.

Adult.—General plumage pure-white; upper surface of wings blackish-brown, varied with pale-brown and white along the edges, and with an extensive patch of white on the humeral flexure; primaries brownish-black, with paler tips and

* "Birds of New Zealand," vol. ii., p. 197.

yellowish-white shafts; secondaries brownish-black, largely marked with white on their inner webs; scapulars white on their basal portion, black towards the tips; tail-feathers largely marked with black in their apical portion, and the outer ones more or less marbled with brown; lining of wings and under tail-coverts, like the rest of the plumage of the under parts, pure-white. Irides very dark brown, almost black; bare eyelids jet-black; bill white, with a roseate or pinky tinge in life, yellowish horn-coloured on the terminal hook; legs and feet flesh-white. Extreme length (approximately), 51in.; extent of wings, 122in.; wing from carpal flexure, 28in.; tail, 10in.; bill, following the curvature of upper mandible, 8·5in.; length of lower mandible, 7·5in.; tarsus, 5in.; middle toe and claw, 7·5in.

Young.—Similar to the adult, except that there is less white on the upper surface of the wings, although all the coverts have white margins; the interscapular region is traversed longitudinally with club-shaped marks of greyish-black, increasing downwards, the larger feathers having their apical portion completely covered; upwards, towards the shoulders, these marks diminish till they become mere arrow-heads; on the mantle and on the upper tail-coverts there are sometimes marginal bars, but there is no vermiculation. Bill yellowish horn-colour, with a bluish tinge on the upper mandible.

Nestling.—Covered with pure-white down, thick and woolly in appearance.

Obs.—In the extremely-old male specimen exhibited the tail is entirely white; there is an unusual amount of white on the upper surface of the wings, all the coverts being more or less margined with it; and the scapulars are obscurely marbled with greyish-brown. The feathers composing the mantle are faintly vermiculated.

Eggs.—Yellowish-white, sometimes with a darker zone at the large end; ovoido-elliptical, and measuring 5in. in length by 3in. in breadth.

II.—GEOLOGY.

Art. XXIX.—*Contributions to the Knowledge of the Fossil Flora of New Zealand.*

By Professor Dr. Constantin Baron von Ettingshausen, Hon. Member N.Z. Institute.

Communicated by Sir James Hector.

[Translated from the German (Vienna, 1887) by C. Juhl.]

[*Read before the Wellington Philosophical Society, 13th February, 1891.*]

Plates XXIV. to XXXII.

Introduction.*

The genealogical relation of the living flora of New Zealand to its Tertiary one has already formed the subject of a paper I submitted to the Imperial Academy of Sciences of Vienna under the title, "Genetische Gliederung der Flora von Neuseeland" (Sitzungsberichte, vol. lviii., part i., p. 953). I have pointed out in it that the endemic New Zealand flora not only contains types which may probably descend from the principal element of its Tertiary flora, but also such ones probably derivable from some accessory elements of the latter flora.

Only a short time had elapsed since my attention had been again drawn to the subject, and I was able to lay a memoir before the above-named Academy, entitled "Beiträge zur Kenntniss der fossilen Flora Neuseelands" (Contributions to the Fossil Flora of New Zealand, Denksch. K. Akad. Wissensch., Wien, vol. lii., part i., 1887), in which I state, "It was my good fortune in 1884 to receive two collections of fossil plants from New Zealand, for which I am indebted to the kindness of Professor Dr. Julius von Haast, of Christchurch, and Professor T. J. Parker, of Dunedin."

Seventeen localities of fossil plants are here represented, which belong to three formations—the Tertiary, Cretaceous, and Trias.

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* See also "Tertiary Flora of Australia," by Baron von Ettingshausen; translated and published by the Gov. Surv. of N. S. Wales, Sydney, 1888; p. 82. Von Haast: Trans. N.Z. Inst., xix., p. 449. Geol. Magazine, 1887, p. 359.

The Tertiary flora, collected from eight localities, as Shag Point, Dunstan, Landslip Hill, Malvern Hills, Redcliffe Gully, Weka Pass, Amuri, and Murderer's Creek, comprises till now, as far as investigation could bring to light, fifty-two species, which are distributed into thirty-nine genera and twenty-six families. Of these species, three are Cryptogamæ, eleven Gymnospermæ, two Monocotyledons, twenty-two Apetalæ, three Gamopetalæ, and ten Dialypetalæ. Regarding the general flora character, it by no means essentially deviates from that of the hitherto known Tertiary flora. We find here the same mixed character as in the Tertiary flora of Europe, North America, and Australia, the analogies of which to the New Zealand Tertiary species may easily be seen in the subjoined table.

Although the Tertiary flora of New Zealand is very different from the living one, yet with regard to several species a close relationship is clearly indicated. Thus, *Aspidium tertiario-zeelandicum* and *A. novæ-zeelandiæ*, Presl., *Dammara oweni* and *D. australis*, Lamb., *Podocarpus parkeri* and *P. totara*, Don., *Dacrydium præcupressinum* and *D. cupressinum*, Sol., &c., are closely allied. Besides, several genera—for instance, *Fagus, Hedycarya, Santalum, Loranthus*, &c.—are represented in both, whereas others seem to be in a genetic relation to living ones, and the latter may in some degree be transmuted from the former. Thus, *Daphnophyllum* or *Laurophyllum* may have turned out to be *Nesodaphne*, likewise *Apocynophyllum* to *Parsonsia*, *Aralia* to *Schefflera*, *Sapindus* to *Alectryon*, &c. On the contrary, we miss in the recent (endemic) flora of New Zealand a considerable series of genera due to its Tertiary one: for example, *Lomariopsis, Sequoia, Araucaria, Seaforthia, Casuarina, Myrica, Alnus, Quercus, Ulmus, Planera, Ficus, Cinnamomum, Dryandra, Diospyros, Aralia, Acer, Sapindus, Elæodendron*, &c.

According to the preceding statements, the principal results of my memoir are as follow:—

Firstly—In New Zealand there exists a genetic relationship between its Tertiary and its living flora.

Secondly—The Tertiary flora of New Zealand contains the elements of several floras.

Thirdly—The Tertiary flora of New Zealand is a part of that universal original flora from which all living floras of the globe descend.

Fourthly—In New Zealand only one part of its Tertiary flora has changed into its living flora; the other has become extinct.

I proceed now to communicate a brief record on the fossil plants occurring in the above-named localities.

I. Of all the localities ascribed to the Tertiary formation that of Shag Point is the richest and most interesting. Of Cryptogamæ two species of *Aspidium*, and of Cycadeæ a specimen betraying some resemblance to *Zamites tertiarius*, Heer, have been found. Of Coniferæ we have ten species, belonging to seven genera. They are fully enumerated in the table affixed below.

Of Monocotyledons one *Caulinites*, and of Dicotyledons a considerable series, occur there, as follow: One *Casuarina*; two species of *Myrica*, the one allied to *M. integrifolia*, Ung., of the European Tertiary flora, the other similar to *M. quercifolia*, Linn., a native of the Cape of Good Hope; one *Alnus*, closely related to the European Tertiary *A. kefersteinii*, as well as to the Australian Tertiary *A. maccoyi*; four *Quercus*, one of them allied to *Q. macranthera*, native of the Caucasus, another related to the European Tertiary, *Q. lonchitis*, Ung.; two species of *Fagus*, the one related to *F. procera* and *F. alpina*, both natives of Chili, the other very similar to *F. deucalionis*, Ung., as well as to the North American *F. ferruginea*; one *Ulmus* and one *Planera*, both analogous to species of the European Tertiary flora; one *Ficus*, a species corresponding to *F. lanceolata*, of the European Tertiary, and to *F. burkei*, of the Australian Tertiary flora; one *Hedycarya*, analogous to the Tertiary *H. europæ*, as well as to the Australian Tertiary, *H. wickami*; one *Cinnamomum*, closely allied to *C. polymorphum* and *C. polymorphoides*; two *Cassia*, the one closely related to *C. phaseolites* and *C. phaseolitoides*, the other to *C. memnonia*. Besides, species of the genera *Santalum*, *Diospyros*, *Aralia*, *Loranthus*, *Acer*, and *Carpolithes*, have been found there, their analogues being represented in the Tertiary of Europe, North America, and Australia (as specified in the subjoined table).

From the flora of the above-mentioned locality we may safely conclude that it, and probably also the following localities, belong to the Lower Tertiary. As many species of this flora are closely related or at least analogous to Eocene species, I refer it to the Eocene period.

II. From Dunstan the following species are now before us: A *Lomariopsis* analogous to *L. bilinica* from the Eocene strata of Kutschlin, near Bilin, and related to *L. triquetra*, a native of Nepal; an *Aspidium*, which has also been collected from the preceding locality; and a *Seaforthia*, analogous to *S. mellingii* of the fossil flora of Eibiswald, and to *S. robusta*, R. Brown, living in Australia.

III. From Landslip Hill the following are derived: *Sequoia*, also found at Shag Point; a *Dryophyllum*, being analogous to *D. lineare*, from the Eocene flora of Sézanne; two *Apocynophyllum*, the one corresponding to *A. helveticum*, of the European Tertiary, and to *A. mackinlayi*, of the Australian Eocene flora, the other related to *A. tabernæmontana*, of the fossil flora of Radoboj; an *Elæodendron*, corresponding to *E. helveticum*, of the European Tertiary flora, and to *E. curtipendulum*, a native of Norfolk Island.

IV. At Malvern Hills, the following species have been found: An *Araucaria* and a *Dammara*, both also occurring at Shag Point; a *Myrica*, representing the widely-spread Tertiary *Myrica lignitum*; a *Quercus*, coming also from Shag Point; a *Fagus*, corresponding to *F. wilkinsoni*, of the Australian Tertiary; a *Planera*, which appears also at Shag Point and at Murderer's Creek; a *Cissophyllum*, approaching the genera *Cissites* and *Ampelophyllum*.

V. At Redcliffe Gully the following species have been found: An *Alnus* and a *Quercus*, both also occurring at Shag Point; a *Sapindus*, corresponding to *S. falcifolius*, of the European, and to *S. caudatus*, of the American, as well as to *S. gossei*, of the Australian Tertiary flora.

VI. From Weka Pass a *Daphnophyllum*, related to *D. ellipticum*, Heer, has been collected.

VII. At Amuri a fragment of wood has been discovered. I referred it to *Dammara oweni*, a species occurring also at Shag Point and at Malvern Hills.

VIII. At Murderer's Creek the following species have appeared: A *Quercus*, a *Planera*, a *Cinnamomum*, and a *Cassia*, all also collected from the preceding localities, I.–V.; a *Dryandra*, closely related to *D. acutiloba*, of the European, and to *D. benthami*, of the Australian Tertiary flora.

The strata containing remains of Dicotyledons in New Zealand have been collectively called "Cretaceo-Tertiary." I have pointed out that some of the strata must be referred only to the Cretaceous, and the others only to the Tertiary formation. The latter having already been taken into consideration in the preceding exposition, I now proceed to explain the results of my investigations on the fossil flora of the Cretaceous formation. The Cretaceous flora of New Zealand has up till now been collected from four localities—namely, Pakawau, Grey River, Wangapeka, and Reefton. It contains thirty-seven species, distributed into twenty-nine genera and seventeen families. Of these species, four are Cryptogamæ, eight Coniferæ, four Monocotyledons, thirteen Apetalæ, and eight Dialypetalæ. Gamopetalæ are wanting here. Several species seem to be the ancestors of Tertiary ones, particularly of the genera *Aspidium, Podocarpus, Dacrydium, Quercus, Fagus, Ulmus, Ficus, Cinnamomum, Dryandroides, Ceratopetalum, Cupanites*, &c. According to the closer relationship of some of these species to Tertiary ones, we may refer the above-mentioned localities to the Upper Cretaceous formation.

I. Pakawau, Nelson, the richest locality of the four, contains well-preserved fossil plants. Its flora is characterized by species of ferns exhibiting the facies of Cretaceous ferns; by the genera of Coniferæ, *Podocarpium* and *Dacrydinium;* by a peculiar genus of Musaceæ, *Haastia*, related to *Musophyllum;* by *Ulmophylon*, a genus comprising the ancestor-species of Tertiary *Ulmus-* and *Planera*-species; by a *Dryophyllum*, and by a *Grewiopsis*—species analogous to species of the American Cretaceous formation; and by species of *Cinnamomum* and *Dryandroides*, corresponding to European Cretaceous species. There have also been found a *Bambusea*, a *Casuarinites*, a peculiar *Fagus*-species, and a *Cupanites*.

II. Grey River, Westland, a locality which offers many but not such well-preserved fossils. There have been discovered a *Flabellaria*, related to *F. longirhachis*, Ung., from the Cretaceous beds of Muthmannsdorf, Austria; two species of *Quercus*, one species of *Celastrophyllum*, and one species of *Palæocassia*, all corresponding to species of the Cretaceous flora; a *Dalbergiophyllum* reminds us of a *Dalbergia*-species of the same flora. There also have been found a *Knightiophyllum* and a *Ceratopetalum*, both peculiar to this locality; whilst a *Bambusea*, a *Casuarinites*, and a *Cupanites*, which also occur at the former locality, have been collected.

III. Wangapeka, Nelson, showing a flora which agrees with that of the preceding localities, inasmuch as some of its species are common to the latter. Of the several forms of fossil plants peculiar to this locality, the following are worthy of notice: Two genera of Coniferæ, the one intermediate between *Cephalotaxus* and *Torreya*, the other uniting *Ginkgo* with *Phyllocladus;* two *Quercus-*, one *Fagus-*, and one *Ficus*-species, all corresponding to Cretaceous forms; a *Sapindophyllum* analogous to *Sapindus prodromus*, Heer, from the Cretaceous strata of North Greenland; a *Dalbergiophyllum*, and a *Poacites*.

IV. Reefton, Nelson. Only *Casuarinites* (Cretaceous) has been found here, a species which also occurs at Pakawau and at Grey River.

Trias.

The collections of Sir Julius von Haast and Professor Parker also contain many fossil plants from localities which I refer to much lower Mesozoic strata. They are—Mount Potts, Haast Gully, Malvern Hills II., Mataura, and Waikawa. A greater difference of age of these localities is excluded by some common species which they contain. The species mostly are analogous to Triassic ones. I may therefore not be far wrong in supposing that all the last-named localities belong to the Trias formation.

A brief record of their flora follows :—

I. Mount Potts. Here have been collected—*Equisetum microdon*, m., a species corresponding to a European Triassic one ; *Tæniopteris pseudo-vittata*, m., closely allied to *T. vittata* from the European Trias flora ; *Asplenium hochstetteri*, Ung., sp. ; *Palissya podocarpioides*, m., analogous to *P. braunii*, Endl. ; *Baiera australis*, m., also corresponding to a European species of that flora ; phyllodes of *Thinnfeldia australis*, m., and of *Protocladus lingua*, m.

II. At Haast Gully (also Clent Hills) have been found—*Sphenopteris amissa*, m., *S. clentiana*, m., *Pecopteris proxima*. m., *Tæniopteris pseudo-simplex*, m.—all more or less related to Triassic species ; *Tæniopteris pseudo-vittata*, *Camptopteris haastii*, m., *Asplenium hochstetteri*, *Equisetum microdon*, *Palissya podocarpioides*, and *Baiera australis*.

III. Malvern Hills II. (not to be confounded with the above-named Tertiary locality, Malvern Hills No. I.). *Pecopteris proxima*, m., *Tæniopteris lomariopsis*, m., both related to Triassic species ; *Asplenium palæo-darea*, m., *A. hochstetteri*. *Podozamites malvernicus*, m., and *Protocladus lingua*, have been collected here.

IV. Mataura ; and V. Waikawa. Here have been found—*Sphenopteris*, *Palæopteris*, Ung., sp., *Hymenophyllites australis*, m., *Tæniopteris pseudo-simplex*, *T. lomariopsis*, *Asplenium hochstetteri*, *Macro-tæniopteris affinis*, m., *Lycopodites palæo-silaginella*, m., *Nilssonia zeelandica*, m., *Zamites mataurensis*. m., *Pterophyllum dieffenbachi*, m. The fossil plants are well preserved here, and the species bear more or less the facies of those of the Triassic flora.

In concluding this brief notice, I have to remark that I am unwillingly compelled to differ from the views expressed by Sir James Hector, and published by him in " New Zealand Court," Catalogue Indian and Colonial Exhibition, London, 1886, p. 60—namely, that there occur Mesozoic plants in New Zealand, as, for instance, species of *Alethopteris*, *Tæniopteris*, &c., together with leaves of Tertiary Dicotyledons in the same strata. I have not seen any trace of such a connection in the rich material the above-mentioned collections offer. Sir James Hector's statement may be based on some mistake : perhaps he has taken specimens of *Camptopteris* for leaves of Dicotyledons, an error easily possible when the specimens are not well preserved.*

* The association of *Alethopteris* (=*Blechnum priscum* ?) and *Tæniopteris* in the same slab with dicotyledonous leaves occurs in the collections from Pakawau, Clarence River, and Malvern Hills I., not in the Jurassic strata that yield *Camptopteris*. The leaves are—*Fagus* (*ninnisiana* ?), *Protophyllum* sp.—J. Hector.

Table of the Tertiary Plants of New Zealand.

Tertiary Flora.				Existing Flora.
New Zealand.	Europe.	North America.	Australia.	
CRYPTOGAMÆ.				
Filices.				
Lomariopsis dunstanensis, *Ett.* ..	L. bilinica, *Ett.* ..	..	..	L. triquetra, *Wall.*
Aspidium otagoicum, *Ett.*	A. serrulatum, *Heer* ..	..	..	A. stramineum, *Kaulf.*
" tertiario-zeelandicum, *Ett.* ..	..	..	..	A. novæ-zeelandiæ, *Pr.*
PHANEROGAMÆ.				
GYMNOSPERMÆ.				
Cycadeæ.				
Zamites, sp.	Z. tertiarius, *Heer.*			
Coniferæ.				
Taxodium distichum coecnicum, *Ett.* ..	T. distichum miocenicum	T. distichum miocenicum	..	T. distichum, *Rich.*
Sequoia novæ-zeelandiæ, *Ett.*	S. couttsiæ, *Heer* ..	S. affinis, *Lesq.* ..	S. australiensis, *Ett.*	S. sempervirens, *Endl.*
Pinus, sp.?				
Araucaria haastii, *Ett.*	..	..	..	A. chilensis, *Mirb.*
" danai, *Ett.*	A. sternbergii, *Gœpp.*	..	..	A. excelsa, *R. Brown.*
Dammara oweni, *Ett.*	..	..	D. intermedia, *Ett.*	D. australis, *Lamb.*
" uninervis, *Ett.*	..	..	..	D. ovata, *Moore.*
Podocarpus parkeri, *Ett.*	F. stiriaca, *Ett.* ..	Podocarpus, sp. ..	..	P. totara, *Don.*
" hochstetteri, *Ett.*	B. elegans, *De l'H.* ..	..	D. præcupressina, *Ett.*	P. tenuifolia, *Dec.*
Dacrydium præcupressinum, *Ett.* ..	..	..	D. cupressinoides, *Ett.*	D. cupressinum, *Sol.*

Table of the Tertiary Plants of New Zealand—*continued.*

Tertiary Flora.				Existing Flora.
New Zealand.	Europe.	North America.	Australia.	
MONOCOTYLEDONES.				
Najadeæ.				
Caulinites otagoicus, *Ett.*	C. radobojensis, *Ung.*	C. sparganioides, *Lesq.*		
Palmæ.				
Seaforthia zeelandica, *Ett.*	S. mellingii, *St.* sp. ..	..	..	S. robusta, *R. Brown.*
DICOTYLEDONES.				
Apetalæ.				
Casuarineæ.				
Casuarina deleta, *Ett.*	C. sotzkiana, *Ett.* ..	..	C. cookii, *Ett.*	Casuarina, sp.
Myriceæ.				
Myrica subintegrifolia, *Ett.*	M. integrifolia, *Ung.*	M. bolanderi, *Lesq.*	M. pseudosalix, *Ett.*	
„ proxima, *Ett.*...	M. lignitum, *Ung.* ..	M. undulata, *Lesq.*	M. konincki, *Ett.*	M. cerifera, *L.*
„ præquercifolia, *Ett.*	..	..	..	M. quercifolia, *L.*
Betulaceæ.				
Alnus novæ-zeelandiæ, *Ett.*	A. kefersteinii, *Gœpp.*	A. kefersteinii ..	A. maccoyi, *Ett.*...	A. glutinosa, *Gaertn.*
Cupuliferæ.				
Quercus parkeri, *Ett.*	..	..	..	Q. macranthera, *F. et M.*
„ deleta, *Ett.*	..	..	..	Q. corrugata, *Hook.*
„ celastrifolia, *Ett.*	Q. tephrodes, *Ung.* ..	Q. ellisiana, *Lesq.*	..	Q. aquatica, *Walt.*
„ lonchitoides, *Ett.*	Q. lonchitis, *Ung.* ..	Q. drymeja, *Ung.*	Q. drymejoides, *Ett.*	
Dryophyllum dubium, *Ett.*	D. lineare, *Sap.* ..	..	D. howitti, *Ett.*	

Fagus ulmifolia, *Ett.*	..	..	..	F. procera, *P. et Endl.*
„ ninnisiana, *Ung.*	F. deucalionis, *Ung.*	F. feroniæ, *Ung.*	F. benthami, *Ett.*	F. ferruginea, *Ait.*
„ lendenfeldi, *Ett.*	..	..	F. wilkinsoni, *Ett.*	F. moorei, *Muell.*
Ulmaceæ.				
Ulmus hectori, *Ett.*	U. braunii, *Heer*	U. tenuinervis, *Lsq.*		
Pianera australis, *Ett.*	P. ungeri, *Ett.*	P. ungeri	..	P. richardi, *Spach.*
Moreæ.				
Ficus sublanceolata, *Ett.*	F. lanceolata, *Heer*	F. lanceolata	F. burkei, *Ett.*	
Monimiaceæ.				
Hedycarya præcedens, *Ett.*	H. europæa, *Ett.*	..	H. wickami, *Ett.*	H. australasica, *De Cand.*
Laurineæ.				
Cinnamomum intermedium, *Ett.*	C. polymorphum, *A.B.*	C. polymorphum	C. polymorphoides, *McCoy*	C. camphora, *L.*
Laurophyllum tenuinerve, *Ett.*				
Daphnophyllum australe, *Ett.*				
Santalaceæ.				
Santalum subacheronticum, *Ett.*	S. acheronticum, *Ett.*	S. americanum, *Lesq.*	S. frazeri, *Ett.*	Santalum, sp.
Proteaceæ.				
Dryandra comptoniæfolia, *Ett.*	D. acutiloba, *Ett.*	..	D. benthami, *Ett.*	D. formosa, *R. Brown.*
GAMOPETALÆ.				
Apocynaceæ.				
Apocynophyllum elegans, *Ett.*	A. helveticum, *Heer*	..	A. mackinlayi, *Ett.*	
„ affine, *Ett.*	A. tabernæmontana, *Ung.*			
Ebenaceæ.				
Diospyros novæ-zeelandiæ, *Ett.*	D. lotoides, *Ung.*			
DIALYPETALÆ.				
Araliaceæ.				
Aralia tasmanii, *Ett.*	..	A. dissecta, *Lesq.*	A. prisca, *Ett.*	

TABLE OF THE TERTIARY PLANTS OF NEW ZEALAND—*continued.*

Tertiary Flora.				Existing Flora.
New Zealand.	Europe.	North America.	Australia.	
DICOTYLEDONES—*continued.*				
DIALYPETALÆ—*continued.*				
Loranthaceæ.				
Loranthus otagoicus, *Ett.*	..	..	..	L. tetrandrus, *R. et P.*
Accrineæ.				
Acer subtrilobatum, *Ett.*	A. trilobatum, *A.B.*..	A. trilobatum ..	A. subproductum, *Ett.*	A. rubrum, *L.*
Sapindaceæ.				
Sapindus subfalcifolius, *Ett.*	S. falcifolius, *A. Br.*..	S. caudatus, *Lesq.*	S. gossei, *Ett.*	
Celastrineæ.				
Elæodendron rigidum, *Ett.*	E. helveticum, *Heer*	..	..	E. curtipendulum, *Endl.*
Ampelideæ.				
Cissophyllum malvernicum, *Ett.*				
Myrtaceæ.				
Eucalyptus dubia, *Ett.*	E. oceanica, *Ung.* ..	E. americana, *Lesq.*	E. mitchelli, *Ett.*	Eucalyptus, sp.
Papilionaceæ.				
Dalbergia australis, *Ett.*	D. bella, *Heer.*			
Cæsalpinieæ.				
Cassia pseudophaseolites, *Ett.* ..	C. phaseolites, *Ung.*	C. phaseolites ..	C. phaseolitoides, *Ett.*	C. micranthera, *De Cand.*
„ pseudomemnonia, *Ett.*	C. memnonia, *Ung.*			
PLANTÆ INCERTÆ SEDIS.				
Carpolithes otagoicus, *Ett.*	C. websteri, *Heer.*			

TABLE OF THE CRETACEOUS PLANTS OF NEW ZEALAND.

Crotaceous Flora.				Tertiary and Existing Flora.
New Zealand.	Europe.	Arctic Zone.	North America.	
CRYPTOGAMÆ.				
FILICES.				
Blechnum priscum, *Ett.*	B. atavium, *Sap.* ..	..	..	B. occidentale, *L.*, *Trop. America.*
Aspidium cretaceo-zeelandicum, *Ett.* ..	..	A. fœcundum, *Heer*	..	A. novæ-zeelandiæ, *Pr.*
Dicksonia pterioides, *Ett.*	..	D. conferta, *Heer*	..	D. smithii, *Hook.*, *Luzon Island.*
Gleichenia obscura, *Ett.*	..	G. rigida, *Heer* ..	..	G. flabellata, *Desv.*, *Australia.*
PHANEROGAMÆ.				
GYMNOSPERMÆ.				
CONIFERÆ.				
Dammara mantelli, *Ett.*	..	Dammara, *sp.* ..	..	D. australis, *Lamb.*
Taxo-torreya trinervia, *Ett.*	..	..	..	{ Cephalotaxus drupacea. Torreya grandis. }
Podocarpium ungeri, *Ett.*	..	..	..	Podocarpus parkeri, *Ett.*, *Tertiary flora.*
" cupressinum, *Ett.* ..	..	..	..	Podocarpus præcupressina, *Ett.*, *Tertiary flora.*
" tenuifolium, *Ett.* ..	..	..	..	P. hochstetteri, *Ett.*, *Tertiary flora.*
" prædacrydioides, *Ett.* ..	..	..	..	P. dacrydioides, *New Zeal.*
Dacrydinium cupressinum, *Ett.* ..	..	..	..	D. præcupressinum, *Ett.*, *Tertiary flora.*
Ginkgocladus novæ-zeelandiæ, *Ett.*				

TABLE OF THE CRETACEOUS PLANTS OF NEW ZEALAND—*continued.*

Cretaceous Flora. New Zealand.	Cretaceous Flora. Europe.	Cretaceous Flora. Arctic Zone.	Cretaceous Flora. North America.	Tertiary and Existing Flora.
MONOCOTYLEDONES.				
GRAMINEÆ.				
Poacites nelsonicus, *Ett.*				
Bambusites australis, *Ett.*				
MUSACEÆ.				
Haastia speciosa, *Ett.*	..	..	..	Musophyllum, *sp.*, *Tertiary flora.*
PALMÆ.				
Flabellaria sublongirhachis, *Ett.* ..	F. longirhachis, *Ung.*			
DICOTYLEDONES.				
APETALÆ.				
Casuarineæ.				
Casuarinites cretaceus, *Ett.*				
Cupuliferæ.				
Quercus pachyphylla, *Ett.*	..	Q. myrtillus, *Heer*	..	Q. daphnes, *Ung.*, *Tertiary flora.*
„ nelsonica, *Ett.*	Q. beyrichii, *Ett.* ..	Q. denticulata, *Heer*	Q. ellsworthiana, *Lesq.*	Q. cyri, *Ung.*, *Tertiary flora.*
„ calliprinoides, *Ett.*	..	Q. rinkiana, *Heer*	..	Q. mediterranea, *Tertiary flora.* / Q. calliprinos, *still existing*
Dryophyllum nelsonicum, *Ett.* ..	..	..	D. holmesii, *Lesq.*	
Fagus nelsonica, *Ett.*	F. prisca, *Ett.* ..	..	F. polyolada, *Lesq.*	F. feroniæ, *Ung.*, *Tertiary flora.*
„ producta, *Ett.*				

Ulmaceæ.				
Ulmophylon latifolium, *Ett.*	..	..	..	Ulmus *and* Planera *sp.*, *Tertiary flora.*
" planeræfolium, *Ett.* ..	..	..	..	
Moreæ.				
Ficus similis, *Ett.*	F. geinitzii, *Ett.* ..	F. atavina, *Heer*	F. magnoliæfolia, *Lesq.*	F. jynx, *Ung.*, *Tertiary flora.*
Laurineæ.				
Cinnamomum haastii, *Ett.*	Cinnamomum, *sp.* ..	Cinnamomum, *sp.*	C. heerii, *Lesq.* ..	C. scheuchzeri, *Heer*, *Tertiary flora.*
Proteaceæ.				
Knightiophyllum primævum, *Ett.* ..	..	..	..	K. daltonicum, *Ett.*, *Tertiary flora.*
Dryandroides pakawauica, *Ett.* ..	D. latifolia, *Ett.* ..	..	..	Dryandroides, *sp.*, *Tertiary flora.*
Dialypetalæ.				
Saxifragaceæ.				
Ceratopetalum rivulare, *Ett.*	..	..	..	C. bilinicum, *Ett.* C. macdonaldi, *Ett.*
Tiliaceæ.				
Grewiopsis pakawauica, *Ett.*	G. orbiculata, *Sap.* ..	..	G. haydenii, *Lesq.*	C. miocenicus, *Tertiary flora.*
Sapindaceæ.				
Sapindophyllum coriaceum, *Ett.* ..	..	S. prodromus, *Heer*		
Cupanites novæ-zeelandiæ, *Ett.* ..	..	..	..	
Celastrineæ.				
Celastrophyllum australe, *Ett.* ..	C. integrifolium, *Ett.*	C. crenatum, *Heer*		
Papilionaceæ.				
Dalbergiophyllum rivulare, *Ett.* ..	..	Dalbergia rinkiana, *Heer.*		
" nelsonicum, *Ett.*				
Cæsalpinieæ.				
Palæocassia phaseolitoides, *Ett.* ..	P. angustifolia, *Ett.*..	..	..	Cassia phaseolites, *Ung.*, *Tertiary flora.*

A.—DESCRIPTION OF SPECIES OF THE TERTIARY FLORA OF NEW ZEALAND.

NOTE.—*The correct localities and authorities for the collection of the specimens have been inserted within square brackets.*—J. HECTOR.

CRYPTOGAMÆ.

FILICES.

Lomariopsis dunstanensis, sp. nov.

Plate XXIV., figs. 1, 2, 2*a*.

L. fronde coriacea pinnata, pinnis linearibus elongatis, circa 14mm. latis, margine subtilissime crenulatis; nervatione Tæniopteridis, nervo primario firmo, recto; nervis secundariis angulo subrecto egredientibus, tenuibus, approximatis paullo arcuatis, parallelis simplicibus vel furcatis, craspedodromis, 1mm. inter se remotis.

Locality: Dunstan (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1864; Hector.]

I have before me two pinnate fragments, from which I infer a linear elongated shape of the pinnæ, and which indicate a leathery texture. The edge is very delicately notched; the secondary nerves, which are delicate yet boldly defined, run into the notches; these nerves show the arrangement of *Tæniopteris*, and are either simply divided at their origin, or a short distance above it, in a fork-like manner. The primary nerve is proportionately stout, and contains a fine middle rib (see fig. 2*a*). I observe on the upper part of the frond in various places a number of closely-situated black spots, which seem to have covered it, and which appear to be the remains of fructification.

The characteristics mentioned indicate the genus *Lomariopsis*, in which a number of similar fan-shaped forms appear. *L. triquetra* (*Acrostichum t.*, Wall., see Ettingsh., Ferns, pl. v., fig. 1, 6) corresponds in the most remarkable manner with the species described, and consequently only an insignificant difference could be discovered. In the existing species the secondary nerves are distant from each other 1·5mm. to 2mm., while in the fossil before me the distance between each of them is only 1mm.; however, in all other characteristic qualities exists the most perfect agreement. In *Lomariopsis* as well as in *Acrostichum* is a thick accumulation of sporules on the under side and sometimes on both sides of the frond. As the spots above referred to are charred, it is impossible to recognise their structure, but in consequence of their distribution it is most probable that they are the remains of the sporule covering.

The home of the *Lomariopsis triquetra* is Nepal. *Lomariopsis bilinica*, Ett., of the fossil flora of Bilin, in Bohemia, is nearly related to the above-described fossil fern; the former may be distinguished from the latter not only by the irregularly-notched edge of the frond, but also by the more acute angles of the secondary nerves at their origin.

Aspidium otagoicum, sp. nov.

Plate XXIV., fig. 3.

A. foliis bipinnatis, pinnis lanceolatis, elongatis, pinnatisectis, pinnulis oblongis, apice obtusis, angulo acuto insertis, inciso-dentatis vel lobatis; nervatione Pecopteridis eupolystichi, nervo primario basi prominente, nervis secundariis paucis, apicem versus abbreviatis, sub angulis acutissimis egredientibus.

Locality: Shag Point, Otago (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1864; Hector.]

This fragment may be completed to form a lanceolate-elongate frond, which betrays the greatest similarity with several species of *Aspidium*. *A. stramineum*, Kaulf., which occurs in Australia and Mauritius, seems to be the most nearly related species (compare Ettingsh., Ferns, pl. cx., fig. 3; pl. cxii., fig. 7). Among the fossil ferns *A. serrulatum*, Heer, from the brown-coal flora of Bornstädt, seems to approach nearest to this fern in consequence of the shape of the frond, and of the junction at acute angles of the smaller fronds. The relation between this fern and *A. oerstedi*, Heer, from the flora of the Atane strata, is more distant, notwithstanding both species show the same type of nerve-system. More exact comparisons can be made when better-preserved remains are submitted.

Aspidium tertiario-zeelandicum, sp. nov.

Plate XXIV., figs. 4, 4*a*.

A. pinnis lanceolato-linearibus, pinnatipartitis vel lobatis, laciniis vel lobis ovalibus vel oblongis, integerrimis obtusiusculis; nervatione Goniopteridis; nervo primario prominente recto, nervis secundariis sub angulis 70°–80° orientibus, prominentibus, marginem versus plus minusve arcuato-convergentibus; nervis tertiariis angulis 40°–50° exeuntibus, simplicibus, inferioribus rectis, superioribus paullo arcuatis, intimis anastomosantibus.

Localities: Shag Point (Canterbury Museum). [*Ex* Coll. Geol. Survey of N.Z.: Report to the Director "*On the Shag Point Coalfields*," *by Julius von Haast, Ph.D., F.R.S.; Geol. Rep., 1872, p. 148.*] Dunstan (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1864.]

Notwithstanding that only a few small fragments of fronds of this species are submitted, it has been possible to determine it exactly, and to ascertain its most nearly related living species, as not only the nervation but also the fructification is distinctly preserved. The fronds indicate a gradual narrowing towards the top, but on the whole a linear form. The division of the foliage is deep towards the base, but less incised towards the top, as the sections of the frond are ovate, sometimes elongated, and the edge is without indentations or notches, becoming smaller and stumpy towards the top. The nervation, which is well preserved in the fragment from Dunstan, fig. 4 (enlarged, fig. 4*a*), shows a strongly-defined primary nerve, which runs straight and gradually decreases, and from which sharply-defined secondary nerves start at somewhat acute angles. The tertiary nerves, which start at far more acute angles, are simple: the lower are straight, the upper somewhat converging and turning to the edge; the lowermost have anastomosis. The sori are situate in the middle of the course of the tertiary nerves.

Consequently this fossil would belong to the genus *Lastræa* according to A. Braun, in which the sori are said to exist midway in the course of the tertiary nerves. This A. Braun seems to have concluded from few specimens, which he more closely examined, of the genus *Aspidium*, which has many species; but he is scarcely correct as regards all species, for in *A. oppositum*, Kaulf., and *A. truncatum*, Gaud., the sori exist nearer to the beginning of the tertiary nerves; in *A. molle*, Sw., and *A. concinnum*, Mett., they are nearer the edge; while in *A. alsophilaceum*, Kze., both conditions exist. In all these species the sori exist also inserted in the middle of the tertiary nerves. It does not occur in *Aspidium* that the sori do not exist between the tertiary nerves instead of on them or on their branches. In consequence of this, Heer's drawing cannot be correct which he gives of the situation of the sori in his *A. meyeri* ("Tertiary Flora of Switzerland," i., pl. 11, fig. 2*b*).

The characteristics described do not agree so well with any species of fern as *Aspidium novæ-zeelandiæ* (*Goniopteris n.z.*, Presl., see Ettings., Ferns, pl. cx., figs. 12, 13), which is indigenous to New Zealand, and for which our fossil may pass as the parent plant. The latter seems to be distinguished from the former by the more stumpy and more rounded sections of the frond. Moreover, the sori in *A. novæ-zeelandiæ* are seldom in the middle, but usually near the origin of the tertiary nerves. Sufficient material has not been submitted to make a searching comparison of this fossil with other fossil ferns already known. A second fragment comes from the strata at Shag Point, in which I observe deeper notches in the frond, the segments of which are more distant from each other; moreover, the angle at the origin of the secondary nerves is more obtuse. These attributes cannot be taken as a difference of species, because the position and angle of the segments in various parts of the frond show little difference, while in the living species named the lower parts of the frond, with which the fossil corresponds, show similar alterations.

PHANEROGAMÆ.

GYMNOSPERMÆ.

CYCADEÆ.

Zamites, sp.

Plate XXIV., fig. 10.

Among the numerous fossil remains from Shag Point I found only one fragment which I believe I may regard as a remainder of a *Cycadea*. It probably represents a frond which is bent upwards, and is traversed by fine parallel-running nerves. The fragment is longitudinal, and the edge is without notches. To judge from the coal-substance, the texture must have been a very compact one, such as exists in the leaves of the *Cycadea*. The fragment mentioned shows, as regards length and delicate stripes, some agreement with the leaves of remains of *Cycadeæ* described by von Heer as *Zamites tertiarius*.

CONIFERÆ.

CUPRESSINEÆ.

I defined a fragment of a small branch from Shag Point as belonging to *Callitris* in consequence of its characteristics, and it seems to denote the existence of this family among the fossil flora of New Zealand. The fragment is, however, too imperfectly preserved to enable me to define a species from it. I am content to mention this circumstance, and leave it to future researches to follow it up.

Taxodium distichum eocenicum, mihi.

Plate XXIV., figs. 11, 11*a*.

T. ramulis caducis tenuibus; foliis distantibus alternis distichis, lineari-lanceolatis abbreviatis planis, uninerviis, basi angustata sessilibus.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. Geol. Surv. N.Z., Rep. 1872; v. Haast, *l.c.*]

The small branch of a Conifer shown in fig. 11 agrees so much with the drooping branches of *Taxodium distichum* that I have no hesitation in placing it in this species, which is so widely scattered throughout the Tertiary period; but I believe that this small branch belongs to a peculiar variety, which is distinguished from *T. distichum miocenicum*, Heer, by somewhat shorter leaves, which are less narrow at the base, and which adhere firmly. As the leaves, from which the small thorn at end is wanting (see enlarged fig. 11*a*), do not run down the shaft, it is easy to distinguish this small branch from the similar slim branches of *Podocarpus hochstetteri*.

Abietineæ.

Sequoia novæ-zeelandiæ, sp. nov.

Plate XXIV., figs. 5–7, 7*a*.

S. ramulis gracilibus, foliis squamæformibus, coriaceis, imbricatis, ramulorum juniorum ovatis acutis vel lanceolatis, basi decurrentibus, seniorum ovato-rhombeis obtusiusculis, arcte adpressis; strobilis parvis globosis, squamis peltatis, dorsi rugosi medio mucronulatis.

Locality: Shag Point; Landslip Hill (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector.]

The branch and cone (fig. 5), both derived from Shag Point, belong doubtless to *Sequoia*. The cone is very similar to *S. couttsiæ*, Heer, only a little smaller. It is a pity that the defective state of preservation of the charred cone made it impossible to ascertain exactly the number of scales; but, in consequence of the form and size of a few scales which may still be recognised, it may be assumed that they were not larger than in *S. couttsiæ*.

The scales agree well with those of the species named, because of their somewhat polygonal shape, the back of the shield being covered by small wrinkles. There is a short thorny point in the middle from which some wrinkles radiate towards the edge.

In both fruit-fossils appear only the slender younger twigs, the leaves of which run down the base, being scale-shaped, either oviform or lanceolate, pointed, imbricate, and are provided with a distinct stem (see fig. 7*a*). Fig. 6 shows one of several fragments of twigs which occur together on one specimen, and which, to all appearance, belong to the same species, notwithstanding that the remains belong to a different locality (Landslip Hill). Fig. 7 agrees perfectly with a younger smaller twig from Shag Point; the fragment previously mentioned shows a piece of a stouter older twig, the leaves of which lie closer, are broader, and less pointed.

In consequence of the foregoing the species described may be regarded as either a species nearly related and vicarious to *S. couttsiæ*, Heer, or to *S. affinis*, Lesq., from both of which it may be distinguished by insignificant differences in the leaves and cones. Further researches might solve the question if in this instance an identity of the species is admissible.

Pinus, sp.(?).

Plate XXIV., figs. 8, 9.

Among the strata from Shag Point (Canterbury and Otago Museums) appear needle-shaped fragments which possibly belong to the genus *Pinus*. These fragments are as wide as those of *Pinus laricio*, and are traversed by a midrib, which, however, is distinctly seen in one fragment only (fig. 8*a*). These fragments occur sometimes in pairs, which lie closely together and in the same direction; from this I may conclude that they belong to a needle-pair. In accordance with this is the appearance of a scale belonging to a cone (fig. 9) which seems to belong to the division *Pinaster*. As the state of preservation of these remains is defective, I do not venture to conclude with certainty, from the fragments before me, that *Pinus* exists among the fossil flora of New Zealand, and I prefer to leave this important decision to future researches based on better finds.

Araucaria haastii, sp. nov.

Plate XXV., figs. 1, 2; Plate XXIX., figs. 10–12.

A. foliis coriaceis, imbricatis, patentibus, ovato-lanceolatis acuminatis, supra concaviusculis, subtus convexiusculis, tenuissime longitudinaliter striatis, medio carinatis.

Localities: Shag Point (Canterbury and Otago Museums): Malvern Hills, I. (Canterbury Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector. Geol. Surv. N.Z., 1872; v. Haast, *l.c.* Geol. Surv. Canterbury; v. Haast.]

Both fragments of branches (figs. 1 and 2) are closely studded with projecting leaves, which are either oviform or lancet-shaped, and which become gradually smaller towards the top; the impression on the stone shows a stiff leathery texture. I can further recognise distinctly that the surface was concave and the underpart convex. A thorny point seems to be wanting at the top. As regards nervation, I observe a midrib projecting like a keel, and longitudinal stripes, which are delicate, close, and parallel to each other.

The same characteristics might be taken from other fragments of branches. Single loose leaves do not appear, which indicates that they firmly adhered to the branches.

The comparison of these fossils with the branches of *Araucaria chilensis*, Mirb. (*A. imbricata*, Pavon), indicates a surprising agreement. The only difference is that the leaves of the living species named are provided with a strong thorny point, while such points cannot be perceived on the fossil specimens before me.

This species is named after Sir Julius von Haast, to do honour to his great merits in the geology of New Zealand.

A petrified wood has been found in the Tertiary strata at Malvern Hills which agrees best with that of *Araucaria*, with which species I classify it.

The transverse section (fig. 10) shows tracheæ, thick-walled and with rounded angles, which have been subjected to considerable pressure, and which have consequently an elliptic curve; in only very few places do they retain their form, as shown in the section referred to. The decay of the wood, which must have been far advanced, is also perceptible in the longitudinal section. A part of the structure in the best state of preservation is shown in Pl. XXIX. very much enlarged (×350). The pitted cell-fibres are frequent, and consist of one to three rows of cells which lie one above the other. In fig. 11 (representing longitudinal section between the radii) the structure of the walls of the tracheæ is most remarkable, and agrees with those of *Araucaria*. The dots are in from two to four rows, close together, and correspondingly flattened as a polyhedron. The tangential section (fig. 12) shows cells in the wood, which wind and run out; there are also short core-streaks which are each built up (or consist of) from four to eight dotted cells. The tangential walls have no dots.

Araucaria danai, sp. nov.

Plate XXIV., fig. 18.

A. ramulis elongatis; foliis coriaceis, lineari-lanceolatis vel linearibus, rigidis, apice acuminatis, falcatis, imbricatis, patentibus.

Locality: Shag Point (Canterbury Museum; Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector: and N.Z. Rep., 1872; v. Haast, *l.c.*]

Fig. 18 represents a fragment of a small elongated branch of a shape of *Araucaria;* the branch is studded with leaves which are close together, stiff, narrow, somewhat lanceolate, bent upwards and projecting; the leaves are flat, and in the fossil many are only visible in the longitudinal fraction: this would lead a casual observer to the belief that only very small awl-shaped leaves have existed.

Among the living species, *Araucaria brasiliensis*, A. Rich., seems to be more nearly related to the fossil species than *A. excelsa*, R. Brown, because of the formation of the leaves, notwithstanding that *A. excelsa* shows a similar sickle-shaped leaf.

I name this species after James Dana, in consequence of his merits as regards the geology of New Zealand.

Dammara oweni, sp. nov.

Plate XXIV., figs. 22–24; Plate XXV., fig. 3; Plate XXIX., figs. 13–15.

D. foliis coriaceis ovalibus vel oblongis, obtusiusculis, breviter petiolatis, basi angustatis, enerviis, strobilis magnis, ovalibus, squamis parvis, tenuiter transverse carinatis, obovato-cuneatis, apicem versus incrassatis, apice obtusis.

Localities: Shag Point; Malvern Hills, I. (Canterbury Museum and Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector. Geol. Surv. N.Z., Rep. 1872; v. Haast, *l.c.* Geol. Surv. Canterbury; v. Haast.]

Of this species I have before me leaves, an impression of a cone, and a scale of a cone. The former are of a leathery texture. The leaf from Shag Point (fig. 24) is oblong, and narrows towards both ends: it has a short stem, and the point is somewhat blunt. The leaf (fig. 22) from the same locality has a broad, somewhat oval form. These fossil leaves show fine streaks along the leaf, but are without a mid-nerve. Between these lie some transition forms, but they belong certainly to one species, which I assign to the genus *Dammara*.

This species is distinguished from *D. mantelli* of the Chalk flora from Pakawau by the fact that the leaves have stems, and that the leaves are less narrow towards the point.

A *Dammara* cone-scale (fig. 23) was found at Shag Point with these leaves; I received the former from the Otago University Museum. The scale shows an inner surface; it is wedge-shaped, broad, and rounded at the upper part; the upper rim is a little thicker; the length is 15mm., width 20mm.

The cone-impression (Pl. XXV., fig. 3) from Malvern Hills preserved in the Canterbury Museum, at Christchurch, I venture to place with *Dammara*. The whole length, at least 15cm., of the impression is preserved, with the exception of a very small piece at the top which is wanting; however, the width, which has been possibly 10cm., is incomplete. The fine cone was oval and was covered with proportionately small scales, across each of which runs, near the middle, a small ridge; the scales are somewhat rounded near the upper part; the *Dammara* scale described agrees well with these scales, but belongs to a larger cone; the ridge mentioned is not visible, as it only appears on the outer surface. As regards the size and form of the leaves, and the size of the cone-scales of the species described, these agree best with *Dammara australis*, Lamb; in consequence of this I have avoided separating their fossil remains. The fossil species is distinguished from the living one by the leaves, which do not adhere, and by the larger cone.

I received from the Canterbury Museum a specimen of petrified wood of *Dammara*, which was collected in Amuri, the section of which (Pl. XXIX., fig. 13) is shown 350 times enlarged. The tracheæ are correspondingly thicker than in the section of *Araucaria* previously described; the walls of the tracheæ are thickened a good deal. The core-streaks are numerous and very fine. Fig. 14 represents the section lying between the radii of a circle, also enlarged 350 times. The spots are especially remarkable; they are flattened, stand in from one to three rows, and are in the form of a polyhedron. The tangent section (fig. 15), equally enlarged, shows the oval bis-elliptical crosscuts of the cells of the core-streaks, which cells are joined together by from 5 to 15.

I believe I ought to ascribe to the above species the wood just described, which I name after Sir RICHARD OWEN, in consequence of his merits as regards the palæontology of New Zealand.

Dammara uninervis, sp. nov.

Plate XXIV., figs. 20, 21.

D. foliis coriaceis ovalibus, obtusis, basi subsessilibus et nervo mediano apicem versus evanescente instructis; squamis strobili magnis, latis, rotundato-cuneatis, apicem versus incrassatis, apice obtusissimo.

Locality: Shag Point (Canterbury Museum; Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector: and N.Z. Rep., 1872; v. Haast, *l.c.*]

The leaf (fig. 20) shows all the characteristics of the previous species, with the only difference that at the somewhat pointed base a median nerve appears, which, however, disappears a short distance from the point. I believe I am correct in ascribing this leaf to *Dammara*, but it belongs to a distinct species. My supposition of a second species of *Dammara* in the Shag Point strata was also strengthened by the existence of a cone-scale (fig. 21), which may be distinguished from the previous species by the following characteristics: The scale is considerably larger—viz., 37mm. wide and 42mm. long—and more rounded and wedge-shaped. This scale agrees best with the broad cone-scale of *Dammara ovata*, Moore, in which also large cones appear.

TAXINEÆ.

Podocarpus parkeri, sp. nov.

Plate XXIV., figs. 12–14, 12*a*.

P. foliis sparsis approximatis patentibus, coriaceis, rectis, linearibus acuminatis, basi subsessilibus angustatis, margine planis; nervo mediano excurrente; fructibus parvis ovalibus, acutis.

Locality: Shag Point (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector.]

Corresponds with *Podocarpium ungeri* of the Chalk flora of New Zealand, which is described in the next section, and with which it may be connected as regards genus.

The difference consists only in the leaves, which are in *Podocarpium ungeri* straight (not bent in sickle-shape), and at the basis often narrowed down to a short stem, and which stand closer together and stiffer (see enlargement, fig. 12A). The impression of a fruit (fig. 13) was found with the fragments depicted, which (the fruit) is very similar to that of *Podocarpium ungeri*, but it is more ovate, and at one end somewhat pointed. I have no doubt that this berry-like fruit belongs to *Podocarpus*.

With the species described I compare *Podocarpus totara*, Don., a species which is now living in the North and South Islands of New Zealand. In the European Tertiary flora I venture to accept as analogous *P. taxites*, Ung., as a nearly related species which appears in the strata of Leoben.

Podocarpus hochstetteri, sp. nov.

Plate XXIV., figs. 15–17, 15*a*, 16*a*.

P. ramulis gracilibus, foliis tenuibus basi decurrentibus, ramulorum juniorum distichis approximatis, linearibus planis, apice acuminato mucronulatis; fructibus parvis globosis.

Locality: Shag Point (Canterbury Museum; Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862: Hector: and N.Z. Rep. 1872; v. Haast, *l.c.*]

Corresponds with *Podocarpus tenuifolia*, DC., now living in New Caledonia. The branch-stem is thin, and on it the deposit of the leaves runs down (as shown in figs. 15*a* and 16*a*). The approaching leaves of the young branches are two-lined, very narrow and linear, 1mm. wide, 7mm.–14mm. long, straight, seldom bent in sickle-shape, flat, narrowing towards the point, which is provided with a small thorn. No older branches have as yet been discovered, which were probably, as those of *P. tenuifolia*, covered with shorter leaves, which either protruded less or were lying closer.

At Shag Point a fruit (fig. 17) has been found, which is distinguished from the preceding species by being spherical and smaller: this fruit lies near fragments of the species described, agrees well with *Podocarpus*, and probably belongs to it. I dedicate this species to the memory of Ferdinand von Hochstetter.

Dacrydium præcupressinum, sp. nov.

Plate XXIV., fig. 19.

D. ramis ramulisque gracilibus elongatis, foliis approximatis, subdecussatim oppositis, erecto-patentibus vel subimbricatis, subulatis falcatis, basi decurrentibus, apice mucronatis.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. Geol. Surv. N.Z., Rep. 1872; v. Haast, *l.c.*]

A fragment of a branch with several slender twigs, which project from it at acute angles. From the whole specimen it may be recognised that the appearance of the plant was very similar to *Dacrydium cupressinum*, Soland., a splendid tree of the present flora of New Zealand.

As shown in Part B of this work, the *Dacrydium* type is already represented in the Chalk flora of New Zealand. The Chalk plant which I assigned to the recent and nearest allied genus *Dacrydinium* deviates, in consequence of its elongated or ovate leaves, from the Tertiary species, which has awl-shaped leaves. The latter is distinguished from the recent species mentioned only by the leaves, which project upwards, and are somewhat bent and sickle-shaped.

Between the Chalk and Tertiary forms of the New Zealand flora is inserted in a remarkable manner *Dacrydium cupressinoides*, Ett., of the Tertiary flora of Australia, which has linear lanceolate leaves which are consequently smaller than those of the Chalk plant, but which are not awl-shaped like those of the Tertiary *Dacrydium* of New Zealand, and which may consequently be considered to be the forerunner of the living *D. cupressinum*.

MONOCOTYLEDONES.

Najadeæ.

Caulinites otagoicus, sp. nov.

Plate XXVI., figs. 1–3.

C. caulibus simplicibus (?) tenuiter striatis crassis, articulis brevioribus longioribusve, rugis transversis necnon punctis verrucæformibus notatis; foliis late linearibus, nervis longitudinalibus tenuissimis parallelis, æqualibus.

Locality: Shag Point (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector.]

The parts of plants here described may be most suitably enrolled with the collective genus of *Caulinites*, which comprises fresh-water growths with cylindrical stems, which are striped lengthways, and sometimes articulated. The stems are studded with scars (marks) of leaves and roots. The leaves of these plants, where such were found, are always elongated, lanceolate or broad-linear, with parallel nerves; the mid-nerve does not project. Fig. 3 is a fragment of the lowest rhizome-stem, on which appear frequently the cross-wrinkles and scars: this stem left behind a thick coal substance. Fig. 2 represents an upper portion of the stem, which has knots placed some distance from each other; the wrinkles and scars above referred to are however wanting in the part represented by fig. 2. The flat impression, the very thin coal-deposit on it, and the delicate longitudinal striæ, often intersected by cross-stripes, indicate a soft herbaceous nature. Fig. 1 represents a fragment of the long, broad-linear leaf of this species of *Caulinites*. Judging from the nature of the impression, the leaf must have been soft and succulent.

These remains are not materially distinguished by their properties from the species of *Caulinites* of the European Tertiary flora; indeed, they approach very closely to one species of the same—viz., *C. radobojanus*. Suitable material is, however, wanting in order to establish the exact relationship of both species.

Palmæ.

Seaforthia zeelandica, sp. nov.

Plate XXIV., fig. 25.

S. foliis maximis, pinnis erecto-patentibus, validis, latis, rhachis crassissimæ parte marginali inferiore adnatis, basi subattenuatis; nervis primariis 5–7, inæqualibus, interstitiales plures includentibus.

Locality: Kawarau Basin, Dunstan (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1864; Hector.]

A fragment of a very large leaf of a pinnate palm; the whole width of the spindle is not before me, but it must have been at least 4cm.–5cm. The spindle is ribbed longitudinally; on its under surface, next to the edge, are the strong pinnæ joined at acute angles. The pinnæ are at least 4cm. wide; they become narrower towards the base, where they stand out somewhat convex. The nervation of the pinnæ shows several principal nerves, which stand out unequally, and between these are several delicate longitudinal nerves. I have before me a second fragment of a leaf of this species, which shows, however, no spindle but only a pinna on which the nervation is better preserved than on the first-mentioned fragment, from which the above description was made. A comparison of the fossil described with living palms pointed to *Seaforthia robusta*, R. Brown, a splendid Australian palm, the leaves of which show a similar junction of very strong pinnæ to a strong spindle, and also a similar nervation. The leaf of this palm attains a length of 3cm.–4cm.; the spindle measures 4cm. at the base. The leaves of the fossil species have probably exceeded considerably the length just mentioned.

It is remarkable that the genus *Seaforthia* belongs also to the European Tertiary flora in consequence of a closely-related species. The spindle and pinnæ of this species, which is still undescribed, are however smaller, and there are not so many principal nerves. The specimen was found in the strata of Eibiswald, in Steiermark.

DICOTYLEDONES.

APETALÆ.

Casuarineæ.

Casuarina deleta, sp. nov.

Plate XXVI., figs. 4, 5, 5*a*.

C. ramis nodoso-articulatis, aphyllis; articulis cylindricis tenuiter striatis, vaginatis, vaginis adpressis, dentibus lanceolato-linearibus; ramulis tenuibus.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. Geol. Surv. N.Z., Rep. 1872; v. Haast, *l.c.*]

The fossil depicted in fig. 4 shows knotty articulated branches, which are leafless and finely striated. At the knots vaginal remains are recognizable; the small narrow lanceolate incisions of the vagina are pressed against the stem. Besides the remains of these branches I noticed much thinner ones, which were also articulated and studded with vaginæ, and which may be considered to have been small branches of the same plant. Fig. 5 represents one of these small branches of its actual size. Fig. 5*a* is only moderately enlarged. There is no doubt that we have before us the fossils of a *Casuarina*. This fossil is distinguished from the *Casuarina*-like plant which I have described in Part B as *Casuarinites cretaceus* by the longitudinal stripes of the articulated branches; the stripes are finer and not ribbed and projecting, and the incisions of the vaginæ are smaller.

Myriceæ.

Myrica subintegrifolia, sp. nov.

Plate XXVI., fig. 13.

M. foliis subcoriaceis, oblongo-spathulatis, ex apice rotundato brevissime et mutice acuminatis, basin versus breviter angustatis, margine integerrimis; nervatione camptodroma, nervo primario validiusculo, secundariis tenuibus sub angulis acutis egredientibus; tertiariis obsoletis.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. Geol. Surv. N.Z., Rep. 1872; v. Haast, *l.c.*]

This reminds me of *Myrica integrifolia*, Ung., of the Central European Tertiary flora, from which it is distinguished by the small thorny point and the thinner texture of the leaf.

From the rather strong primary nerve spring delicate secondary nerves, which run somewhat curved, and which have been preserved in few places. No trace of tertiary nerves exists; however, these may have been very delicate, as in the related *M. integrifolia*.

Myrica proxima, sp. nov.

Plate XXVI., fig. 14.

M. foliis coriaceis, lanceolato-oblongis, apice breviter, basi longe (?) angustatis, margine denticulatis; nervatione camptodroma, nervo primario valido, secundariis sub angulis vix acutis orientibus, prominentibus, simplicibus vel furcatis, longioribus cum brevioribus alternantibus; nervis tertiariis e latere externo secundariorum sub angulis valde acutis egredientibus; reticulo obsoleto.

Locality: Malvern Hills, I. (Canterbury Musem). [*Ex* Coll. Geol. Surv. Cant.; v. Haast.]

This species as well as the previous one represents also a species in the European Tertiary flora—viz., *Myrica lignitum*. Ung. I have before me only a fragment of a leaf (fig. 14). The characteristics which it presents do not only indicate the genus *Myrica*, but they designate *M. lignitum*, and consequently I consider the identity of the species as most probable; however, I do not venture to accept this unreservedly, as only a single imperfect fragment is before me. I therefore leave the final decision to future researches.

I may here mention, in order to meet possible doubts as regards the acceptance of the genus *Myrica* among the Tertiary flora of New Zealand, that I have found three species of *Myrica* among the Tertiary fossils of Australia, which are closely related to the European Tertiary species, of which latter *M. koninki* approaches *M. proxima* very closely.

Myrica præquercifolia, sp. nov.

Plate XXVI., figs. 6, 12, 6*a*.

M. fructibus sphæricis, granulosis, foliis subcoriaceis, oblongis, basi breviter cuneiformibus, margine subopposite sinuatis pinnatilobisve, subsessilibus; nervatione camptodroma, nervo primario debili, recto, infra apicem evanescente; nervis secundariis tenuibus, angulis variis acutis egredientibus, simplicibus rectis; nervis tertiariis tenuissimis; reticulo obsoleto.

Locality: Shag Point (Canterbury Museum; Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector: and Geol. Surv. of N.Z., Rep. 1872; v. Haast, *l.c.*]

Small firmly-fixed leaves, 20mm.–35mm. long by 8mm.–13mm. wide, narrowing at the base, where they are wedge-shaped; sinuate at the edges or pinnate-lobate. The leaves are very similar to those of *Myrica quercifolia*, L., especially to the variety *laciniata*, in which the lobes of the leaves are unequally wide and long, sometimes projecting at an acute angle, sometimes almost horizontal, and consequently the simple secondary nerves, which supply them, start at different acute angles.

The primary nerve is somewhat delicate, and disappears below the top of the leaf, as in the living species named. There are only traces of the tertiary nerves, which are very delicate; the reticulation, however, is not preserved. The acceptance of this fossil leaf as a fern-fragment is completely precluded.

A fruit (fig. 12) was found at Shag Point, which agrees well with that of *M. quercifolia*, and which I place together with the leaves described as belonging to the same species. The fruit is globular, measures 6mm. in diameter, and shows a grained surface.

The species described may consequently be considered in every respect as a forerunner of *M. quercifolia*, L., which is indigenous at the Cape of Good Hope, from which it is only distinguished by the leaves, which are on the whole comparatively narrower, but at the base less narrow, and also by the fruit, which is larger.

Betulaceæ.

Alnus novæ-zeelandiæ, sp. nov.

Plate XXVI., figs. 15–17.

A. foliis membranaceis, petiolatis, latiusculis, obovatis vel ellipticis basi obtusis, margine integerrimis vel parce denticulatis; nervatione mixta, camptodroma, hinc inde craspedodroma, nervo primario prominente recto; nervis secundariis angulis 40°–50° egredientibus, subrectis vel paullo curvatis, simplicibus vel apice furcatis; nervis tertiariis distinctis, latere externo secundariorum angulis acutis exeuntibus, simplicibus vel ramosis, inter se conjunctis, reticulo inconspicuo.

Locality: Shag Point (Otago Museum); Redcliffe Gully (Canterbury Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector: and Geol. Surv. Cant.; v. Haast.]

Alder-leaves which I could almost bring to an agreement with *Alnus kefersteinii*, Gœpp., as the agreement in all characteristics is so great, with the exception of the nature of the edge and the manner in which the secondary nerves end. The leaf is thin and herbaceous; the stem attains a length of 18mm.; the edge is either unbroken or now and then dentate with the notches distant from each other. Some of the secondary nerves run along the edge toward the notches; others end before they reach the edge, in a short upward curve. In the larger leaves the lower secondary nerves are provided with outer nerves, as in most alder-leaves; in the same manner the tertiary nerves start at the outside of the secondary nerves at acute angles, and run out either singly or in branches in order to connect among each other. Reticulation is not visible; it is probable it was only faintly developed, as in most of the *Alnus* species.

Cupuliferæ.

Quercus parkeri, sp. nov.

Plate XXVI., fig. 23.

Q. foliis submembranaceis, petiolatis, oblongo-ellipticis, in superiore parte crenato-lobatis, lobis rotundato-obtusis integerrimis, in inferiore profunde sinuato-lobatis, lobis undulatis vel sublobatis obtusis; nervatione craspedodroma, nervo primario prominente recto; nervis secundariis sub angulis 50°–60° orientibus, rectis, simplicibus vel inferioribus extus ramulis instructis; nervis tertiariis latere externo sub angulis acutis egredientibus, in superiore parte fere transversis, inter se conjunctis, reticulo obsoleto.

Locality: Shag Point (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector.]

An oak-leaf which belongs to a species of the section *Lepidobalanus*, Endl., and to the group *Robur*. The texture of the leaf is thin, almost skin-like, the shape is oblong-elliptic; the leaf has a stem 1cm. long, which springs from a stumpy base. At the upper part of the leaf the edge is provided with small lobes, which may be almost termed notches. From the middle of the lamina the edge is sinuate and has pairs of lobes, which are at this part of the leaf wavy at the edge (or notched and provided with lobes). The lobes at this part of the leaf are the largest, and are all bluntly rounded off. The nervation shows altogether the type of the lobate oak-leaves of the group named, the comparison of which led me to three species, the characteristics of which seem to be united in the fossil. The species referred to are *Quercus macranthera*, Fisch. et Mey., *Q. mongolica*, Fisch., and *Q. pubescens*, Willd. Our fossil species has, in common with the first-named, the larger number of lobes which stand more outwards; with the second species the greater number of lobes which are rounded, and also the arrangement of the smaller lobes at the upper and the larger lobes at the lower part of the leaf; our fossil and the third-named species have in common the shape of the larger lobes and the length of the stem of the leaf. *Quercus parkeri* is distinguished from the living species named as follows: From

Q. macranthera by the more unequal lobes and the longer stem; from *Q. mongolica* by the lobes which stand more outwards and by the longer stem; from *Q. pubescens* by the larger number of lobes, especially of the small ones at the top of the leaf.

I have named this species after Professor T. J. Parker, of Dunedin.

Quercus deleta, sp. nov.

Plate XXVI., fig. 25.

Q. foliis membranaceis, breviter petiolatis e basi acuta late lanceolatis, margine undulato remote denticulatis; nervatione craspedodroma, nervo primario valido, apicem versus sensim attenuato, subflexuoso, nervis secundariis sub angulis 60°–70° orientibus arcuatis, simplicibus vel apice ramosis; nervis tertiariis tenuissimis, angulis acutis exeuntibus; reticulo obsoleto.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. Geol. Surv. N.Z., Rep. 1872; v. Haast, *l.c.*]

An imperfectly-preserved fossil leaf, of which the edge, the outline, and the nervation may be so far completed that its designation as an oak-leaf seems by no means uncertain. The texture is thin, the base somewhat narrowed, with a short stem; the shape is elongated; the width reaches 4cm.; the edge is irregular and wavy, and also fringed with small sharp notches, on which the secondary nerves run, which are curved. The secondary nerves start at somewhat acute angles from a stout primary nerve, which is bent irregularly. The tertiary nerves, which are very delicate and mostly imperfectly at preserved, start from the outer side of the secondary nerves acute angles and are connected among each other. There are indications of very delicate reticulation with narrow meshes.

I compare the leaf described with the fallen leaves of some species of American oaks. Especially it seems to correspond with those of *Quercus corrugata*, Hook.

I could not find any among the known fossil oak-leaves which show a noticeable agreement with the leaf here described.

Quercus celastrifolia, sp. nov.

Plate XXVI., fig. 24.

Q. foliis submembranaceis petiolatis, obovato-oblongis, margine serrato-dentatis; nervatione craspedodroma, nervo primario firmo; nervis secundariis sub angulis 30°–40° orientibus, leviter arcuatis, subsimplicibus; nervis tertiariis tenuibus, angulis acutis egredientibus, reticulo obsoleto.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. Geol. Surv. N.Z., Rep. 1872; v. Haast, *l.c.*]

The leaf has a thinner, more herbaceous texture; it has a short stem, it is elongated inverted-ovate, being wide towards the base and somewhat narrower towards the point. The imperfectly-preserved edge shows in places unequal notches, which, however, are wanting at the base. The secondary nerves start from the strongly-defined nerve at remarkably acute angles; the secondary nerves converge towards the edge and diverge towards the base; they are simple and end in the teeth. The tertiary nerves are very delicate, and start at the outer side of the secondary nerves at right angles. The reticulation is not preserved.

This leaf is similar to, and agrees as regards genus with, the inverted-egg-shaped leaves of *Quercus aquatica*, Walt., which are sometimes provided with a few notches.

A minute examination of the relationship of this species with other forms of oaks of former ages must be left to future researches upon suitable material, but I believe, in consequence of the characteristics of the leaf before me, that on the one side I may designate it as analogous with the oak species of the European Tertiary flora, *Q. tephrodes*, Ung.: and on the other side with the American Tertiary flora, viz., *Q. ellisiana*, Lesq.

Quercus lonchitoides, sp. nov.

Plate XXVI., figs. 20–22.

Q. foliis submembranaceis, petiolatis, lanceolatis vel oblongis, utrinque angustatis, basi æqualibus vel subinæqualibus, apice acuminatis, margine argute et grosse serratis; nervatione craspedodroma, nervo primario prominente recto; nervis secundariis distinctis, sub angulis 35°–45° orientibus, numerosis simplicibus rectis vel subarcuatis, inter se parallelis; nervis tertiariis vix conspicuis.

Localities: Shag Point (Otago Museum). Murderer's Creek (Trelissick); Malvern Hills, I.; Redcliffe Gully (Canterbury Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector: and Geol. Surv. Cant.; v. Haast.]

These leaf-fossils indicate a thinner texture, which may scarcely be termed leathery. They have a stem the length of which could not be fixed, as it is imperfectly before me. The leaves have either an elongated or an equally-sided lanceolate form, or are sometimes unequal at the base. The shape becomes narrower towards both ends, but more so towards the point. The edge is closely and coarsely notched. The nervation shows a rather strong defined primary nerve, which is straight and diminishing towards the point. There are also numerous almost well-defined secondary nerves, which are either straight or somewhat curved and simple. They start at acute angles, are parallel with each other, and terminate in the teeth at the edge. In consequence of the unfavourable nature of the stone the tertiary nerves are scarcely recognizable. I was enabled to discover in specimens figs. 21 and 22 a few tertiary nerves, which start from the outer sides of the secondary nerves almost at right angles.

There is no doubt that these leaves belong to *Quercus*. They show on the one hand the greatest similarity with those of *Q. drymejoides*, Ett., of the Tertiary flora from Dalton, near Gunning, in New South Wales (*vide* my Contributions to the Tertiary Flora of Australia, Memoir i., vol. xlvii., p. 117; pl. ii., fig. 2); and on the other hand they are similar to the leaves of *Q. lonchitis*, Ung., of the European Tertiary flora; between both of which they occupy an intermediate position as regards size, shape, and notches. There is no difference in the nervation.

We may conclude from the few fossil leaves here shown that not only the size but also the condition of the edge of the leaf is subject to a few alterations. Fig. 20, from Murderer's Creek, comes nearest to the above-named *Q. drymejoides* in consequence of the more projecting teeth of the leaf.

Dryophyllum dubium, sp. nov.

Plate XXVI., figs. 19, 19*a*; Plate XXVII., fig. 6.

D. foliis coriaceis, anguste lanceolatis, basi rotundata petiolatis, apicem versus sensim attenuatis, irregulariter spinoso-dentatis; nervatione craspedodroma, nervo primario prominente recto, apicem versus attenuato, secundariis distinctis, sub angulis 55°–65° orientibus, numerosis approximatis flexuosis, leviter curvatis, apice furcatis, ramo antico marginem adscendente, postico craspedodromo; nervis tertiariis e latere externo sub angulis acutis egredientibus, tenuissimis ramosis, in rete irregulariter polygono coeuntibus.

Locality: Landslip Hill (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector.]

The remains depicted were found in the same stratum beside each other. They appear to belong to one species, although the basal piece (fig. 19) seems doubtful. The nervation (fig. 19*a*) and the shape of the leaf indicate *Dryophyllum*. *D. lineare*, Sap., of the fossil flora of Sézanne, seems nearest to our species, of which the secondary nerves are, however, more bent and ascend more towards the edge. The species before us is distinguished from *D. nelsonicum*, m., which appears in the Chalk flora of Pakawau, and which has been described in Part II., by the horn-like serrated edges, by the winding fork-like secondary nerves, and the very delicate tertiary nerves.

Fagus ulmifolia, sp. nov.

Plate XXVII., figs. 4, 4*a*, 5.

F. foliis membranaceis, breviter petiolatis, oblongis vel lanceolatis, basi rotundatis vel obtusiusculis, apice angustatis acutis acuminatisve, margine irregulariter vel duplicato-dentatis; nervatione craspedodroma, nervo primario prominente recto; nervis secundariis numerosis approximatis, sub angulis 40°–50° orientibus, distinctis, rectis vel paullo arcuatis, simplicibus, rarius furcatis; nervis tertiariis tenuissimis rectangularibus, ramosis, inter se conjunctis; reticulo obsoleto.

Localities: Shag Point; Wangapeka (?) (Canterbury Museum). [*Ex* Coll. Geol. Surv. N.Z., 1862–1867; Hector.]

A series of fossil leaves from Shag Point made it possible for me to obtain elucidation not only as regards the genus to which they belong, but also as regards the circle of forms of the species. The leaves are of delicate texture. They have a short stem; they are oblong or lanceolate. At the first glance the leaves might be taken for those of *Ulmus* in consequence of the irregular edge, which is partly biserrate, and also because of the crowded parallel secondary nerves, which are slightly curved in a bow-like form. The base of the leaves is, however, not oblique as in *Ulmus*, but symmetrically rounded off, the point sometimes more, sometimes less, drawn forward. The serrations are very small; they stand a little outwards, and are directed forwards; the biserrate edge, where it can be traced, is not distinctly defined, and becomes gradually irregular. The primary nerve is not pronounced, but is most prominent at the base, where it springs out of a petiole, which is 4mm. long. The secondary nerves, which start at acute angles, are rather delicate, seldom straight, mostly somewhat converging and bent towards the edge; they are either undivided or now and then bifurcate; they end usually in the points of the serrations, or sometimes in the sinuations. The latter has never been observed in *Ulmus*, but it is normal in some species of *Fagus*. A leaf, which is at the base almost heart-shaped, has on the lowest tertiary nerves a development of outer nerves which are not pronounced. The reticulation is not preserved. The tertiary nerves, which are very delicate and close together, start from both sides of the secondary nerves at right angles; the tertiary nerves are only partly preserved in a few fossils. I have a leaf before me from Wangapeka, which I cannot classify here with certainty, as the state of its preservation leaves much to be desired.

The comparison of these leaf-fossils with corresponding forms of living species demonstrates that here the genus *Fagus* only can be accepted. Two species, *F. procera*, Poepp. et

Endl., and *F. alpina*, Poepp. et Endl., both indigenous to Chili, have been proved to be the most nearly related to the fossils described. In the first the secondary nerves run to the points of the serrations, in *F. alpina* to the sinuations. As both occur in the fossil species, this combination of characteristics indicates clearly a common origin which the living species have in the fossil species. The leaves of these descended species are usually much smaller than those of the original species; sometimes, however, the leaf of *F. procera* attains perfectly the dimensions of the leaf of *F. ulmifolia*, as shown by a specimen of a leaf from the herbarium in Kew Gardens. The leaf of *F. alpina* attains a length of 33mm., and a breadth of 13mm. (see Ettingsh.: Leaf-skeletons of the *Apetalæ*, Memoir, vol. xv., pl. viii., fig. 6).

Fagus ninnisiana, Ung.

Plate XXVII., fig. 1.

Unger: Remains of Fossil Plants from New Zealand, Voyage de "Novara," vol. i., div. 2, p. 6, pl. iii., figs. 1–9.

Locality: Shag Point (Otago Museum). [*Ex* Coll. Otago Geol. Surv., 1862; Hector.]

The fossil leaf (fig. 1) from Shag Point shows a remarkable approach on the one hand to the European Tertiary species *Fagus deucalionis*, and on the other hand to the North American *F. ferruginea*. The secondary nerves are straight, approaching each other, close together, and rather pronounced. The tertiary nerves are not preserved. The serrations agree with those of *F. ninnisiana*, and the shape agrees perfectly with the leaf-fragment No. 6, mentioned by Unger in the passage indicated.

Fagus lendenfeldi, sp. nov.

Plate XXVI., fig. 18; Plate XXVII., figs. 2, 3.

F. foliis coriaceis, petiolatis, ovato-oblongis vel lanceolatis, basi obtusissimis vel truncatis, apicem versus angustatis, margine irregulariter dentatis; nervatione craspedodroma, nervo primario firmo, prominente recto; nervis secundariis numerosis, sub angulis 40°–50° orientibus, prominentibus, rectis vel divergenti-arcuatis, simplicibus, basilaribus extrorsum ramosis; nervis tertiariis e latere externo secundariorum sub angulis acutis exeuntibus; reticulo obsoleto; nuculis ovali-trigonis, striatis.

Locality: Malvern Hills, I. (Canterbury Museum). [*Ex* Coll. Geol. Surv. Cant.; v. Haast.]

In the locality named a few impressions of beech-leaves were found in a sandy ferruginous rock, which, upon nearer examination, were found to be distinguished by several characteristics from those already known. To judge from the impressions left in the rock, the texture of the leaves must have been rather firm, and even leathery. The petiole, as shown in fig. 3, attains at least a length of 1cm. I must, however, remark here that I could not come to the conclusion that I had prepared the whole of it in its entirety. The base of the leaf, where the same is before me in its perfect state, is rather terminated abruptly than obtusely rounded off; the serrations are unequal or biserrate where it is possible to recognise them notwithstanding the coarse nature of the rock, which is unfavourable to the preservation of delicate parts. The numerous secondary nerves are at their origin often diverging and bent; the lowermost are provided with pronounced outer nerves. The tertiary nerves start outwards at acute angles.

A fruit-fossil (fig. 2) was found at Malvern Hills, I., together with the leaves described, which, in consequence of its characteristics, may be considered to be a small beech-nut, and which may probably belong to the same species.

In consequence of the leathery texture of the leaf, this series may be placed in the division *Nothofagus*, while as regards form and nervation of the leaf it corresponds to the species of the division *Eufagus*. The species now under discussion is distinguished from the foregoing not only by the firmer texture but also by the obtuse or abruptly terminated base of the leaf, and also by the pronounced outer nerves of the lowermost secondary nerves. It seems to agree with the Australian Tertiary *Fagus wilkinsoni*, Ett.

I dedicate this species to Dr. R. von Lendenfeld, who is deserving as regards the exploration of New Zealand.

Ulmaceæ.

Ulmus hectori, sp. nov.

Plate XXVII., fig. 8.

U. foliis membranaceis, lanceolatis acuminatis, grosse crenato-dentatis; nervatione craspedodroma, nervo primario debili; nervis secundariis sub angulis 40°–50° orientibus, tenuibus, simplicibus, paullo curvatis; nervis tertiariis obsoletis.

Locality: Shag Point (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector.]

This recalls the narrow leaves of *Ulmus braunii*, Heer (compare "Tertiary Flora of Switzerland," ii., pl. 79, fig. 17); but from the latter it is distinguished by the coarse and simple serrations. The narrow shape of the leaves of *Planera ungeri* approaches also the fossil very closely, and consequently it seems doubtful if it ought to be placed with *Ulmus*. As regards this, more perfectly preserved specimens must necessarily give elucidation. As regards the choice of genus, the observation may suffice that in *Planera* it is unusual for the secondary nerves to start at acute angles, while this often occurs in *Ulmus*.

Planera australis, sp. nov.

Plate XXVII., fig. 9.

P. foliis breviter petiolatis, membranaceis, ovatis vel ovato-oblongis, basi rotundata subinæquali, apice acuminatis, margine grosse dentatis, dentibus obtusiusculis antrorsum versis; nervatione craspedodroma, nervo primario prominente recto, apicem versus valde attenuato; nervis secundariis sub angulis 55°–65°, inferioribus sub obtusioribus orientibus, tenuibus, subcurvatis; nervis tertiariis angulo subrecto egredientibus, tenuissimis, plerumque obsoletis.

Localities: Shag Point (Otago Museum); Malvern Hills, I.; Murderer's Creek (Canterbury Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector: and Canterbury; v. Haast.]

Shows an extraordinary similarity with *Planera ungeri*, m., which is spread throughout the European Tertiary flora and the North American Tertiary strata. I found it impossible to discover a difference in so far as the characteristics of these leaves could be compared, so that if the *Planera* remains from New Zealand occurred in European Tertiary strata we should immediately ascribe them to *P. ungeri*. As, however, in these remains the tertiary nerves are defectively preserved and the reticulation is altogether wanting, no exact comparison could be made, the decision as regards the identity of the species must be left to future researches, and for the present the New Zealand *Planera* species must be brought under the above designation.

Moreæ.

Ficus sublanceolata, sp. nov.

Plate XXVII., fig. 7.

F. foliis coreaceis oblongis, integerrimis, nervatione camptodroma, nervo primario valido recto, nervis secundariis sub angulis 65°–85° orientibus, firmis prominentibus, valde arcuatis, marginem versus inter se conjunctis; nervis tertiariis prominentibus, fere rectangularibus, flexuosis, ramosis, inter se conjunctis, reticulo obsoleto.

Locality: Shag Point (Otago Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector.]

Corresponds on the one hand with *Ficus lanceolata*, Heer, on the other with *F. burkei*, m., but is distinguished from both by the stronger, closer secondary nerves, which start at obtuse angles; it is moreover distinguished from the last-named species by the tertiary nerves, which start at nearly a right angle: these latter are strong, bent hither and thither, they have branches and form a loose prominent net of meshes, in which possibly a very delicate net may have existed, which, however, has been lost. The margin of the fossil leaf is partly destroyed, but it is possible to conclude that it had no serrations. The remains of the charred substance on the stronger nerves indicate a firm leathery substance.

MONIMIACEÆ.

Hedycarya præcedens, sp. nov.

Plate XXVII., fig. 19.

H. foliis coriaceis, lanceolato-oblongis, utrinque angustatis, margine dentatis; nervatione brochidodroma, nervo primario firmo, recto, versus apicem attenuato; nervis secundariis sub angulis 50°–60° orientibus, distinctis, arcuato-flexuosis, ramosis, laqueos marginales 1–2 seriatos formantibus; nervis tertiariis angulo subrecto exeuntibus tenuibus, vix conspicuis.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., Rep. 1872; v. Haast, *l.c.*]

This agrees well with the living species *Hedycarya australasica*, DC., on the one hand, and on the other with *H. europæa*, Ett. ("Tertiary Flora of Bilin," ii., vol. xxviii., p. 191, pl. 30, figs. 3, 4), which has so far been found only in the polished slate of Kutschlin, near Bilin. The fossil leaf before me may be perfected to an elongated or almost lanceolate leaf, which has probably attained a length of 15cm. and a width of 5cm. The lamina narrowed towards both ends; the edge shows rather large serrations, which stand closely together, and the points of which are turned outwards. The primary nerve is strongly pronounced, but it is less strong than in *H. europæa*. The secondary nerves start at a distance of 10mm.–16mm. from each other, while there are fewer in the species named. The meshes at the edge and the tertiary nerves are only indistinctly perceptible, in consequence of the unfavourable nature of the rock.

LAURINEÆ.

Cinnamomum intermedium, sp. nov.

Plate XXVII., figs. 20–22.

C. foliis petiolatis, coriaceis, oblongis, basi acutis vel angustato-productis, margine integerrimis; nervatione acrodroma, nervo primario valido, recto; nervis secundariis prominentibus, infimis suprabasilaribus curvatis, elongatis, a margine remotis, reliquis sub angulis 45°–60° orientibus, nervis tertiariis transversis, inter se remotis.

Localities: Shag Point; Redcliffe Gully (Canterbury Museum). [*Ex* Coll. Geol. Surv. Otago, 1862; Hector: and Cant.; v. Haast.]

Inserted between *Cinnamomum polymorphum*, A. Braun. sp., and *C. polymorphoides*, McCoy, with both of which it has in common the shape, the texture of the leaf, and also the characteristics of the nervation. The species under description is distinguished from the first-named by the more numerous secondary nerves, which start principally at more acute angles, and which come closer to those running to the points; it is distinguished from the last-named species by the suprabasilar nerves, which are more distant from the edge, and which run to the points, and also by the more acute angles at which the other secondary nerves start. It must be reserved for future finds to lead to a decision as to whether these species are connected by transitions, and consequently united, or whether they must be considered as separate.

Laurophyllum tenuinerve, sp. nov.

Plate XXVII., fig. 11.

L. foliis coriaceis, petiolatis, lanceolato-oblongis, basi acutis, nervatione camptodroma; nervo primario prominente, apicem versus valde attenuato; nervis secundariis tenuibus, paucis, inter se remotis, sub angulis 50°–60° orientibus; nervis tertiariis obsoletis.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., Rep. 1872; v. Haast, *l.c.*]

An oblong fossil leaf, with a petiole; the apex of the leaf is destroyed, but if perfected it presents an almost lanceolate form. The petiole is 13mm. long; the edge is not serrate; the texture is leathery to a remarkable degree. The primary nerve is prominent as far as the middle of the lamina, and from it proceed the secondary nerves, which are undivided, and in the middle 10cm. distant from each other: they disappear towards the edge in a faint curve. In consequence of the unfavourable nature of the rock, the tertiary nerves and reticulation are not perceptible; to judge from a few indications of the latter, it was composed of very delicate and narrow meshes of equal shape. This fossil has altogether the same appearance as those from the brown-coal flora of Loeben, which I decided as belonging to *Laurus phœboides*; the secondary nerves of this species are equally delicate, and run in curves; the reticulation is very delicate, and composed of narrow meshes, as in many living *Laurineæ*. However, the species described may remain for the present under the designation *Laurophyllum*, until it is possible to gain from better material safer points for a more exact designation of the genus.

Daphnophyllum australe, sp. nov.

Plate XXVII., fig. 10.

D. foliis coriaceis petiolatis, ovalibus, basi obtusiusculis, margine integerrimis, nervatione camptodroma, nervo primario crasso, recto; nervis secundariis sub angulis 40°–50° orientibus, paucis, paullo arcuatis, simplicibus; nervis tertiariis inconspicuis.

Locality: Weka Pass (Canterbury Museum). [*Ex* Coll. Geol. Surv. Cant.; v. Haast.]

The petiole, which is more than 2mm. thick and 14mm. long, appears to be joined to the lamina somewhat obliquely; I have observed this often in *Daphnophyllum* leaves. From a very strong primary nerve start on each side a few secondary nerves slightly curved upwards, which are distant from each other 13mm.–17mm. The more delicate nerves have not been preserved, but traces of these indicate an extremely fine reticulation. The fossil betrays some similarity to *Daphnophyllum ellipticum*, Heer, from the Chalk flora of Moletein, in Moravia, from which it is, however, distinguished by the smaller number of the secondary nerves and the greater distances between them.

Santalaceæ.

Santalum subacheronticum, sp. nov.

Plate XXVII., fig. 12.

S. foliis petiolatis coriaceis ovato-oblongis, utrinque obtusiusculis, margine integerrimis, nervatione hyphodroma, nervo primario vix prominente, apicem versus evanescente; nervis secundariis vix conspicuis.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., Rep. 1872; v. Haast, *l.c.*]

The somewhat bent petiole is 6mm. long, and joined to an obtuse, somewhat narrowed base of the leaf; it runs into a scarcely defined primary nerve, which in its further course soon disappears. Traces of the secondary nerves are visible only in the lower part of the lamina. The fossil leaf shows, as regards size, texture, and shape, the greatest similarity to those of *Santalum acheronticum*, Ett., of the European Tertiary flora, from which it is only distinguished by the much more delicate nerves. As regards this, future researches upon better material will furnish information.

Proteaceæ.

Dryandra comptoniæfolia, sp. nov.

Plate XXVII., figs. 14–18, 18*a*; Plate XXVIII., figs. 9–12.

D. foliis coriaceis breviter petiolatis, lanceolato-linearibus, basi apiceque longe angustatis, subopposite pinnatilobis, lobis *medio æqualibus, antrorsum et deorsum decrescentibus confluentibusque, ovatis vel rhombeis, integerrimis; nervatione camptodroma, nervo primario distincto, recto; nervis secundariis in quovis lobo 1–3, angulo recto vel subrecto egredientibus, simplicibus; rete vix conspicuo.*

Locality: Murderer's Creek, Trelissick (Canterbury Museum). [*Ex* Coll. Geol. Surv. Cant.; v. Haast.]

Notwithstanding the unfavourable nature of the rock, the leaf-impressions have an appearance as if the leaves which have formed them have not been coarse, but rather fine and leathery. The lamina is more linear than lanceolate, and narrows towards both ends somewhat equally; at the base it ends in a short petiole. The lobes vary in their position, size, and shape; they are most frequently opposite or nearly opposite each other, they are seldom alternate; they are largest in the middle of the lamina; their size diminishes gradually towards both ends, where they run often together, so that the ends appear only serrate. The shape of the lobes fluctuates between the oviform and the rhomboidal; their points are sometimes short and narrowed, and sometimes obtuse. The secondary nerves start from the proportionately little-prominent primary nerve at angles from 75° to 90°, one to three of which run to each lobe (see the enlargement, fig. 18*a*), in which only one becomes prominent, and represents the middle nerve of the lobe; the remaining nerves are fine and almost obliterated. Of the reticulation hardly anything is visible, but this may probably be ascribed to the sandy rock, provided it was of a very delicate nature. On one lobe I was enabled to discover meshes, which are similar to those of the species *Dryandra*.

The fossil leaves described have a great similarity on the one hand to those of *Dryandra benthami*, Ett., of the Tertiary flora of Australia, and on the other hand to those of *D. acutiloba*, Ett., of the Tertiary flora of Bilin. The fossils described are distinguished from both of the species named by the more delicate texture and the nervation; they cannot be mistaken for the species of *Gleichenia* if the nervation is taken into consideration, the not unimportant similarity notwithstanding.

GAMOPETALÆ.

APOCYNACEÆ.

Apocynophyllum elegans, sp. nov.

Plate XXVIII., fig. 1.

A. foliis coriaceis petiolatis, lanceolatis, basi attenuatis, margine integerrimis, nervatione camptodroma, nervo primario valido, prominente; nervis secundariis sub angulis 75°–85° orientibus subtilibus, numerosis, approximatis, subparallelis, *flexuosis; nervis tertiariis irregulariter sub angulis variis insertis, abbreviatis, dictyodromis, rete macrosynammatum formantibus.*

Locality: Landslip Hill (Otago Museum). [*Ex* Coll. Otago Geol. Surv., 1862; Hector.]

A fine-looking well-preserved fossil leaf. There is no doubt as to its designation as belonging to the *Apocynaceæ*. A fragment of the petiole about 13mm. long has been preserved, but as the rock is broken it is impossible to give the exact length of the stem; the texture was leathery. The nervation shows a prominent straight primary nerve, which diminishes considerably towards the point. The secondary nerves are fine and numerous, they are close together, winding, and start nearly at right angles from the primary nerve; the secondary nerves are connected with each other near the edge by anastomosing loops. The tertiary nerves are short, and start irregularly at different angles; they are also branched and resolve in a net, consisting of rather loose irregularly-cornered meshes. *Apocynophyllum helveticum*, Heer, from the Tertiary flora of Switzerland; *A. alstonioides*, Heer, and *sumatrense*, Heer, of the Tertiary flora of Sumatra; and also A. *mackinlayi*, m., of the Australian Tertiary flora, may be considered as analogous species, which are only distinguished from the species described by the better-developed formation of the reticulation.

Apocynophyllum affine, sp. nov.

Plate XXVII., fig. 13.

A. foliis petiolatis, lanceolatis, basi attenuatis, margine integerrimis, nervatione camptodroma, nervo primario debili, recto; nervis secundariis sub angulis 70°–80° orientibus, tenuibus, numerosis, parallelis, leviter arcuatis; nervis tertiariis tenuissimis, angulo recto exeuntibus.

Locality: Landslip Hill (Otago Museum). [*Ex* Coll. Surv. Otago, 1862; Hector.]

Notwithstanding that the fossil leaf shown on fig. 13 is imperfectly preserved, it is possible to complete it with tolerable certainty as a petiolate lanceolate leaf, which becomes narrower towards the base, the texture of which seems to have been delicate. The primary nerve is fine and straight; the secondary nerves are also fine, parallel with each other, and somewhat curved. They start at somewhat acute angles. Only in two places in the fossil is it possible to discover that the tertiary nerves start at right angles. The fossil shows the best agreement with *Apocynophyllum tabernæmontana*, Ung. (Syll. Plant. Foss. iii., pl. iv., fig. 9, of the fossil flora of Radoboj), which I conclude to be the most nearly related to the species described. As the tertiary nerves of the fossil leaf mentioned by Unger, and depicted at the place mentioned, are not preserved, a more searching comparison and establishment of the distinguishing characteristics must be left to a future occasion; meantime the difference of these species may be accepted as probable.

EBENACEÆ.

Diospyros novæ-zeelandiæ, sp. nov.

Plate XXVIII., figs. 4, 4*a*.

D. foliis subcoriaceis, lanceolato-oblongis, utrinque angustatis, integerrimis; nervatione camptodroma, nervo primario valido, recto excurrente; nervis secundariis sub 55°–65° orientibus, tenuibus flexuosis ramosisque; nervis tertiariis e latere externo secundariorum sub angulis acutis exeuntibus.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., Rep. 1872; v. Haast, *l.c.*]

To judge from the impression of the edge of the fossil on the rock, the texture is rather more leathery than herbaceous. The lanceolate leaf narrows more towards the base than towards the point; the edge is not serrate. The nervation shows a straight, strong, prominent primary nerve, from which proceed fine winding secondary nerves at somewhat acute angles; in the middle of the leaf the distance of the secondary nerves from each other is 1cm. The tertiary nerves are delicate, and joined at oblique angles; they are only visible in a few places on the fossil (*vide* enlargement of the nervation, fig. 4*a*).

The fossil leaf shows, as regards form and nervation, the greatest agreement with those of *Diospyrus lotoides*, Ung. (Syll. Foss. Plant. iii., pl. x., figs. 1–12), from which it is, however, distinguished by a somewhat firmer texture and more delicate secondary nerves. With reference to the fineness of the latter, the fossil described agrees better with the leaf of *D. sagoriana*, Ett., with which it also agrees in shape and texture; but the latter has a different arrangement of the secondary nerves.

DIALYPETALÆ.

ARALIACEÆ.

Aralia tasmani, sp. nov.

Plate XXVIII., figs. 13, 13*a*, 14.

A. foliis coriaceis longe petiolatis, palmatim 3–5 lobatis, lobis lobatis vel irregulariter grosse dentatis, basi coarctatis, margine integerrimo vel irregulariter dentatis; nervatione actinodroma, nervis primariis 3–5, firmis prominentibus, medio validiore; nervis secundariis sub angulis 30°–40° orientibus, prominentibus, rectis, plerumque craspedodromis; nervis tertiariis *sub angulis acutis exeuntibus, simplicibus vel ramosis, inter se conjunctis; reticulo obsoleto.*

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., Rep. 1872; v. Haast, *l.c.*]

There is no doubt that the fossil leaves shown in figs. 13–14 belong to *Aralia*. Of the petiole shown in fig. 14, a fragment 29mm. long has been preserved, but as it is broken off at the lower end it is certain that it was longer. The substance of the leaf must have been more leathery than herbaceous, to judge from the impression and from the charred remains. The larger lobes are narrowed at the base as in many species of *Aralia*, whereby peculiar rounded incisions are formed in the lamina. The edge of the lobes is partly provided with small lobes, or partly irregularly bluntly serrate. The nervation shows three or five principal nerves, of which the centre one is a little more prominent. The lowermost side-nerves unite in fig. 13 just above the base, and consequently there exist here, at the base only, three principal nerves: this does not seldom occur in species of *Aralia*. The secondary nerves start at somewhat acute angles; at the middle nerve stronger ones alternate with finer ones on both sides; from the side base-nerves the stronger secondary start principally at the outer side; these and their branches run principally into the points of the lobes and larger serrations: where this, however, is not the case they form loops. The tertiary nerves are rather pronounced, and traverse the surface of the leaf, as in leaves of *Aralia*, and, as in these, they show also the same distance from each other. The reticulation is not preserved, but traces of it indicate loose meshes as in the leaves of *Aralia dissecta*, Lesq., and similar related species (*vide* enlargement of nervation, fig. 13*a*).

The fossil deviates, in consequence of the more numerous lobes and nerves which run to the edge, from the somewhat similar lobate *Ficus* leaves—for instance, those of *F. carica*.

Of the species of *Aralia* known at present, I can name only *A. dissecta*, Lesq., of the North American Tertiary flora, to which the species described comes remarkably near. *A. dissecta* is distinguished from our species by the smaller number of principal nerves, and the lesser development of the lobes.

LORANTHACEÆ.

Loranthus otagoicus, sp. nov.

Plate XXVIII., fig. 2.

L. foliis coriaceis breviter petiolatis, ovatis, basi rotundatis, apice obtusis, integerrimis; nervatione acrodroma, nervo primario basi prominente, apicem versus subevanescente; nervis secundariis basalibus sub angulis 40°–50° cum primario divergentibus, reliquis inconspicuis.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., Rep. 1872; v. Haast, *l.c.*]

A small ovate leaf with a short stem, which is rounded off at the base and obtuse at the top. It is traversed by three nerves, of which the middle one is more pronounced at the base, but further on it, as well as the side-nerves, becomes indistinct or disappears. No other nerves are visible besides those mentioned. The texture may be designated as firm or leathery. It appears to me that this leaf in its characteristics is most similar to those of the species *Loranthus*—namely, *L. tetrandus*, R. et P. (*vide* Ettingsh., Leaf-skeletons of the *Loranthaceæ*, Memoir, vol. xxxii., pl. v., figs. 9–12). In the species named, besides the three to five ground-standing nerves, only a few delicate secondary and tertiary nerves are visible, which may easily disappear in a rock which is unfavourable to their preservation.

Acerineæ.

Acer subtrilobatum, sp. nov.

Plate XXVIII., figs. 7, 7*a*.

A. foliis longe petiolatis, palmato-trilobis, lobis inæqualibus, lobo medio lateralibus longiore et latiore, sinubus angulum acutum formantibus, margine inæqualiter dentatis; nervatione actinodroma, nervo medio longiore prominente, nervis basilaribus lateralibus cum priore angulis 20°–30° includentibus, extus ramosis; nervis secundariis sub angulis 20°–30° orientibus, plus minusve adscendentibus, craspedodromis; nervis tertiariis tenuissimis sub angulis acutis exeuntibus, inter se conjunctis.

Locality: Shag Point, with *Fagus ulmifolia* (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., Rep. 1872; v. Haast, *l.c.*]

As regards the formation of the leaf, this is very similar to *Acer trilobatum*, A. Braun, so that it is very difficult to discover any difference. The species named has a rather large circle of forms; the variations extend to nearly all the characteristics of the leaf. To the fossil leaf depicted in fig. 7 the variety *productum* comes nearest as regards the form. As regards the nervation (shown enlarged in fig. 7*a*), our fossil approaches nearest to the leaf shown in Heer's "Tertiary Flora of Switzerland" (vol. iii., pl. 115, fig. 4), as the latter shows secondary nerves which start at unusually acute angles, which may also be observed in the fossil leaf from New Zealand, but the secondary nerves at the outside of the side basal nerves start at more acute angles than the corresponding nerves in the Swiss fossil named. Up to the present no smaller diverging-angles than 30° have been observed in *Acer productum*, so far as the secondary nerves are concerned. As the New Zealand maple leaf corresponds to the variety named, a difference might be based upon this characteristic. Finally, the serrations are more delicate, and the upper secondary nerves somewhat more bent upwards, than in *Acer trilobatum*. More ample material for research must settle if the differences named are valid.

Sapindaceæ.

Sapindus subfalcifolius, sp. nov.

Plate XXVIII., fig. 3; Plate XXIX., fig. 2.

S. foliolis membranaceis, petiolulatis, anguste lanceolatis acuminatis subfalcatis, basi angustatis, margine integerrimis; nervatione camptodroma; nervo primario prominente; nervis secundariis tenuibus sub angulis 60°–70° orientibus, arcuatis adscendentibus, inter se conjunctis; nervis tertiariis obsoletis.

Locality: Redcliffe Gully (Canterbury Museum). [*Ex* Coll. Geol. Surv. Cant.; v. Haast.]

The similarity of the fossil leaves shown in figs. 2 and 3 with the leaflets of *Sapindus falcifolius*, A. Braun, is so very remarkable that, if these fossils had been unearthed out of European Tertiary strata, no one would hesitate to ascribe them to the species named. However, I do not venture upon the badly-preserved remains before me to pronounce their identity with *S. falcifolius*.

Celastrineæ.

Elæodendron rigidum, sp. nov.

Plate XXIX., fig. 1.

E. foliis rigide coriaceis, breviter petiolatis, oblongo-ellipticis, basi attenuatis, apice rotundato-obtusis, margine minute crenulatis: nervatione camptodroma, nervo primario valido, recto, excurrente; nervis secundariis sub angulis 40°–50° orientibus: tertiariis obsoletis.

Locality: Landslip Hill (Otago Museum). [*Ex* Coll. Otago Geol. Surv., 1862; Hector.]

An oblong elliptical leaf with a petiole, which has left such an impression as leads one to conclude that it must have had a remarkably stiff leathery consistency. The petiole is short, somewhat bent to one side; the lamina is somewhat narrowed at the base, but at the top bluntly rounded off; the edge is provided with small notches, which are close together. In consequence of the unfavourable nature of the stone, nothing is visible of the nervation except the strong straight primary nerve, which is very pronounced nearly as far as the top of the leaf. From this primary nerve start at the middle distance of 1cm. and at acute angles a few secondary nerves.

The form, the texture, the characteristics of the edge, and the nervation of the leaf as far as the latter is preserved, indicate *Elæodendron*, in which, indeed, occur similar thick leathery finely-notched leaves, as, for instance, in *E. curtipendulum*, Endl., from Norfolk Island, and *E. helveticum*, Heer, from the Tertiary flora of Switzerland.

AMPELIDEÆ.

Cissophyllum malvernicum, sp. nov.

Plate XXVIII., fig. 8.

C. foliis coriaceis ovato-rotundatis, inæquilateris, irregulariter lobatis, lobis obtusis; nervatione subactinodroma, nervo primario medio prominente, subflexuoso, nervis basilaribus lateralibus inæquilongis, longiore extus nervis secundariis instructis, breviore simplici; nervis secundariis sub angulis 40°–50° orientibus, prominentibus, 17mm.–20mm. inter se distantibus, rectis, simplicibus, craspedodromis; nervis tertiariis obsoletis.

Locality: Malvern Hills, I. (Canterbury Museum). [*Ex* Coll. Geol. Surv. Cant.; v. Haast.]

The fossil leaf, fig. 8, occurs in a sandy ferruginous stone, which is unfavourable to the preservation of remains of plants. Notwithstanding this circumstance, one is able to observe so many characteristics that at least the approach to a correct definition is possible. It is quite certain that the texture must be accepted as having been firm and leathery. The impression which the fossil has left on the stone denotes this, as it is developed remarkably unequally. If the contour is completed, we have a broad oval shape. On the narrower side one perceives a few broad, short, rounded-off lobes. The broader side is mutilated, and consequently the edge of it is only visible at the base. However, to judge from the perfect part of this side, we cannot infer a much greater development of the lobes. The nervation is incomplete, running in rays with three basal nerves, the middle one of which is rather pronounced, and winds to the starting-point of the secondary nerves. One of the side basal nerves is longer and more pronounced; it starts just above the base, and sends off at the outer side a few secondary nerves. The shorter one on the other side is not as pronounced as the middle secondary nerves; it is somewhat diverging, bent outwards, and undivided. The secondary nerves, which are not numerous, start with a somewhat diverging curve; they continue straight, and run to the ends of the lobes. Tertiary nerves and reticulation are not preserved. I rank this fossil leaf with the genera *Cissites* and *Ampelophyllum*.

Myrtaceæ.

Eucalyptus dubia, sp. nov.

Plate XXIX., figs. 5, 5*a*.

E. foliis coriaceis, lineari-lanceolatis, acutis, subfalcatis, integerrimis; nervatione brochidodroma, nervo primario prominente; nervis secundariis tenuibus, angulis subacutis exeuntibus, nervo marginali inter se conjunctis; nervis tertiariis obsoletis.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. Geol. Surv. N.Z., Rep. 1872; v. Haast, *l.c.*]

The fragment (fig. 5) from Shag Point belongs undoubtedly to *Eucalyptus*. It is possible to complete it so as to form a linear lanceolate leaf, which is curved almost like a sickle. The top is partly preserved, and does not become much narrower. As regards the nervation, the primary nerve is strongly pronounced, and bent in accordance with the shape of the leaf. A few of the delicate secondary nerves are preserved, which start from the primary nerve at scarcely acute angles. The characteristic seam- or edge-nerve, which connects the secondary nerves with each other, is also preserved. The last-named nerves can, however, be only observed under the lens with a favourable light (see enlargement, fig. 5*a*).

The species described is most nearly related to *Eucalyptus mitchelli*, Ett., of the Australian Tertiary flora, from which it is distinguished by the fact that the top of the leaf narrows only a little; but, as, in *Eucalyptus*, leaves occur in the same species, and even on the same tree and on the same branch, which are pointed and little narrowed at the top, this distinguishing mark carries no weight, and I should have no hesitation in uniting the New Zealand *Eucalyptus* species of former ages with the Australian species named if more points had been offered for comparison of the nervation, especially of the reticulation, which only in the latter is eminently well preserved; consequently I must leave the decision, if there is a difference in the nervation, to further researches.

Papilionaceæ.

Dalbergia australis, sp. nov.

Plate XXVIII., fig. 5.

D. foliolis membranaceis, breviter petiolatis, oblongo-ellipticis, basi acutis, apice rotundato emarginatis; nervatione camptodroma, nerva primario debili; nervis secundariis numerosis, tenuissimis, sub angulis acutis orientibus.

Locality: Shag Point (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., Rep. 1872; v. Haast, *l.c.*]

A delicate, oblong, elliptic leaflet, which has a short petiole, and which reminds one in its characteristics most of *Dalbergia bella*, Heer, of the Tertiary flora of Switzerland. Our fossil is distinguished from the species named only by the much shorter petiole, the less narrow base, and the more oblong form.

CÆSALPINIEÆ.

Cassia pseudophaseolites, sp. nov.

Plate XXIX., fig. 6.

C. foliolis submembranaceis, petiolulatis, ovato-oblongis, basi obliquis, paullo angustatis, apice subacuminatis, margine integerrimis; nervatione camptodroma, nervo primario distincto, basi prominente; nervis secundariis sub angulis acutis variis exeuntibus, tenuibus; nervis tertiariis obsoletis.

Localities: Shag Point; Murderer's Creek (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., Rep. 1872; v. Haast, *l.c.*]

Corresponds so much with *Cassia phaseolites*, Ung., that one might be betrayed into accepting the occurrence of this species in the Tertiary flora of New Zealand. The only differences which seem to exist between this part of a leaflet and the species named are the following: The texture of the New Zealand species may be accepted to have been somewhat firmer, and the diverging-angles are more acute. However, these differences are too insignificant and too little confirmed to uphold the division of these fossils if no difference should appear in the characteristics of the tertiary nerves and of the reticulation. The proof of this must be a task for future researches. The fossil leaves here shown lie on one stone beside each other, and might be parts of leaflets of the same leaf.

Cassia pseudomemnonia, sp. nov.

Plate XXVIII., fig. 6.

C. foliolis membranaceis, petiolulatis, lanceolatis, basi acutis, apice acuminatis, margine integerrimis; nervatione camptodroma, nerva primario tenui, basi prominente; nervis secundariis tenuissimis approximatis, arcuatis, adscendentibus; nervis tertiariis obsoletis.

Locality: Shag Point (Otago Museum). [*Ex* Coll. Otago Geol. Surv., 1862; Hector.]

Small narrow parts of leaflets of distinctly delicate texture, provided with a faint primary nerve, and with very ascending secondary nerves, which approach each other. They may be compared very well with part-leaflets of *Cassia memnonia*, of which latter well-preserved remains from Parschlug are before me; but our fossil is distinguished from these by the direction and the larger number of the secondary nerves.

PLANTÆ INCERTÆ SEDIS.

Carpolithes otagoicus, sp. nov.

Plate XXIX., figs. 7–9.

C. fructibus oblongis subcompressis, utrinque obtusis, supra basin incurvatam paullo constrictis, extus longitudinaliter rugoso-striatis, rima longitudinali dehiscentibus, monospermis; superficie interna valvularum minutissime reticulato-foveatis.

Locality: Shag Point (Otago Museum). [*Ex* Coll. Otago Geol. Surv., 1862; Hector.]

Small fruits which have so extraordinary a similarity to the enigmatical fossil fruits which are designated *Carpolithes websteri*, Heer (*Folliculites minutulus*, Bronn, and *F. kaltennordheimensis*, Zenker), that at the first glance I thought I had before me the kind of fruit named. These fruits are oblong (obtuse), blunt at both ends; at one end, which may be considered as the base, bent to one side; somewhat narrowed neck-fashion; becoming a little thicker at the end. The surface is wrinkled and longitudinally ribbed. The stripes have small point-like warts, which are only visible under a high power (fig. 8*a*). These outer characteristics of the fruit as compared with those of *Carpolithes websteri* show only very insignificant deviations, which become apparent under repeated minute observation. The fossil fruits of the species named show at the middle a length of 7mm. and a width of 3mm.; the New Zealand species are in the middle 5mm. long and 2·5mm. wide. In *Carpolithes websteri* appears at the belly-side [lit.] a rather sharp edge, along which the fruit springs up. This edge is connected with the thicker part of the basal end, so that if observed in section the continuation of the edge seems continued beyond the fruit. In the New Zealand Carpolith the edge mentioned stands out less, and consequently the enlargement at the basal end is smaller. The inner surface of the fruit-rind (or husk) shows a fine network of pittings (*vide* enlargement, fig. 8*b*), and in this characteristic our Carpolith seems to deviate specifically from *C. websteri*. In the sandy clay of Shag Point the fossil fruits described have been found accumulated in great numbers: only the husks were found (filled with matrix), which had burst open and were empty; no trace was visible of the seed, nor of the delicate skin which covered the hollow of the fruit. Figs. 9*a* and 9*b* represent two halves of the fruit, which fit to each other, and which are moderately enlarged.

B.—DESCRIPTION OF THE SPECIES OF THE CHALK FLORA OF NEW ZEALAND.

CRYPTOGAMÆ.

FILICES.

Blechnum priscum, sp. nov.

Plate XXX., figs. 1, 1*a*.

B. fronde subcoriacea pinnata, pinnis rhachidem sub angulo acuto insertis, confertis, alternantibus, lineari-lanceolatis, integerrimis; nervatione Neuropteridis; nervo primario prominente, versus apicem sensim attenuato, recto; nervis secundariis angulis acutis egredientibus, approximatis, inferioribus dichotomis, reliquis furcatis, ramis elongatis, marginem versus arcuato-divergentibus.

Locality: Pakawau, Nelson (Canterbury Museum).

The remainder of a fern shown in fig. 1 is pinnatifid, linear, lanceolate, and approximate; the edges are not broken or notched; the pinnæ are joined to a comparatively thin petiole at acute angles; the base is towards top and bottom drawn forward. The secondary nerves start at acute angles, and run with their fork-like branches diverging towards the edge (see the enlargement of the nervation, fig. 1*a*). The position, the mode of joining, and the nervation of the pinnæ, as well as the whole habit of the fossil, speak for the genus *Blechnum*. The most nearly related living species is *B. occidentale*, Linn., indigenous to tropic America (see Ettingsh., Ferns, pl. lxxv., figs. 4 and 13). By analogy the fossil may be considered as a fragment of the whole frond, which is only simply pinnate. Of fossil ferns, *B. atavium*, Sap., from the fossil flora of Sézanne, is the most nearly related; it is only distinguished by somewhat wider pinnæ, and secondary nerves which are less close together.

Aspidium cretaceo-zeelandicum, sp. nov.

Plate XXX., figs. 2, 3.

A. pinnis lanceolato-linearibus, lobatis, lobis abbreviato-ovatis acutis, integerrimis; nervatione Goniopteridis (?); nervo primario prominente, recto; nervis secundariis sub angulis 65°–75° orientibus, distinctis, rectis vel marginem versus arcuatis; nervis tertiariis tenuissimis, vix conspicuis.

Locality: Pakawau, Nelson (Canterbury Museum).

The pinnate fragments of a fern shown in figs. 2 and 3 agree best with *Aspidium;* the comparison of these with the small fructifying fragment, figs. 4, 4*a*, Pl. XXIV., from the Tertiary strata of Dunstan, and also with a sterile fragment from the strata of Shag Point, permit a supposition of a close relationship of these species—yea, probably, a relation as regards genus. The Chalk species is distinguished from the Tertiary species by the lesser notches of the pinnæ and the oviform pointed lobes of same; the diverging-angles of the secondary nerves seem also to be more acute in the latter. I consider *Aspidium fœcundum*, Heer, from the fossil flora of the Atane strata, as analogous to the Chalk species; the former is distinguished by the deeper and the bluntly-rounded-off lobes of the pinnæ.

Dicksonia pterioides, sp. nov.

Plate XXX., fig. 4–6.

D. fronde bi- vel tri-pinnata, pinnis alternis, rarius subop-positis, sessilibus, ovatis vel lanceolatis, superioribus denticulatis obtusis, inferioribus dentatis vel lobatis, dentibus vel lobis rotundato-obtusis; nervatione Pecopteridis sphenopteridis, nervo primario tenui, sub angulis variis acutis e rhachi oriente, sub apice evanescente; nervis secundariis sub angulis acutis exeuntibus; nervis tertiariis furcatis.

Locality: Pakawau, Nelson (Canterbury Museum).

The remains of ferns before me betray a frond which is more composite than the fern previously described. Fig. 4 is probably the point of a pinna of the second order. The small pinnæ here often run together in lobes; but in figs. 5 and 6 the pinnæ are more developed, they adhere to elongated, lanceolate pinnæ of the second order; they are ovi-lanceolate, serrated, or lobate, and close together. The nervation, fig. 6*a*, is very delicate, and only visible if a favourable light can be brought to bear upon the object. The primary nerve is very fine, and from it start secondary nerves at acute angles, which are arranged anadromously. The tertiary nerves, which are not numerous, are divided fork-like. By no means is it possible to give here the related analogies with such certainty as those of the ferns previously described, but it seems as if these must be looked for in the divisions of the *Davalliaceæ* and *Cyatheaceæ*. The following show analogous formation of the frond: *Alsophila pruinata*, Kaulf., an American fern; *Microlepia pinnata*, Presl, indigenous in the East Indies and Oceana; *Balantium brownianum*, Presl, of the Australian flora; but most of all *Dicksonia smithii*, Hook., which occurs in the Island of Luzon.

Among fossil ferns, *Dicksonia conferta*, Heer, of the flora from the Atane strata, approaches nearest to the species described, but it is distinguished from it by the unbroken edge of the small pinnæ.

Gleichenia (Mertensia) obscura, sp. nov.

Plate XXX., figs. 7, 7*a*.

G. pinnis elongatis pinnatifidis, pinnulis lineari-lanceolatis, integerrimis; nervatione Alethopteridis, nervo primario prominente, recto; nervis secundariis numerosis, furcatis.

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

A fragment of a pinnate frond imperfectly preserved, which must have been laid aside as indeterminable had it not been that it was possible to discover a few characteristics, which just enabled me to determine the genus. The fragment shows a stout spindle of the pinna, from which we may conclude that it belonged to the lower part of a long pinna, which up to the spindle is pinnatifid; the small pinnæ are remarkably narrow, almost linear, with an unbroken edge, traversed by a pronounced primary nerve, from which the very fine secondary nerves start, which are close together, and are branched in a fork-like manner (see the enlargement of the nervation, fig. 7*a*). The characteristics mentioned agree very remarkably with the frond of *Gleichenia* (*Mertensia*) *flabellata*, Desv., a fern which is indigenous to Australia.

Among the fossil *Filices*, approaches most closely to our species *Gleichenia* (*Mertensia*) *rigida*, Heer, from the Kome strata.

PHANEROGAMÆ.

GYMNOSPERMÆ.

CONIFERÆ.

Abietineæ.

Dammara mantelli, sp. nov.

Plate XXX., fig. 20.

D. foliis suboppositis, coriaceis, patentibus, approximatis, ovato-lanceolatis, basi angustata sessilibus, apice acuminatis, enerviis.

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

The fragment of a branch (fig. 20) bears ovi-lanceolate leaves, which stand almost opposite each other, have an unbroken edge, and become gradually narrower towards the top, and which stand out from the branch-spindle almost at right angles. The leaves betray a leathery texture, but there is no nervation whatever beyond many fine parallel stripes. The similarity of this fossil to *Dammara australis*, Lamb.—which at the present time is spread over eastern Australia and New Zealand—is so great that I almost venture to ascribe it to the living species.

I name this species after Walter Mantell, in recognition of his deserving geological works about New Zealand.

TAXINEÆ.

Taxo-torreya.

According to the small branch, described below, of a fossil *Taxinea* from the strata of Wangapeka, which are ranked among the Chalk formations, we must accept a family genus which unites the characteristics of *Cephalotaxus* and *Torreya*. The position of the leaves, and the nature of the petiole, are the same as in *Cephalotaxus;* on the other hand, the nervation is the same as in *Torreya*. All other characteristics of the formation of the leaf are the same as in both genera.

Taxo-torreya trinervia, sp. nov.

Plate XXX., figs. 16, 16*a*.

T. foliis suboppositis, approximatis, distichis, rigide coriaceis, parvis, lanceolato-linearibus, in petiolum brevissimum subincrassatum contortis, apice subobtuso mucronulatis; nervo mediano prominente latiusculo, excurrente, nervis duabus lateralibus sulcum longitudinalem includentibus.

Locality: Wangapeka, Nelson (Otago Museum). [*Ex* Coll. N.Z. Geol. Surv., Rep. 1867; Hector.]

The small fragment of a branch (fig. 16) is distinguished from the below-described branch of *Podocarpium* by the three nerves which traverse the leaves; the latter stand closely together, and are arranged in two lines almost opposite each other; they indicate a strong leathery texture; they are disguished by a short, somewhat stout stem. All these characteristics remind one of *Cephalotaxus*, especially of *C. drupacea*, Sieb. et Zucc. (Japan), since this species agrees also with the fossil as regards size and shape of the leaves. In the latter the leaves are 10mm.–15mm. long and 2mm.–3mm. wide, but the nervation of the leaves shows the characteristics of *Torreya* (see the enlargement, fig. 16*a*). In this genus appears on the underside of the leaves a pronounced and broad mid-nerve, which runs out towards the top, and on each side of it exists a narrower nerve along the leaf, which limits the narrow furrow that runs along the mid-nerve. The broad mid-rib, as well as the longitudinal furrows and side-nerves, are distinctly perceptible in the fossil. Of the now living species of *Torreya*, *T. grandis*, Fort., from China, agrees best with our fossil as regards size and shape of the leaves.

Podocarpium ungeri, sp. nov.

Plate XXX., figs. 13–15.

P. ramis patentibus, foliis dense approximatis patentibus, rigide coriaceis, subfalcatis, linearibus acutis vel acuminatis, basi sessilibus angustatis, margine planis; nervo mediano excurrente; fructibus ellipsoideis, utrinque obtusis.

Locality: Pakawau (Canterbury Museum; Otago Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

On the piece of rock from Pakawau (shown in fig. 13) lie fragments of twigs pell-mell in different directions; these twigs have belonged most probably to the same tree, and must have been projecting. The leaves on the branch-fragment (fig. 14) are the largest and most distinct: one recognises their firm leathery texture and the mid-nerve which runs to the top of the leaf. In the specimen named, as well as in the other specimens of branches before me, the leaves appear in close juxtaposition, projecting, but seldom straight; they are mostly somewhat sickle-shaped, curved, linear, pointed, 2mm.–3·5mm. wide and 15mm.–25mm. long; they are at the base short and narrowing, and flat at the edge.

Beside the fragments of branches shown in fig. 13, I saw remains of fruits, which are small ellipsoidal charred impressions, which originate from berry-like fruits, which latter belong without doubt to the same plant as the branches; their similarity in shape and size to the fruits of *Podocarpus* is at once apparent. Fig. 15 shows such a fruit.

In accordance with the facts enumerated, it would not be a fault altogether to classify these remains with the genus *Podocarpus.* From this, however, I am prevented by the circumstance that Unger has described a fossil wood from New Zealand which, as regards its construction, is midway between *Podocarpus* and *Dacrydium*, and which has probably belonged to a special defunct genus, which Unger named *Podocarpium* ("Voyage of the Austrian Frigate 'Novara,'" vol. i., part ii., page 13; pl. v., fig. 1*a–c*). I believe I must ascribe to this genus all those species of the New Zealand Chalk flora which resemble *Podocarpus* or *Dacrydium.*

Podocarpium cupressinum, sp. nov.

Plate XXX., fig. 11.

P. ramis gracilibus elongatis, foliis parvis basi decurrentibus, ramulorum juniorum distichis, patulis linearibus acuminatis; seniorum brevioribus adpressis lanceolatis; nervo mediano distincto.

Localities: Pakawau, Wangapeka, Nelson; Grey River, Westland (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

The specimen from Pakawau (fig. 11) shows a small mature branch, which is studded with lanceolate leaves, which are appressed. At the top of the mature branch are the sprouts of younger branches, also provided with leaves, which are erect, linear, pointed, and arranged in two rows. I associate with this branch another mature branch from Grey River, not shown here, which is covered with similar leaves, which are pressed against the branch. Although top and base are wanting, it has the considerable length of 25cm., and a diameter of only 3mm.; consequently the tree was provided with long slender branches.

Not a little analogous to this species is *Podocarpus præcupressina,* Ett., of the Australian Tertiary Flora, which is distinguished by more slender branches and less closely-set, pointed leaves.

Podocarpium tenuifolium, sp. nov.

Plate XXX., figs. 8–10, 10*a*.

P. ramulis gracilibus, foliis tenuibus basi decurrentibus, ramulorum juniorum distichis, dense approximatis, lineari-subfalcatis, planis, apice acuminato mucronulatis.

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

Figs. 8–10 are enlarged. Fig. 10*a* shows the younger branches studded with leaves in two rows. This species may be considered as the ancestor of *Podocarpus prætenuifolia,* m., which latter is described in Part A, and which occurs in the Tertiary flora of New Zealand. The species under observation is distinguished from the latter by a stiffer spindle, and leaves which are more closely situated, which are curved and somewhat sickle-shaped.

Podocarpium prædacrydioides, sp. nov.

Plate XXX., fig. 12.

P. ramulis abbreviatis, foliis parvis basi decurrentibus, compresso-subtetragonis, ramulorum juniorum distichis, approximatis, linearibus subfalcatis, seniorum minimis imbricatis.

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

I have before me only a fragment of a twig, which is broken off just where the younger branches join the older. These twigs are remarkably short; they are studded with small, linear, somewhat sickle-shaped leaves, which are arranged in two rows. The enlargement shows a mid-rib, which projects almost like a keel, also an elevated margin; from which we may infer a thick-edged leaf. The base is decreasing; most of the leaves betray a faint sickle-like curve; their width is scarcely 1mm., their length 2·5mm.–4mm.; but, as none of the points of the leaves are preserved, it is impossible to determine if they were provided with a small thorn. At the lower end of the branch are perceptible the much smaller leaves, which are arranged like tiles side by side in rows, and with which the older branch must have been covered.

In all the characteristics described this species agrees so exactly with *Podocarpus dacrydioides*, Rich., which is at present spread over northern New Zealand, that we must here admit the possibility of the identity of the genus; but this decision must be reserved to future researches upon more complete material. The name of the species, *prædacrydioides*, was allotted not only to indicate the relationship as regards genus of the plant of former ages with the now living plant, but also to distinguish it from *Podocarpium dacrydioides*, Ung., which fossil wood from the Tertiary formation of New Zealand has been previously mentioned.

Dacrydinium cupressinum, sp. nov.

Plate XXX., figs. 17, 18, 18*a*.

D. ramis ramulisque gracilibus elongatis; foliis approximatis, subdecussatim oppositis, squarroso-patentibus vel subimbricatis, compresso-carinatis, ovatis vel oblongis falcatis, basi decurrentibus, apice mucronulatis.

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

I have before me a fragment of a branch and a few broken pieces of a smaller branch, which may probably have belonged to the same branch. All these parts show a slender spindle, and from them we may conclude upon elongated branches and twigs. The leaves, which are best preserved on the fragment of a twig (fig. 18), stand close together and almost opposite each other. In the enlarged part of another twig (fig. 18*a*) it is distinctly perceptible that a crossed position of the pairs of leaves exists. The leaves are more or less erect: this is especially the case in the small twig with longish leaves (fig. 18). In fig. 17 the leaves are somewhat shorter, oviform, pointed, and arranged almost like tiles. In the enlargement referred to it is perceptible that the leaves were of firmer substance, and had longitudinal edges; the leaves decrease towards the base, are shaped like an awl, and bent somewhat like a sickle, and are provided with a very short thorn at the top.

In the characteristics enumerated the fossil species agrees best with *Dacrydium cupressinum*, Sol., a tree forming extensive forests in the South Island and Stewart Island. The only difference between these two seems to be that the leaves in the living species are awl-shaped and almost straight, while those of the fossil species are broader, distinctly sickle-shaped, and bent upwards. The great similarity of the twigs of the fossil and of the living plant permits the possibility of both belonging to the same genus; at least, we may conjecture that the former stands a degree nearer to the genus *Dacrydium* than the middle genus *Podocarpium*. In the temporary assumption that the Chalk species must be separated from the recent species, I name the former *Dacrydinium*, while I designate a Tertiary plant of New Zealand, which corresponds with the living *Dacrydium cupressinum*, as *D. præcupressinum*.

Gen. *Ginkgocladus*.

Ramuli secundarii phyllodinei; phyllodia longe petiolata, flabellato-pinnatim nervosa, nervi omnes tenuissimi.

As regards the pinnate-nerved lobate phyllodia, this genus shows the habit of *Phyllocladus*: as regards the very delicate traversing nerves and the long petiole of the phyllodium, it reminds one very much of *Ginkgo*.

Ginkgocladus novæ-zeelandiæ, sp. nov.

Plate XXX., fig. 19.

G. phyllodiis subcoriaceis, ovato-rhombeis, lobatis, in petiolum longum decurrentibus, lobis truncatis dentatis; nervo primario vix prominente, nervis secundariis et tertiariis angulis acutissimis insertis, simplicibus, craspedodromis.

Locality: Wangapeka, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., 1867; Hector.]

The fossil leaf shown in fig. 19 might under superficial inspection be mistaken for a frond of *Asplenium* or *Adiantum*; however, under closer observation and comparison we must come to the conclusion that this fossil could only belong to the *Taxineæ*, which carry phyllodia, and midway between *Phyllocladus* and *Ginkgo*.

The existence of a carbonized substance on the impression indicates plainly a leathery texture; but the charred deposit is so thin that we may infer a delicate and yet leathery nature such as belongs to the phyllodia-leaves of *Ginkgo*. As regards the more pronounced rhomboidal shape, which runs down the stem, the fossil is similar to the phyllodia of *Phyllocladus rhomboidalis*, but there is a lobate formation perceptible, which is similar to *Ph. trichomanoides*; the truncate lobes are at the front edge minutely, obtusely, and unequally serrate. The comparatively long petiole is most remarkable, as thereby the fossil approaches to the petiolate phyllodia of *Ph. rhomboidalis*, but it comes even closer to the long petiolate leaves of *Ginkgo*.

We recognise in the nervation of the fossil described a kind of combination of the nervation of *Ginkgo biloba* and of *Ph. trichomanoides*. From the petiole, which is winged from the descending lamina, starts a primary nerve, which is faint at the base, and scarcely pronounced in its further course; from this primary nerve start already in the wings of the petiole secondary nerves at acute angles. This circumstance occurs neither in *Adiantum* nor in *Asplenium*, but it may be observed in *Ginkgo*. The other secondary nerves, which start in the further course of the primary nerve at very acute angles, are also as fine as the basal ones, and are divided among the lobes, the middle of which they traverse to the end, without, however, being bifurcate. As regards their delicacy these nerves have most similarity with those of *Ginkgo*, as regards their simplicity with those of *Phyllocladus*. These nerves are most similar to the secondary nerves of *Ph. trichomanoides* as regards their relation to the lobes. The tertiary nerves start from both sides of the secondary nerves at very acute angles; they are very delicate, almost straight, close to each other, and they run undivided into the small serrations of the edge. As regards the characteristics just described of the tertiary nerves, the fossil agrees best with *Phyllocladus trichomanoides*.

MONOCOTYLEDONES.

Gramineæ.

Poacites nelsonicus, sp. nov.

Plate XXX., figs. 22, 22*a*.

P. foliis elongatis anguste linearibus, 4mm. latis; nervis longitudinalibus primariis 6, tenuibus, æqualibus, cum nervis interstitialibus solitariis tenuissimis alternantibus.

Locality: Wangapeka, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., 1867; Hector.]

The fossil shown in fig. 22 is a fragment of a long, very narrow blade of grass, which shows a few equally delicate primary nerves, between which run out a few very fine nerves (see enlargement, fig. 22*a*). The primary nerves approach each other more closely towards the edge; the substance of the blade is rather firm, almost leathery. A more exact definition of this fragment must be left to future researches.

Bambusites australis, sp. nov.

Plate XXX., fig. 21; Plate XXXI., figs. 1–3, 3*a*.

B. rhizomate solido lignoso crasso, ramoso (?), culmis validis, 4·5cm. fere crassis, nodosis, tenuiter striatis, nodis prominentibus hinc inde obliquis; foliis late linearibus, nervis primariis et interstitialibus pluribus.

Localities: Grey River, Westland; Pakawau, Nelson (Canterbury Museum).

The remains shown under above figures I take to be the residue of a grass from the division of the *Bambuseæ*. Fig. 21, from Pakawau, is a fragment of the strong ligneous rhizome. Fig. 2, from the same locality, represents a piece of a young stalk, which shows traces of fine longitudinal stripes and knots. Fig. 1, from Grey River, is a well-preserved fragment of a stronger stalk with fine longitudinal stripes and a somewhat oblique knot. Fig. 3, from the same deposit, shows a small fragment of a blade, which, according to its width and the several principal nerves, which are surrounded by several fine intermediate nerves (see enlargement, fig. 3*a*), agrees with the above remains of a *Bambusea.*

Musaceæ.

Haastia speciosa, sp. nov.

Plate XXXI., fig. 5.

H. foliis amplis, nervo primario 6cm.–8·5cm. crasso, striato, nervis secundariis tenuissimis oblique insertis simplicibus, densissime confertis, apicem versus arcuatim convergentibus; nervis interstitialibus vix distinctis.

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

Of this *Musacea*, I have before me several large pieces, which can only be parts of an uncommonly large leaf. In order to save space it was possible to depict only one piece, which contains a characteristic part of the leaf. Fig. 5 is taken from about the middle of this gigantic leaf. We see the huge primary nerve, which is more than 8cm. wide, the surface of which is traversed by both fine and coarse longitudinal stripes, which latter stand out partly, somewhat like a keel. From this primary nerve start delicate secondary nerves at very acute angles, which are close together and run outwards in diverging curves. The nerves between these seem not to have been preserved. From the thickness of the mid-nerve we may conclude that the leaf was about 4m. long, as the length of a living *Musa*-leaf is 1·5m., and the mid-nerve of it is 2cm. wide. A second part of the upper portion of the leaf, not shown here, has the primary nerve only 4cm. wide, and more delicately striped; the longitudinal keels do not exist in this piece; the origin and course of the secondary nerves are the same as in the previous specimen. Another fragment corresponds with a portion near the top of the leaf; the primary nerve at the lower end of it is only 2mm. wide—the lamina is torn in several places; the secondary nerves start at much more acute angles.

The fossil leaf deviates from all known *Musophyllum* forms in consequence of its considerable size: as these have been found in the Tertiary strata only, we must take it for granted that they belong to a special genus, which I dedicate to the discoverer, Dr. Julius von Haast.

Palmæ.

Flabellaria sublongirhachis, sp. nov.

Plate XXXI., figs. 4, 4*a*.

F. foliis flabellifidis, laciniis rhachidi compressæ longissimæ striatæ insidentibus, numerosis, congestis, linearibus basi constrictis conduplicatis; nervis longitudinalibus parallelis, mediano valido, prominente, interstitialibus pluribus.

Locality: Grey River, Westland (Canterbury Museum).

The fossil, fig. 4, represents a fragment of a fan-palm leaf, which is provided with a long spindle. The specimen reminds one immediately of *Flabellaria longirhachis*, Ung., from the Chalk flora of Muthmannsdorf, in Nether-Austria (see Unger, Iconogr. Plant. Foss., Memoir, bd. iv., p. 19; pl. viii., fig. 1; pl. ix., fig. 1), from which it is distinguished by a flatter, more compressed spindle. The pinnate segments are joined to the spindle at an angle of 25°–30°. This circumstance and their less close position to each other correspond exactly to the lowest part of the large fossil leaf described by Unger on pl. viii., the spindle of which, as well as the spindle of our fossil, shows a width of 15mm.

Besides the fossil depicted, a few shreds of the tips of the pinnæ of this palm-leaf were found in the same locality. These species show distinctly the immense pronounced mid-nerve, and also the fine interstitial nerves which are joined in between the side length-nerves (see the enlargement, fig. 4*a*).

DICOTYLEDONES.

APETALÆ.

Casuarineæ.

Casuarinites cretaceus, sp. nov.

Plate XXXI., figs. 6, 6*a*, 7.

C. ramis nodoso-articulatis, aphyllis, articulis cylindricis costato-striatis; ramulis gracilibus, tenuibus, congestis; vaginis solummodo in ramulis tenuioribus conspicuis, erecto-patentibus, dentatis, dentibus lanceolatis.

Localities: Grey River, Westland; Pakawau, Reefton, Nelson (Canterbury Museum).

In the deposit at Grey River were found fragments of small branches, which have knotty joints and rib-like stripes; their diameter is from 3mm. to 7mm. At Pakawau the twigs found are very thin (see fig. 6), of a diameter of only 1mm., in which it was possible to recognise the fine longitudinal stripes and the joints; but in consequence of the defective preservation the sheaths were scarcely perceptible; however, I was able to discover traces of these only on a single twig, and in a place where they were, like a fascicle, together lying, the twigs having been macerated. Fig. 6 shows an enlargement of such a thin twig, with the lanceolate serræ of the sheath on one of the joints. I take these fossils to be remains of a *Casuarina*-like plant, the more accurate comparison of which with species of this genus could only be undertaken with better-preserved material.

Cupuliferæ.

Quercus pachyphylla, sp. nov.

Plate XXXI., figs. 8, 8*a*.

Q. foliis rigide coriaceis, breviter petiolatis, obovato-ellipticis, basi angustatis, apice rotundato-obtusis, margine integerrimis; nervatione brochidodroma, nervo primario valido, recto; nervis secundariis sub angulis 55°–65° orientibus, tenuibus, ramosis; nervis tertiariis abbreviatis; rete microsynammato.

Locality: Brunner Mine, Grey River (Otago Museum).

Corresponds on the one hand to *Q. daphnes*, Ung., of the European Tertiary flora, and on the other hand to the oaks of the Australian Tertiary flora, which have whole-edged leather-like leaves, such as *Q. wilkinsoni*, *Q. greyi*, and *Q. austini*, which have been described in my contributions to that flora. Of the species of oaks now living, *Q. virens*, Ait., shows the greatest similarity in the construction of the leaf. In fig. 8*a* an enlargement of the reticulation of the fossil leaf just described is shown. Among the oaks of the Chalk flora, *Q. myrtillus*, Heer, from the Patoot strata, comes nearest to the species described.

Quercus nelsonica, sp. nov.

Plate XXXI., fig. 10.

Q. foliis petiolatis, coriaceis, oblongo-ellipticis, utrinque paullo angustatis, margine dentatis, nervatione craspedodroma, nervo primario valido, crasso; nervis secundariis numerosis approximatis, sub angulis 65°–70° orientibus, leviter arcuatis; nervis tertiariis obsoletis.

Locality: Wangapeka, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., 1867; Hector.]

A fossil leaf which, in accordance with its characteristics, as far as these may be recognised, can be best compared with the leaves of a few East Indian species of oaks—namely, *Q. lobbii* and *Q. oxyoden*, Miq.—but in these the serræ are standing more forward. Among the fossil oaks, *Q. cyri*, Ung., from the flora of Sotzka, approaches our species in a remarkable manner, with the only difference that the leaf of the latter is broader and narrows less towards the top. The following may be considered as vicarious species: *Q. beyrichii*, m., from the

Chalk of Niederschöna; *Q. ellsworthiana*, Lesq., of the North American Chalk formation; and *Q. denticulata*, Heer, from the Patoot strata.

Quercus calliprinoides, sp. nov.

Plate XXXI., fig. 9.

Q. foliis coriaceis, ellipticis, apice obtusis, basin versus paullo angustatis, margine undulato-dentatis, nervatione craspedodroma, nervo primario valido, secundariis subarcuatis, fere obsoletis.

Localities: Grey River; Wangapeka, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., 1867; Hector.]

A small leathery leaf, which as regards habit reminds me on the one hand of *Q. rinkiana*, Heer, from the Atane strata, and on the other hand of *Q. calliprinos*, Webb, of the present time. This fossil was found together with the remains of a leaf of a second species of oak described in the foregoing. The state of preservation leaves much to be desired, and future discoveries must give more exact disclosures as regards its nature. A second fossil leaf, not shown in the illustration, was found at the Grey River.

Dryophyllum nelsonicum, sp. nov.

Plate XXXI., figs. 11, 11*a*.

D. foliis coriaceis, lanceolatis, apicem versus angustatis, obtuse-dentatis; nervatione craspedodroma, nervo primario firmo, recto; nervis secundariis prominentibus, sub angulis 50°–60° orientibus, numerosis approximatis, parallelis, leviter curvatis, simplicibus; nervis tertiariis e latere externo secundariorum sub angulis acutis exeuntibus, prominentibus, flexuosis simplicibus vel furcatis, fere transversim conjunctis.

Locality: Pakawau, Nelson (Canterbury Museum).

A fossil leaf which bears the type of *Dryophyllum*. The texture must be designated as firm and leathery; the edge is bluntly serrated; the secondary nerves which feed same are sharply defined and undivided, they are close to each other, little curved, not winding; the tertiary nerves are pronounced and run almost across (see enlargement, fig. 11*a*).

Of the species described already, *Dryophyllum holmesii*, Lesq., from the flora of the Dakota group, comes nearest to the species above described.

Fagus nelsonica, sp. nov.

Plate XXXII., figs. 9, 9*a*.

F. foliis membranaceis, ovatis, basi acutis, apice acuminatis, margine inæqualiter vel duplicato dentatis; nervatione craspedodroma, nervo primario basi vel vix ad dimidium laminæ promi-

nente, recto vel paullo flexuoso; nervis secundariis in uno latere 7, sub angulis 40°–50° orientibus, rectis simplicibus; nervis tertiariis tenuissimis, angulis subrectis egredientibus, approximatis, flexuosis ramosis, inter se conjunctis, reticulum tenerrimum vix conspicuum includentibus.

Locality: Wangapeka, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., 1867; Hector.]

The beech-leaf shown in fig. 9, which was found among the plant-fossils at the locality indicated, makes the impression of a delicate, not at all leathery leaf; it is oviform, pointed, either unevenly serrate or almost biserrate; it is traversed by a fine primary nerve, which is scarcely pronounced to the middle of the lamina; from the primary nerve start on each side a few straight secondary nerves, which run at acute angles to the marginal serræ. The tertiary nerves are very fine; they start almost at right angles, are remarkably close together and connected with each other; they are winding, bifurcate or branching. The tertiary nerves, as well as the very delicate network which lies between them, are shown enlarged in fig. 9*a*. They were only perceptible on the lower part of the fossil leaf.

The species to which the beech-leaf described belonged is a true representative of the European Tertiary *Fagus ferroniæ*, Ung., and consequently of the division *Eufagus*, DC., under close comparison of the reticulation and of the tertiary nerves of *Fagus ferroniæ* (for which I could command ample material) with the relative characteristics of the beech-leaf described. I find, however, that in the Tertiary beech the reticulation is more developed, and composed of comparatively larger meshes. I find also that the tertiary nerves are neither so fine nor so close together. In *Fagus prisca*, m., of the Chalk flora of Niederschöna, we have a similar quercoid reticulation formed by very close meshes as in *F. nelsoniana*, but in the former species the secondary and tertiary nerves are almost the same as in *Fagus ferroniæ*, and the texture is leathery.

We may consider *Fagus polyclada*, Lesq., of the Dakota group, as a vicarious species of the North American Chalk flora, the leaf of which agrees in shape and texture with the leaf described, but it deviates as regards the nature of the edge.

Fagus producta, sp. nov.

Plate XXXII., fig. 1.

F. foliis coriaceis, e basi ovata lanceolato-acuminatis, margine denticulatis; nervatione craspedodroma, nervo primario valido, recto; nervis secundariis sub angulis 40°–50° orientibus, *pluribus, arcuatis, inferioribus extrorsum ramosis; nervis tertiariis tenuibus, angulis subrectis exeuntibus, inter se conjunctis; reticulo obsoleto.*

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

A leaf which, as regards shape, reminds one of the larger leaves of *Fagus muelleri*, which are long and become narrow towards the top; the leaf agrees also with these as regards the leathery texture; but as this leaf is considerably larger than those of *F. muelleri*, and as the nervation deviates in several respects, I believe that it belongs to a distinct species. The edge is provided with comparatively small serrations, which are bent forward; the base is scarcely narrowed and somewhat blunt. Notwithstanding the fossil seems very much torn, it is possible to discern sufficiently the course of the nerves. From the straight primary nerve, which is very strongly pronounced to the middle of the lamina, start curved secondary nerves, which ascend to the edge; the lower of these seem somewhat closer, and provided with pronounced outer nerves. The tertiary nerves are preserved only in a few places; they are very delicate, run straight and almost at right angles; they cross and connect with the secondary nerves. There is no trace of the reticulation preserved. A comparison of this interesting fossil with other similar forms must be left to future researches, as soon as more ample material will permit of such; but I believe I must mention here that *F. producta* must be placed in the division *Nothofagus*. Of the now living species of this division, *F. dombeyi*, Mirb., betrays the nearest relation.

Ulmaceæ.

Gen. *Ulmophylon.*

Among these I count fossil plants of the Chalk flora which according to their characteristics belong well to the *Ulmaceæ*, but which cannot be enrolled with any living genus. The two species here described have leathery leaves, one of which shows the closest relation to *Ulmus*, the other to *Planera*. Both genera are found in the Tertiary flora of New Zealand.

Ulmophylon latifolium, sp. nov.

Plate XXXII., figs. 6–8.

U. foliis subcoriaceis, petiolatis, late ovatis, basi inæquali vel obliqua obtusis, apice acuminatis, margine inæqualiter vel duplicato-dentatis; nervatione craspedodroma, nervo primario valido, recto, excurrente; nervis secundariis prominentibus, sub angulis 40°–50° orientibus, basin versus approximatis et nervos externos emittentibus, superioribus simplicibus; nervis tertiariis *e latere externo secundariorum sub angulis acutis exeuntibus, simplicibus vel ramosis, inter se conjunctis; reticulo obsoleto.*

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

Corresponds somewhat to *Ulmus prisca*, Ung., of the fossil species, but it deviates somewhat from this, as it is biserrate, has a firmer texture, and the outer nerves of the lower secondary nerves are pronounced. Among the living species of *Ulmus* the analogue of the species described might be found in the division *Microtela*, which has firmer, almost leathery leaves; however, for a more searching comparison more complete and better-preserved specimens than the fossils before me are necessary. I class the small leaf (fig. 7), which shows so plainly the characteristics of an *Ulmus*-leaf, with the same species because it lies on the same stone together with the large leaf (fig. 6), and with a few remains of leaves which, as regards size, lie between the two leaves shown.

This fossil plant is certainly a forerunner of the *Ulmus* species. It seems that in the European Chalk formation the genus *Ulmophylon* is not wanting: later researches will probably prove this.

Ulmophylon planeræfolium, sp. nov.

Plate XXXII., figs. 2–5, 4*a*.

U. foliis breviter petiolatis, coriaceis, ovatis vel ovato-oblongis, basi rotundata æquali vel inæquali, apice acuminatis, margine crenatis vel irregulariter obtuse dentatis; nervatione craspedodroma; nervo primario prominente recto, excurrente; nervis secundariis sub angulis 50°–60° orientibus, prominentibus, arcuatis simplicibus rarius ramosis; nervis tertiariis e latere externo secundariorum angulis peracutis egredientibus, approximatis, subflexuosis, fere transversim inter se conjunctis.

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

At the first glance these leaves have great similarity with those of *Planera*, from which they are however distinguished by a leathery texture, and by the close, more pronounced tertiary nerves, which run almost across the leaf (see enlargement, fig. 4*a*). These essential differences made it seem advisable to accept a distinct genus for the Chalk flora, from which the genera *Planera* and *Ulmus* during the Tertiary period proceeded.

It is probable that in the fossil plant before us we have the forerunner of *Planera*, as this seems to be indicated by the shape of the serræ and several characteristics of the nervation.

Planera antiqua, Heer, of the Patoot strata, may be considered as analogous to the species described.

MOREÆ.

Ficus similis, sp. nov.

Plate XXXII., figs. 10, 10*a*.

F. foliis petiolatis rotundato-ovalibus vel ellipticis, basi subacutis, margine integerrimis; nervatione camptodroma; nervo primario prominente, recto; nervis secundariis sub angulis 65°–80° orientibus, numerosis, paullo arcuatis parallelis; nervis tertiariis e latere externo secundariorum sub angulis acutis exeuntibus, ramosis inter se conjunctis, reticulum tenerrimum includentibus.

Locality: Wangapeka, Nelson (Otago Museum). [*Ex* Coll. N.Z. Geol. Surv., 1867; Hector.]

Corresponds in all its characteristics with *Ficus jynx*, Ung., with the exception of the shorter petiole. The finest reticulation seems to be more developed in the New Zealand species, as shown in the enlargement (fig. 10*a*). On the whole the nervation is in this also very similar to that of *Ficus jynx*. (Compare "Tertiary Flora of Switzerland," vol. ii., pl. 85, fig. 8.) The following are analogous species in the Chalk flora: *F. geinitzii*, Ett., from Niederschöna; *F. atavina*, Heer, from the Atane strata of Greenland; but especially *F. magnoliæfolia*, Lesq., from the Dakota group. The latter species approaches *Ficus jynx* in a like manner as the species described, from which it is distinguished by the more ascending secondary nerves.

LAURINEÆ.

Cinnamomum haastii, sp. nov.

Plate XXXII., fig. 11.

C. foliis coriaceis, ovalibus, basi obtusis, margine integerrimis; nervatione acrodroma, nervo primario prominente; nervis secundariis paucis, infimis suprabasilaribus curvatis, elongatis; nervis tertiariis transversis, inter se remotis.

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

Approaches to *Cinnamomum scheuchzeri*, Heer, from which it is distinguished only by the very much curved secondary nerves, which start at less acute angles. From these characteristics, the obtuse base of the leaf and the lesser number of the secondary nerves, the species of the New Zealand Chalk flora may be distinguished on the one hand from *C. intermedium*, m., of the New Zealand Tertiary flora, and on the other hand from the analogous *Cinnamomum heerii*, Lesq., of the North American Chalk flora.

Proteaceæ.

Knightiophyllum primævum, sp. nov.

Plate XXXII., fig. 12.

K. foliis coriaceis obovato oblongis, margine argute dentatis; nervatione camptodroma, nervo primario valido; nervis secundariis tenuibus, sub angulis 70°–80° orientibus, marginem versus flexuosis, fere evanescentibus; nervis tertiariis brevissimis rectangularibus, dictyodromis, vix conspicuis.

Locality: Grey River (?) (Otago Museum).

The fossil leaf before me appears on a dark slate, which is very similar to the slate from Grey River, which came to hand without designation of the locality. A considerably-charred substance on the impression indicates a rigid leathery texture. The shape of the leaf may be completed to an inverted oblong-oviform. The edge is preserved only in one place, where it shows close, rather uneven serræ, the points of which are rather blunt. From a pronounced primary nerve start at little-acute angles secondary nerves, which ascend in a curve towards the edge, and which are distant from each other about 10mm. These nerves become so fine in their further course that they are only visible under the microscope in a favourable light; at last these draw a short distance along the edge in a remarkable winding manner, without however forming visible loops. The tertiary nerves are in consequence of their fineness only preserved in a few places in the unfavourable stone, and consequently it is only perceptible that they dissolve in a confused reticulation of close meshes. The characteristics named indicate the genus *Knightia* (compare Ettingsh., "Leaves of the Apetalæ," Memoir, vol. xv., pl. 42 and 43), which, in our epoch, is only indigenous to New Zealand and New Caledonia. The fossil species seems to be distinguished from the most similar New Zealand *K. excelsa*, R. Brown, only by the inverted oviform-oblong leaves, and the secondary nerves, which ascend along the edge.

Our fossil is distinguished from the second species of this genus, the New Caledonian *K. strobilina*, R. Brown, only by the serrations of the edge of the leaf; but, as the shape of the leaf agrees more with the second species, we must assume that *Knightiophyllum primævum* according to its characteristics stands between both living species, and must consequently be considered as the parent plant of these.

A similar fossil leaf has appeared also in the Eocene flora at Dalton, near Gunning, in New South Wales, which I attributed to *Knightia*, and which I compared with *K. excelsa*, R. Brown ("Contributions to the Tertiary Flora of Australia," I. Memoir, vol. xlvii., p. 128; pl. iv., fig. 7).

Dryandroides pakawauica, sp. nov.

Plate XXXII., fig. 13.

D. foliis rigide coriaceis, lineari-lanceolatis, longe acuminatis serratis, nervo primario valido; secundariis sub angulis 60°–70° orientibus, ramosis; tertiariis inconspicuis.

Locality: Pakawau, Nelson (Canterbury Museum.) [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

The fossil leaf before me betrays a stiff leathery texture; it has a narrow lanceolate form, which is considerably elongated towards the top; there is a sharply-serrated edge. On the whole the characteristics are such as are found in those fossil leaves which we have so far ascribed to *Dryandroides*. The nervation, as far as it is preserved in the fossil described, does not contradict this designation, and consequently we may leave this fossil enrolled in the collective genus named until better material permits of more exact researches.

We may designate *Dryandroides latifolia*, Ett., from Niederschöna, of the European Chalk formation, as an analogous species.

DIALYPETALÆ.

Saxifragaceæ.

Ceratopetalum rivulare, sp. nov.

Plate XXXII., figs. 15, 16.

C. foliis simplicibus, petiolatis coriaceis, lanceolatis acuminatis, basi paullo angustatis, margine argute minute serratis; nervatione camptodroma, nervo primario prominente, recto; nervis secundariis sub angulis 50°–60° orientibus, ante marginem furcatis; nervis tertiariis e latere externo secundariorum angulo acuto egredientibus, tenuissimis.

Locality: Grey River, Westland (Canterbury Museum).

The fossil leaves here shown may belong to the same species, notwithstanding fig. 15 shows a smaller leaf, which is broader and somewhat ovate. The consistency was leathery; the petiole 11mm. long. The lamina is lanceolate, sometimes wider, sometimes narrower; the base is rather more obtuse, and almost broad and ovate, seldom somewhat narrowed; the top is long and narrowed; the edge is sharply serrated. A thickening of the points of the serræ, as it occurs in other species, is here not perceptible. The nervation runs in curves. The primary nerve is strongly pronounced along its whole course; the secondary nerves start at slightly-acute angles at a distance of 4mm.–5mm. from each other. Near the edge they are abruptly curved upwards, and mostly bifurcate. The tertiary nerves are very fine; they start at right angles from the outside of the secondary nerves. The reticulation has not been preserved.

The fossils described may best be compared with leaves of *Ceratopetalum*, and they approach remarkably to *C. macdonaldi*, Ett., of the Australian Tertiary flora, on the one hand, and to *C. bilinicum*, of the European Tertiary flora, on the other. It is distinguished from both species principally only by the secondary nerves, which are more distant from each other.

Tiliaceae.

Grewiopsis pakawauica, sp. nov.

Plate XXXII., fig. 21.

G. foliis parvis, coriaceis, ovatis, dense et inæqualiter crenulatis, basi subtruncatis, apice acuminatis; nervatione subactinodroma, nervo primario prominente excurrente, nervis basilaribus lateralibus 3–5, abbreviatis; nervis secundariis paucis sub angulis 40°–50° orientibus, 8mm.–14mm. inter se distantibus, craspedodromis, inferioribus extus ramosis, superioribus simplicibus vel furcatis; nervis tertiariis tenuissimis, sub angulis acutis emissis.

Locality: Pakawau, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv.; Hector.]

An ovate finely and unevenly notched leaf of firm consistency, the surface of which is peculiarly finely gibbous, and from this we may conclude that it may have been provided with a rough hairy covering. The nervation may be designated as imperfectly radiate, in consequence of the radius-shaped arranged but unequal basal nerves. The principal mid-nerve is strongly pronounced, and runs out to the apex; two basal nerves start from one side of it, and one from the other: these are short, and provided with a few outer branches. The larger of the lowest secondary nerves send off outer nerves, which are stronger than those of the basal nerves. The remainder of the secondary nerves, which start at acute angles, are either simple or bifurcate, and they run in faint curves to the notches of the edge. The tertiary nerves are very fine, simple, and joined at acute angles. The reticulation is not visible.

The fossil leaf described agrees best in its characteristics with *Grewiopsis*, and follows *G. orbiculata*, Sap., a species of the fossil flora of Sézanne which has small leathery leaves of a similar shape and nervation: these are however distinguished from the New Zealand species by the different nature of the edge and a smaller number of secondary nerves. *Grewiopsis haidenii*, Lesq., from the Dakota group of the North American Chalk flora, may be considered as a vicarious species.

SAPINDACEÆ.

Sapindophyllum coriaceum, sp. nov.

Plate XXXII., figs. 22, 23.

S. foliolis rigide coriaceis, lanceolatis inæquilateris, falcatis, basi angustatis, margine integerrimis ; nervatione camptodroma, nervo primario valido, nervis secundariis tenuibus, plerumque obsoletis.

Locality : Wangapeka, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., 1867 ; Hector.]

The fossil leaves before me (figs. 22, 23) from Wangapeka are without doubt part-leaflets : they betray a specially firm leathery texture ; they are lanceolate, and have remarkably uneven sides ; they are sickle-shape-curved, narrowed towards the base ; the edge is without serrations. It was impossible to ascertain the existence or non-existence of a petiole. Only a little of the nervation is perceptible in consequence of the thick, much-charred substance. The strongly-pronounced primary nerve becomes gradually smaller towards the top, and from it start fine curved secondary nerves.

I believe I do not make a serious mistake if I connect these remains of fossil leaves with the *Sapindaceæ*, a family the existence of which in the flora of former ages has been proved beyond a doubt. Moreover, this family is represented both in the Tertiary flora and in the flora now living in New Zealand. and the characteristics described of the fossils mentioned seem to agree best therewith. Future researches might throw more light upon this matter. We have an analogous plant in *Sapindus prodromus*, Heer, from the Atane strata of Greenland, which is distinguished from the species described only by the more delicate leaflets, which are less narrow at the base.

Cupanites novæ-zeelandiæ, sp. nov.

Plate XXXII., figs. 18, 20.

C. foliolis coriaceis, oblongis vel lanceolatis, basi obliqua rotundato-obtusis, apicem versus angustatis, margine integerrimis ; nervatione camptodroma ; nervo primario valido, recto ; nervis secundariis sub angulis 60°–70° orientibus, arcuatis marginem adscendentibus, simplicibus ; nervis tertiariis obsoletis.

Localities : Grey River, Westland (Canterbury Museum) : Pakawau, Nelson. [*Ex* Coll. N.Z. Geol. Surv. ; Hector.]

The oblique base and the only indicated inequality of the sides of these fossil leaves permit of the assumption that they are only part-leaflets of a composite leaf. The texture, as far as may be recognized from the nature of the impression, is leathery; the shape varies from broad to narrow lanceolate. Of the nervation, only the stout straight primary nerve, which narrows gradually towards the top, and the curved secondary nerves, which start at slightly-acute angles, are preserved. The secondary nerves are distant from each other 7mm.–12mm.

I take these fossils to be part-leaflets of *Sapindaceæ*, and I ascribe them to *Cupanites*, where similar part-leaflets occur—for instance, as in *C. miocenicus*, *C. neptuni*, and others.

Celastrineæ.

Celastrophyllum australe, sp. nov.

Plate XXXII., fig. 14.

C. foliis coriaceis petiolatis, obovatis, basin versus angustatis, apice rotundato-obtusis, margine serrulatis; nervatione camptodroma; nervo primario distincto, basi prominente, recto; nervis secundariis tenuibus, sub angulis 50°–60° orientibus; nervis tertiariis obsoletis.

Locality: Grey River, Westland (Canterbury Museum).

A leathery, inverted-ovate leaf, which narrows into the petiole. The edge is finely serrate, the nervation is curved, and the fine secondary nerves start at slightly-acute angles. The tertiary nerves are not preserved. I suppose that this leaf belongs to *Celastrus*, but for the present I enroll it in the collective genus *Celastrophyllum* until better-preserved remains permit of a more exact designation.

Celastrophyllum crenatum, Heer, from the Patoot strata of the Chalk flora of Greenland, seems to be an analogous species.

Papilionaceæ.

Dalbergiophyllum rivulare, sp. nov.

Plate XXIX., fig. 4.

D. foliolis coriaceis ovatis, inæquilateris, apice acuminatis, margine integerrimis; nervatione camptodroma, nervo primario basi prominente, apicem versus attenuato, excurrente; nervis secundariis paucis, sub angulis acutis variis egredientibus, curvatis adscendentibus; nervis tertiariis obsoletis.

Locality: Grey River, Westland (Canterbury Museum).

A part-leaflet of leathery texture which, according to shape and nervation, may be best enrolled with the *Papilionaceæ*, and especially with the *Dalbergiæ*. The comparison of these with leaflets of the division named leads to the genera *Andira*, *Trioptolemæa*, *Pterocarpus*, *Hecastophyllum*, and *Machærium*. A closer limitation of the analogues is only possible when more completely preserved remains are submitted. *Dalbergia rinkiana*, Heer, from the Atane strata of Greenland, seems to be more nearly related to the species described.

Dalbergiophyllum nelsonicum, sp. nov.

Plate XXIX., fig. 3.

C. foliolis coriaceis, oblongis, basi inæqualibus, apice acuminatis, margine integerrimis; nervatione camptodroma, nervo primario valido; nervis secundariis pluribus, approximatis; nervis tertiariis obsoletis.

Locality: Wangapeka, Nelson (Canterbury Museum). [*Ex* Coll. N.Z. Geol. Surv., 1867; Hector.]

A part-leaflet which betrays especially a similarity with those of the *Pterocarpus* and *Machærium* species. The texture is rather more firm than that of the species previously described; the shape is narrower; the inequality of the sides is less. The primary nerve is very stout. The secondary nerves, which may only be perceived with difficulty on the charred substance of the fossil, are numerous and close to each other.

CÆSALPINIEÆ.

Palæocassia phaseolitoides, sp. nov.

Plate XXXII., fig. 17.

C. foliolis coriaceis petiolulatis, oblongis vel ovato-lanceolatis, basi obliquis, apice acuminatis, margine integerrimis; nervatione camptodromis, nervo primario distincto prominente; nervis secundariis sub angulis 50°–60° orientibus, tenuibus; nervis tertiariis obsoletis.

Locality: Grey River, Westland (Canterbury and Otago Museums).

Part-leaflets which, according to their shape and nervation, agree perfectly with those of *Cassia pseudo-phaseolites*, m., of the Tertiary strata of Shag Point, New Zealand, but they are distinguished from these by a firm leathery texture. It is quite possible to assume the connection of this species as regards genus with the Tertiary species named. It is, however, doubtful if the Chalk parent species may be enrolled with the same genus as the Tertiary descending species until further actual proofs of this are before us.

I consider *Palæocassia angustifolia*, Ett., from the strata of Niederschöna, as a vicarious species of the European Chalk flora.

DESCRIPTION OF PLATES XXIV.-XXXII.

Plate XXIV.

Figs. 1, 2. *Lomariopsis dunstanensis*, Ett., Dunstan.
Fig. 3. *Aspidium otagoicum*, Ett., Shag Point.
Fig. 4, 4a. *Aspidium tertiario-zeelandicum*, Ett., Dunstan.
Figs. 5–7. *Sequoia novæ-zeelandiæ*, Ett. (Fig. 5, Shag Point; figs. 6, 7, Landslip Hill.)
Figs. 8, 9. *Pinus* (?), Shag Point.
Fig. 10. *Zamites* sp.? Shag Point.
Fig. 11. *Taxodium distichum eocenicum*, Ett., Shag Point.
Figs. 12–14. *Podocarpus parkeri*, Ett., Shag Point.
Figs. 15–17. *Podocarpus hochstetteri*, Ett., Shag Point.
Fig. 18. *Araucaria danai*, Ett., Shag Point.
Fig. 19. *Dacrydium præcupressinum*, Ett., Shag Point.
Figs. 20, 21. *Dammara uninervis*, Ett., Shag Point.
Figs. 22–24. *Dammara oweni*, Ett., Shag Point.
Fig. 25. *Seaforthia zeelandica*, Ett., Dunstan.

Plate XXV.

Figs. 1–2. *Araucaria haastii*, Ett., Shag Point.
Fig. 3. *Dammara oweni*, Ett., Malvern Hills.

Plate XXVI.

Figs. 1–3. *Caulinites otagoicus*, Ett., Shag Point.
Figs. 4, 5. *Casuarina deleta*, Ett., Shag Point.
Figs. 6–12. *Myrica præquercifolia*, Ett., Shag Point.
Fig. 13. *Myrica subintegrifolia*, Ett., Shag Point.
Fig. 14. *Myrica proxima*, Ett., Malvern Hills.
Figs. 15–17. *Alnus novæ-zeelandiæ*, Ett., Shag Point.
Fig. 18. *Fagus lendenfeldi*, Ett., Malvern Hills.
Fig. 19. *Dryophyllum dubium*, Ett., Landslip Hill.
Figs. 20–22. *Quercus lonchitoides*, Ett. (Fig. 20, Murderer's Creek; figs. 21, 22, Shag Point.)
Fig. 23. *Quercus parkeri*, Ett., Shag Point.
Fig. 24. *Quercus celastrifolia*, Ett., Shag Point.
Fig. 25. *Quercus deleta*, Ett., Shag Point.

Plate XXVII.

Fig. 1. *Fagus ninnisiana*, Ung., Shag Point.
Figs. 2, 3. *Fagus lendenfeldi*, Ett., Malvern Hills.
Figs. 4, 5. *Fagus ulmifolia*, Ett., Shag Point.
Fig. 6. *Dryophyllum dubium*, Ett., Landslip Hill.
Fig. 7. *Ficus sublanceolata*, Ett., Shag Point.
Fig. 8. *Ulmus hectori*, Ett., Shag Point.
Fig. 9. *Planera australis*, Ett., Malvern Hills.
Fig. 10. *Daphnophyllum australe*, Ett., Weka Pass.
Fig. 11. *Laurophyllum tenuinerve*, Ett., Shag Point.
Fig. 12. *Santalum subacheronticum*, Ett., Shag Point.
Fig. 13. *Apocynophyllum affine*, Ett., Landslip Hill.
Figs. 14–18. *Dryandra comptoniæfolia*, Ett., Murderer's Creek.
Fig. 19. *Hedycarya præcedens*, Ett., Shag Point.
Figs. 20–22. *Cinnamomum intermedium*, Ett., Shag Point.

Plate XXVIII.

Fig. 1. *Apocynophyllum elegans*, Ett., Landslip Hill.
Fig. 2. *Loranthus otagoicus*, Ett., Shag Point.
Fig. 3. *Sapindus subfalcifolius*, Ett., Redcliffe Gully.
Fig. 4. *Diospyros novæ-zeelandiæ*, Ett., Shag Point.
Fig. 5. *Dalbergia australis*, Ett., Shag Point.

Fig. 6. *Cassia pseudo-memnonia*, Ett., Shag Point.
Fig. 7. *Acer subtrilobatum*, Ett., Shag Point.
Fig. 8. *Cissophyllum malvernicum*, Ett., Malvern Hills.
Figs. 9–12. *Dryandra comptoniæfolia*, Ett., Murderer's Creek.
Figs. 13, 14. *Aralia tasmani*, Ett., Shag Point.

Plate XXIX.

Fig. 1. *Elæodendron rigidum*, Ett., Landslip Hill.
Fig. 2. *Sapindus subfalcifolius*, Ett., Shag Point.
Fig. 3. *Dalbergiophyllum nelsonicum*, Ett., Wangapeka.
Fig. 4. *Dalbergiophyllum rivulare*, Ett., Grey River.
Fig. 5. *Eucalyptus dubia*, Ett., Shag Point.
Fig. 6. *Cassia pseudo-phaseolites*, Ett., Shag Point.
Figs. 7–9. *Carpolithes otagoicus*, Ett., Shag Point.
Figs. 10–12. Wood-tissue of *Araucaria haastii*, Ett. (350 diameters.)
Figs. 13–15. Wood-tissue of *Dammara oweni*, Ett. (350 diameters.)

Plate XXX.

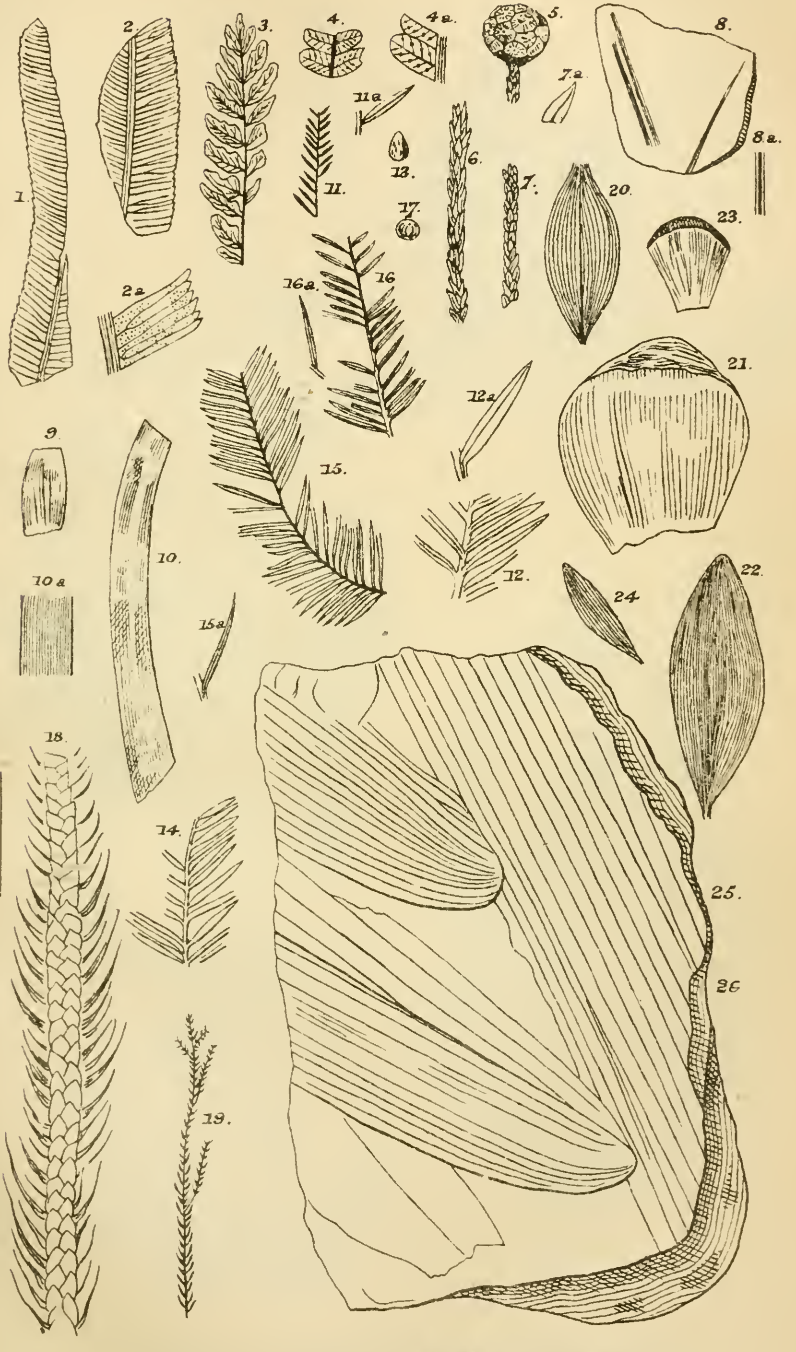
Fig. 1. *Blechnum priscum*, Ett., Pakawau.
Figs. 2, 3. *Aspidium cretaceo-zeelandicum*, Ett., Pakawau.
Figs. 4–6. *Dicksonia pterioides*, Ett., Pakawau.
Fig. 7. *Gleichenia obscura*, Ett., Pakawau.
Figs. 8–10. *Podocarpium tenuifolium*, Ett., Pakawau.
Fig. 11. *Podocarpium cupressinum*, Ett., Pakawau.
Fig. 12. *Podocarpium prædacrydioides*, Ett., Pakawau.
Figs. 13–15. *Podocarpium ungeri*, Ett., Pakawau.
Fig. 16. *Taxo-torreya trinervia*, Ett., Wangapeka.
Figs. 17, 18. *Dacrydinium cupressinum*, Ett., Pakawau.
Fig. 19. *Ginkgocladus novæ-zeelandiæ*, Ett., Wangapeka.
Fig. 20. *Dammara mantelli*, Ett., Pakawau.
Fig. 21. *Bambusites australis*, Ett., Pakawau.
Fig. 22. *Poacites nelsonicus*, Ett., Wangapeka.

Plate XXXI.

Figs. 1–3. *Bambusites australis*, Ett., Pakawau.
Fig. 4. *Flabellaria sublongirhachis*, Ett., Grey River.
Fig. 5. *Haastia speciosa*, Ett., Pakawau.
Figs. 6, 7. *Casuarinites cretaceus*, Ett. (Fig. 6, Pakawau ; fig. 7, Grey River.)
Fig. 8. *Quercus pachyphylla*, Ett., Grey River.
Fig. 9. *Quercus calliprinoides*, Ett., Wangapeka.
Fig. 10. *Quercus nelsonica*, Ett., Wangapeka.
Fig. 11. *Dryophyllum nelsonicum*, Ett., Pakawau.

Plate XXXII.

Fig. 1. *Fagus producta*, Ett., Pakawau.
Figs. 2–5. *Ulmophylon planeræfolium*, Ett., Pakawau.
Figs. 6–8. *Ulmophylon latifolium*, Ett., Pakawau.
Fig. 9. *Fagus nelsonica*, Ett., Wangapeka.
Fig. 10. *Ficus similis*, Ett., Wangapeka.
Fig. 11. *Cinnamomum haastii*, Ett., Pakawau.
Fig. 12. *Knightiophyllum primævum*, Ett., Grey River.
Fig. 13. *Dryandroides pakawauica*, Ett., Pakawau.
Fig. 14. *Celastrophyllum australe*, Ett., Grey River.
Figs. 15, 16. *Ceratopetalum rivulare*, Ett., Grey River.
Fig. 17. *Palæocassia phaseolitoides*, Ett., Grey River.
Figs. 18–20. *Cupanites novæ-zeelandiæ*, Ett., Grey River.
Fig. 21. *Grewiopsis pakawauica*, Ett., Pakawau.
Figs. 22, 23. *Sapindophyllum coriaceum*, Ett., Wangapeka.



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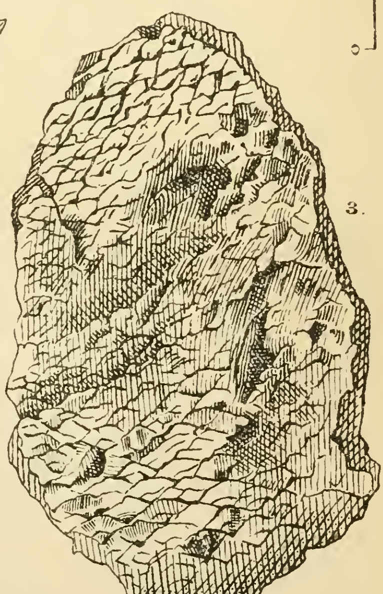

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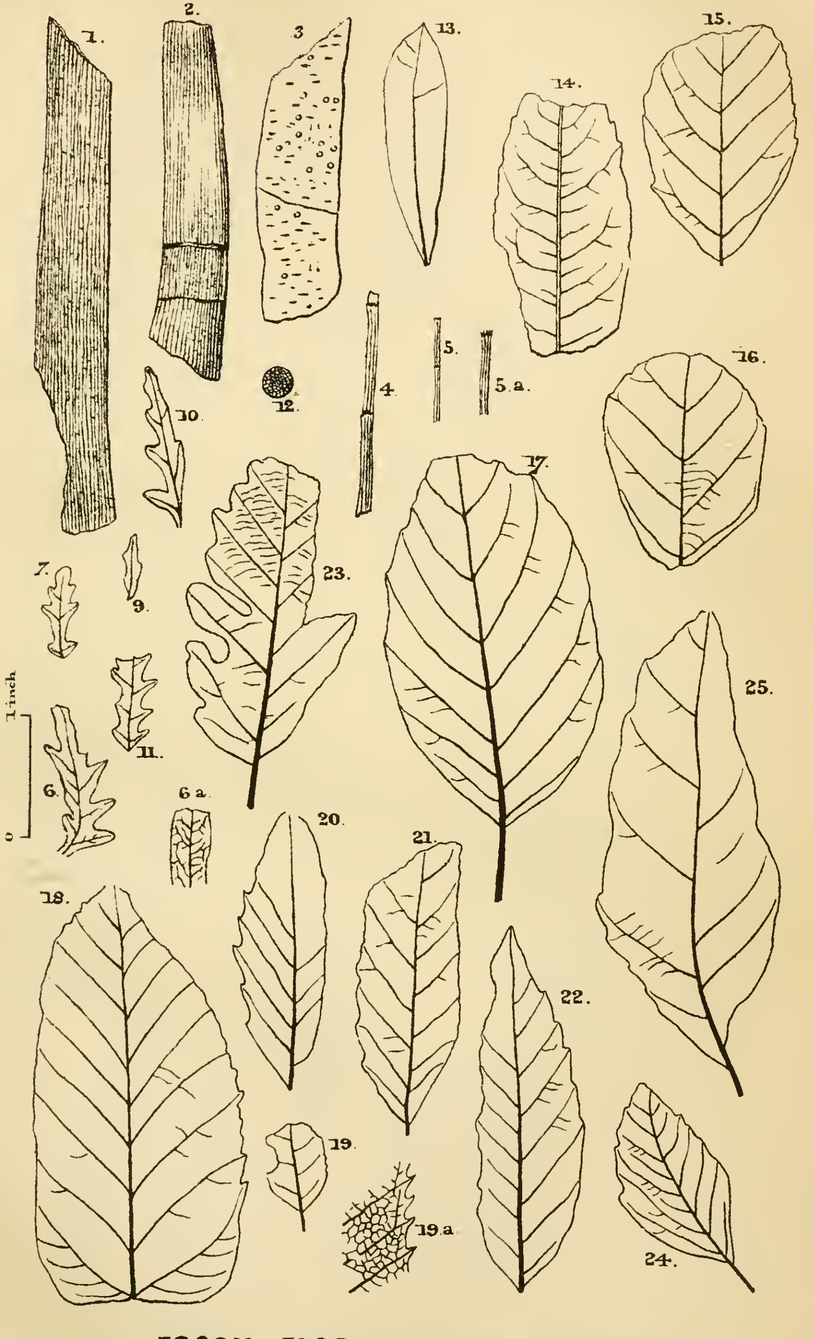

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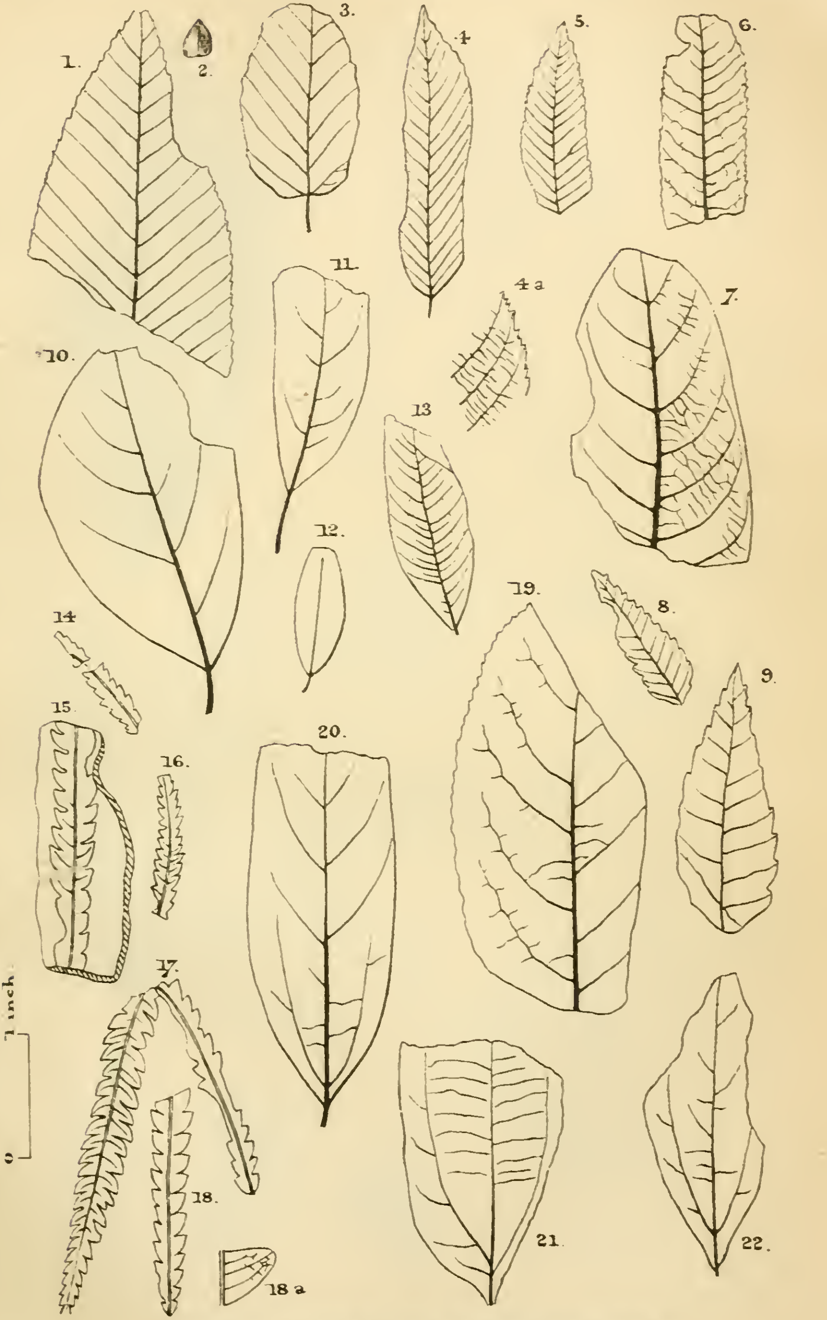

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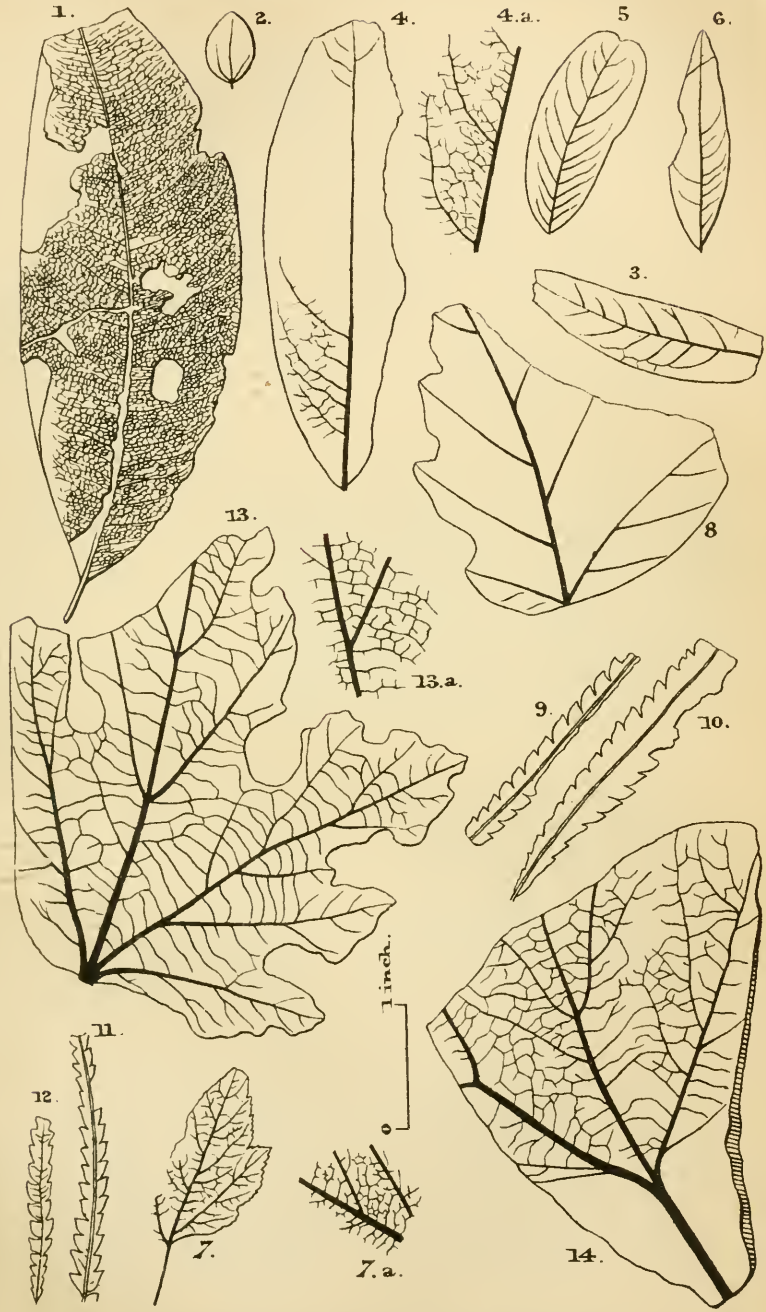

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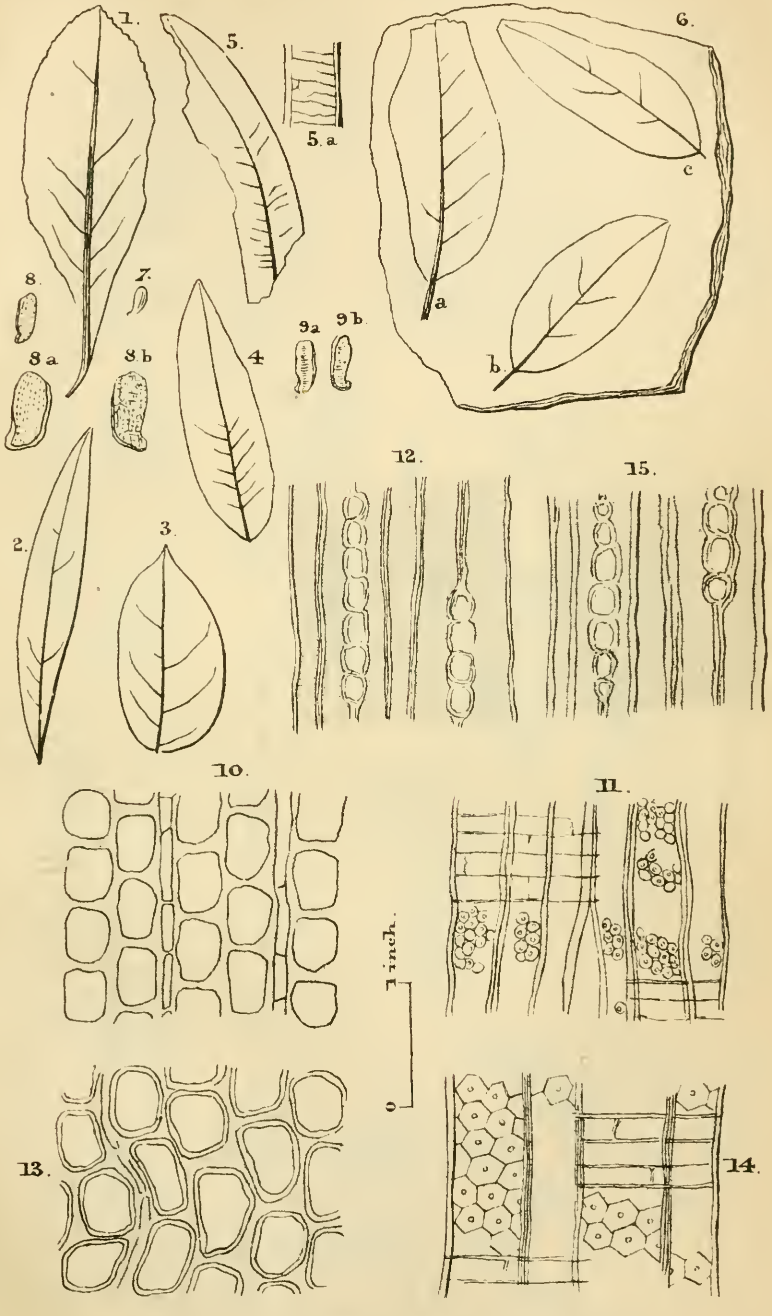

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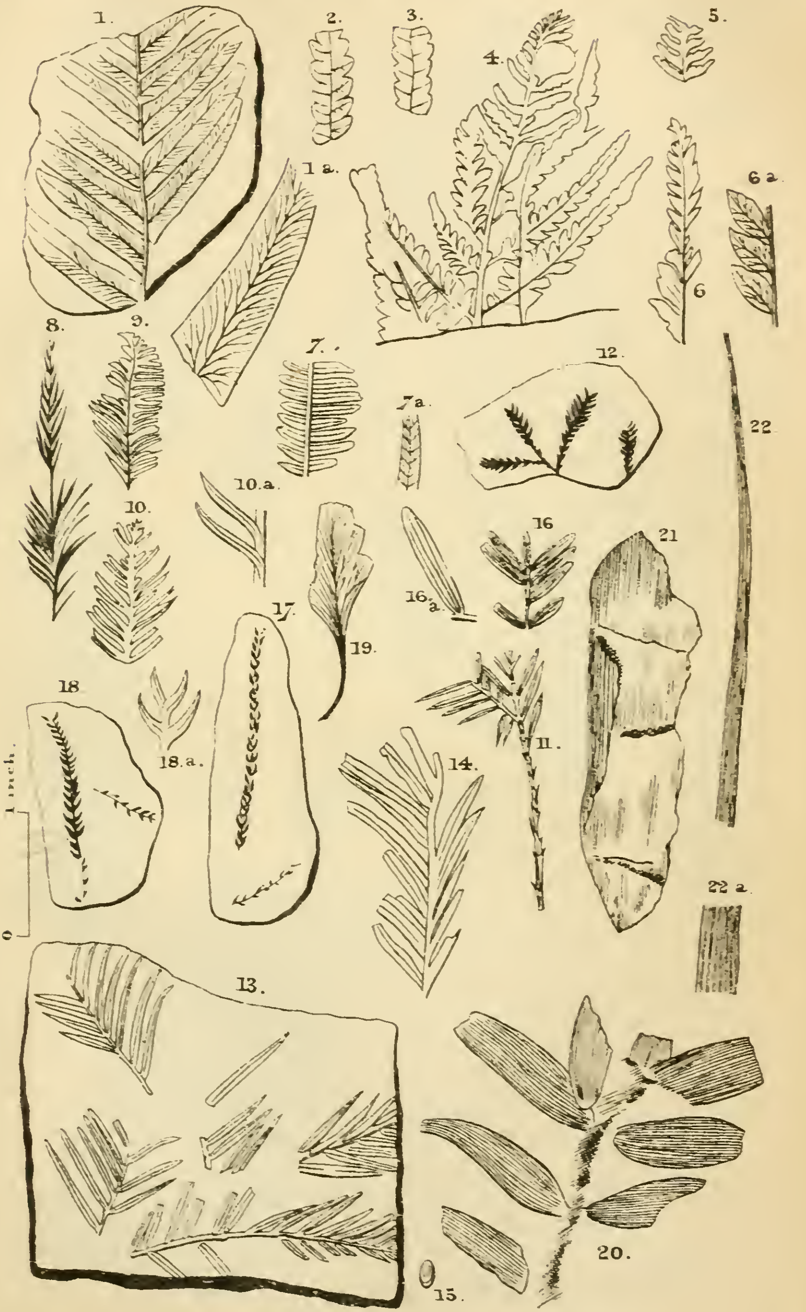

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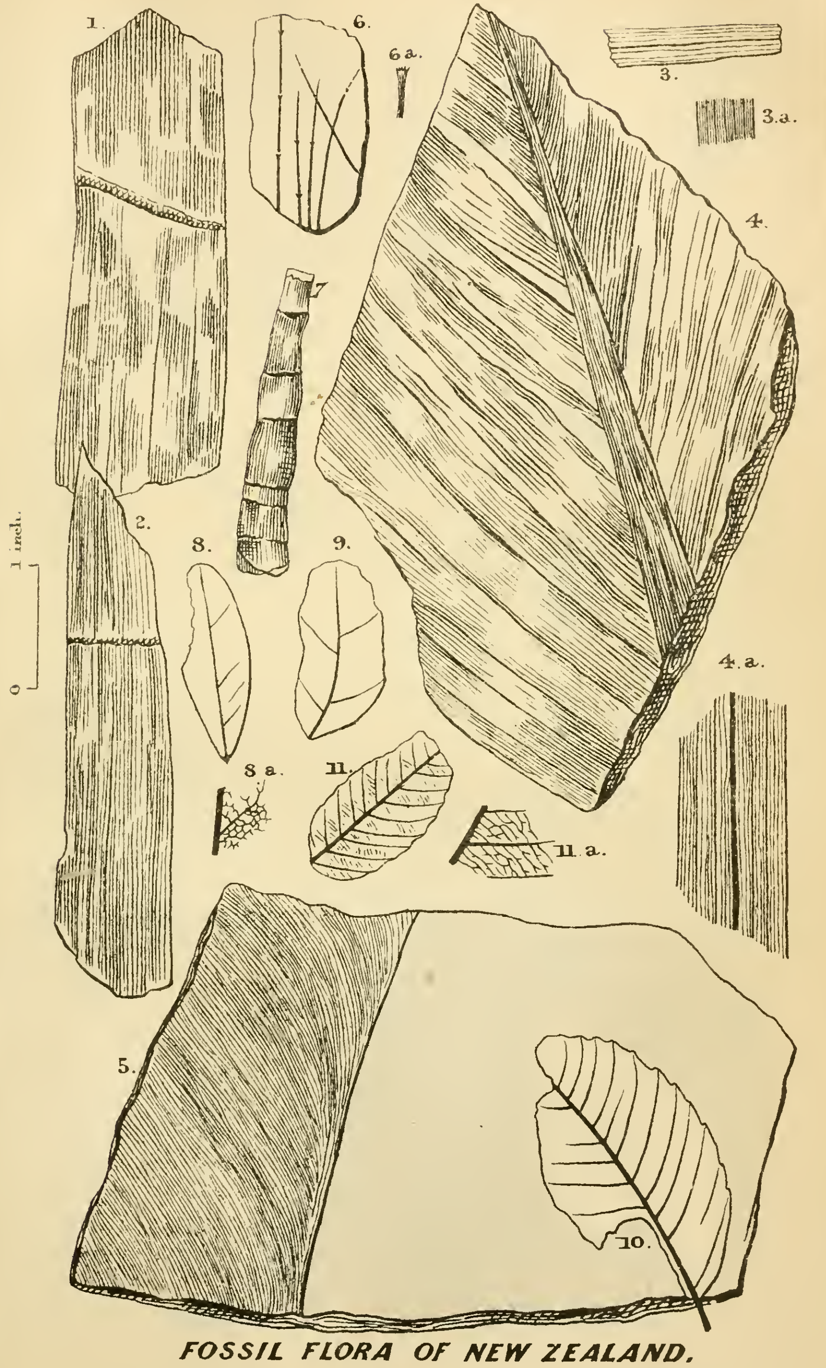

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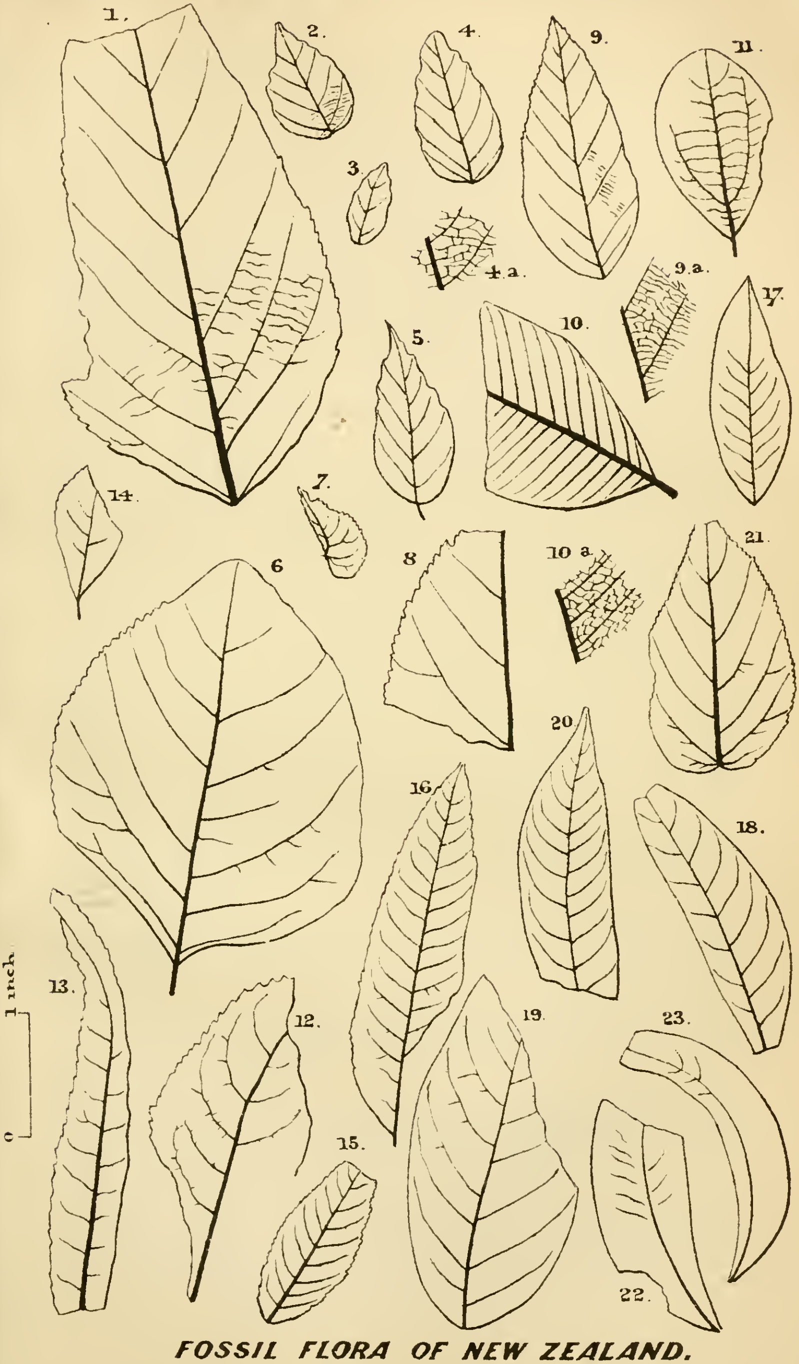

FOSSIL FLORA OF NEW ZEALAND.

Art. XXX.—*On the Drift in South Canterbury.*

By J. Hardcastle.

[*Read before the Philosophical Institute of Canterbury, 3rd July, 1890.*]

The Transactions of the earlier seventies show that fifteen to twenty years ago the glacial or great glacier period of New Zealand was a favourite topic of discussion with members of the Institute. Since then the subject appears to have been laid aside, though it was by no means threshed out, differences of opinion remaining as to both the cause and the extent of the glaciation. In the course of the controversy the following remark was made by Mr. A. D. Dobson: "I believe that a careful examination of the drift-formation of New Zealand generally will throw a great deal of light upon many points at present unsettled, and that until the age of the drift is satisfactorily settled we may speculate in vain upon the origin of the glacial period."* Having long been familiar with what I take to be portions of the formation Mr. Dobson referred to, in South Canterbury, it occurred to me on meeting with Mr. Dobson's remark recently that a few notes on the drift of this district would be acceptable to members of the Institute. I propose to go over somewhat wider ground than the drift-formation only, sufficiently to trace, to the best of my ability, its relations to the preceding and succeeding formations, and, viewing the drift as the record of a particular condition of climate, my notes will have special reference to the changes of climate registered by the deposits dealt with.

In the plains and downs of South Canterbury east of the ranges, omitting recent and incomplete deposits, we have, in descending order,—

1. The great shingle-fans of the plains, including smaller fans laid down by the smaller rivers, such as the Hare, Waihi, and Opihi.

2. An extensive but irregular deposit of loess, upon areas elevated above the reach of the fan-building rivers.

3. Sheets and streams of doleritic lavas at two points, Timaru and Geraldine.

4. The drift, a vast mass of stream-laid gravel and sand, with interstratified clays and silts, the shingle highly oxidized and decomposed, the whole formation greatly denuded, and more or less disturbed by subterranean action.

5. A series of fresh-water beds of totally different kind, these being almost wholly of fine material. These beds also show local, and almost certainly independent, disturbance.

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* Trans. N.Z. Inst., vol. vii., 1874, p. 444.

6. Fine-bedded, loose, rusty, unfossiliferous sands, which appear to be rearrangements by fresh-water of portions of (7).

7. Fossiliferous sands of the Pareora (marine) formation.

Working upward again, at the upheaval of the Pareora sea-bed as a starting-point, we commence with a temperate, or rather warm, climate, as shown (according to the authorities) by the character of the Pareora fossils. This evidence of the shells is fully corroborated by that of the physical character of the marine beds close to steep mountains. The inorganic material is uniformly fine ; there is no evidence of frost-work in gravels, conglomerates, or breccias.

The emergence of a sandy sea-bed would certainly be followed by the rearrangement of some portions of it by rains and streams, and to such a process, I think, must be referred certain loose, rusty, fine-bedded, unfossiliferous sands, seen in terrace sections in the valley of the Tengawai between Pleasant Point and the Cave ; under the gouged western face of Mount Horrible, and elsewhere. These fine-bedded sands are of no great thickness, under 20ft. probably, as a rule, and they rest upon sands of the same mineral character, but fossiliferous, and massive instead of fine-bedded.

Deposited conformably upon the rearranged sands in the Tengawai sections is a series of fresh-water beds, showing 150ft. or 200ft. in thickness in one exposure—Howell's Bluff —and they may have been much thicker. These beds consist of alternations of silts, clays, white sands and grits, and dirt-beds. Some of the clays are full of beautiful plant-impressions, and these should tell an instructive story to the botanist. The physical characters of the beds, however, sufficiently attest the warmth of the climate during their deposition. The white grits perhaps supply the clearest and simplest evidence. They aggregate, in the Howell's Bluff section, 30ft. or 40ft., in three principal layers. The coarser grits are quite loose, and well sorted and stratified. The fragments range in size up to that of small peas. Most of them are well waterworn, but a considerable percentage are quite angular, only a little worn. These are easily recognized as vein-quartz, and they suggest that the whole of the quartz—grits and sands—was derived from the highly metamorphosed, intricately-veined, slaty or schistose rocks of The Brothers Mountain, four or five miles away. Save for some rolled pellets of clay containing carbonized vegetable matter, the grit beds are of pure quartz, and the total absence of slate pebbles shows clearly that in the denudation of the mountain, by which the quartz was set free, frost played no part. The whole series appears to have been of slow growth, and there are marks of several pauses in its deposition, in the dirt-beds and drought-veined surfaces of clay-beds. Beyond the Cave, on the opposite side of The Brothers Mountain, is a seam of good lignite, about 2ft. thick, associated with a dirt-bed of greater thickness, and white sands and clays. These rest upon a denuded surface of blue fossiliferous (Pareora) sand-rock, and the two formations have been steeply tilted together. The fresh-water and carboniferous beds must belong to the same period as those lower down the river, and I feel sure some of the lignites of the Upper Kakahu are of the same age. Silts, clays, and sands resembling those of the Tengawai (but with less whitish material), with a dirt-bed, and a seam or pocket of lignite near the base, are exposed in the south bank of the Hare River, near Geraldine. This section contains two or three thin beds of quartz-gravel, with some admixture of sandstone pebbles. The quartz is evidently vein-quartz; much or most of it is angular, and, as the section is only two or three miles from hills of slaty rocks that yield readily to frost, these beds, equally with those of the Tengawai, show that during the time of their deposition a practically if not perfectly frostless climate prevailed in this region. The base of the Hare beds is not exposed, but in sinking through the denuded crown of the arch into which they have been thrown, some years ago, in search of lignite, I soon reached loose red sands, resembling those I have since seen beneath the Tengawai fresh-water beds. I have no doubt there are other exposures of these beds, but the two described are the only ones I have examined.

The Tengawai beds were disturbed and denuded before any later beds of different material were deposited upon them. No such gap of unconformability exists in the Hare section, where the fine-grained series is regularly overlain by red gravels of the succeeding formation. The junction has been brought into view by denudation following a disturbance which elevated both together into an independent anticlinal fold.

This brings us to the red gravels, which I take to be the "drift," or "dispersed gravels," of writers in the Transactions and Geological Reports. As these terms, however, seem to imply a partial or complete ignorance of the mode of origin and deposit of this formation, neither of which does there seem any necessity for admitting so far as the red gravels of South Canterbury are concerned, I prefer to avoid them, and to use the descriptive term "red gravels." They form "red cliffs" everywhere.

In South Canterbury the red gravels, usually with a covering of loess, form a large part of the country east of the ranges, generally in the shape of downs, whose easy contours and good loess soil make them first-rate agricultural country. They have been greatly denuded, cut into by streams, and their structure is exposed in many fragmentary natural sections, and on a smaller scale in numerous road-cuttings. I have examined them in the Geraldine, Waitohi, and Cave–Albury downs, and in the Timaru plateau. The same formation stretches from Albury to Fairlie Creek, and from Timaru to Waimate. Everywhere near the hills the gravels present the same broad features—beds of stream-laid subangular shingle, and sand, separated by clays and silts. In places the formation is hundreds of feet in thickness; in Geraldine Hill, I believe, nearly, if not over, 1,000ft., and in the Cave–Albury downs it must be over 500ft. Generally the shingle is coarser and the clays less numerous towards the top. Wherever I have examined them the gravels are unquestionably stream-laid, and generally, I believe, are of quite local origin. The Geraldine downs, however, contain pebbles of a volcanic rock, which must have come from somewhere northward, and across existing drainage-lines. (These are pebbles of a dense, tough, micro-crystalline rock, black in colour, with minute white specks; the stone weathers to a pale blue, of chalky softness.) I have read that there is volcanic rock at the head of the Orari. There is none in the hills opposite the Geraldine downs. At Timaru, the point furthest from the hills where the red gravels appear, only the upper portion is exposed to observation, the formation sloping just down to sea-level. Here the shingle is largely replaced by finer material. About two miles inland is a gravel-pit, disclosing about 30ft. of the uppermost beds, two-thirds or so of which are of silts and clays, the rest of small shingle, in two layers. The silts are fine-bedded, and at more than one level contain vestiges of having been vegetated. A boring put down at the freezing-works—commencing at the bottom of a bricked well sunk 43ft. into the gravels, the nature of which was not recorded—passed through 40ft. of shingle, 39ft. of clay, and 25ft. of sand, each in several layers. The thickest bed was of fine yellow clay, 12ft., the base of which for about 1ft. was stained dark-brown as if by humus, and contained the rust-granules common in wet soils. The clays near the hills vary from a few inches to 10ft. or 12ft. in thickness, and they vary much in character, some being fine and white, others blue, most of them yellow, and of all degrees of coarseness up to silt. In some places beds of clay show abrupt changes of thickness, as if from contemporary denudation. Some of the beds show drought-veins in their upper surfaces, the mark of their having been for a considerable period persistent land-surfaces under a dry climate. The silts have the character of flood-deposits, and some of the clays probably had a similar origin. Others require further examination to decide whether they are not really loess of the same kind which afterwards overspread so much of the formation, *i.e.*, wind-blown dust. One of the clay-beds related to the red gravels appears to be of this nature. It underlies the dolerite at Mount Horrible, and directly overlies rearranged marine sands, at a spot which must always have been above the reach of rivers. The only doubt as to this being a loess-bed is founded on the possibility of its being a slope-deposit, or rain-wash, from some eminence which has since been removed.

The shingle is everywhere highly oxidized and much decomposed. It is somewhat harder as well as coarser near the hills; but generally, and the smaller shingle everywhere, is too rotten to be of any use for road-making. At Timaru, pebbles whose smooth surface shows that they were once hard enough to take a fine polish can now be cut with a knife like chalk.

The great quantity of the red gravels implies a correspondingly great denudation of the neighbouring mountains, from which the material was derived, plus a liberal allowance for finer material carried further away. The greater part of the formation being of shingle is proof that frost was the agent of denudation. Large deposits of river-shingle can only be produced in one way—by frost and thaw breaking up the surface of mountains steep enough to enable gravity to deliver the spoil to streams sufficiently powerful to transport it so long as their channels are confined and the fall great, but not powerful enough to transport it all when the fall is reduced and the channels become indefinite. The form of deposit—except in deltas, and these are not deltas—is necessarily the fan, modified, it may be, by the work of other streams or by obstructive eminences. From my observations I conclude that in the red gravels of South Canterbury we have the decomposed, disturbed, and denuded remains of a coalescing system or systems of fans, laid down by small streams issuing from the neighbouring low ranges, as the larger fans of the plains were laid down by the larger rivers at a later date.

Mr. Sandham Gillingham, who owns an estate on the Albury–Fairlie Creek downs, and who has paid much attention to their formation, is also of opinion that those downs were piled up by the streams which now intersect them. It appears, therefore, that at some time long subsequent to the upheaval of the Pareora sea-bed, a warm climate having prevailed during the interval, a profound change of climate set in, and King Frost began a long and vigorous reign, though perhaps not continuous, whose history is writ large in these red gravels.

The question now to be asked is: What degree of cold was concerned in the production of these gravels? Are they the product and record of a glacial period in the Southern Hemisphere?

The gravels themselves, so far as I am acquainted with them, contain no evidence of even the proximity of glaciers. It seems, however, difficult to believe that an area in which was produced such a massive record of frost-work could have been far removed from a region where glaciers and ice-fields existed at as low a level. In default of direct evidence on the point, we could hardly doubt that the frosts which effected such great denudation were much more severe than those experienced in the same localities to-day. We may safely assume that the eastern ranges, having been exposed to the action of the sea as promontories or islands for a prolonged period under a warm climate, had become extremely rugged and precipitous, and that, consequently, when the frosts did begin to work upon them, they would do so under great advantages.

Still, such frosts as we now have, though working under such favourable conditions, could hardly produce chips for shingle-making in such quantities as to overload the streams and compel them to lay out fans. There is, however, some direct evidence in the gravels that, at a certain stage at all events, the frosts were much more severe than they now are. In two or three of the beds of shingle, separated by clays, in the Geraldine downs, there are numerous lumps of white silty clay, so large, so irregular in shape, and so distributed among the shingle, that their sizes, forms, and pell-mell positions can only be explained by the supposition that they are pieces of the bed of a lake or pool, picked up and transported by being frozen to and buoyed up by thick ice, and were deposited where they are by stranding or the loss of their buoys. There are also numerous smaller rolled pieces, some of silt so incoherent—some even of coarse sand—that they could not have withstood rolling along a shingle river-bed unless they were cemented by ice. The larger pieces—some of them 6ft. long by 2ft. thick—could not have been floated, ice-buoyed, through the rough channels of the stream within the mountains; they must have been picked up below the gorges. In them, therefore, we have evidence of winters in the lowlands so severe that they may well have been related to the existence of great ice-fields and glaciers in the alpine regions and at lower levels in the south of the island.

As moraines and boulder-clays are perhaps the most trustworthy and most easily-recognized marks of glacier work, it is desirable that search should be made for such deposits of the red-gravel age, as indices of the extent of the glaciation during that age. Such indices might be hopefully looked for in Otago; and it appears to me that one has been found there.

In the Progress Report of the Director of the Geological Survey for 1887, p. xxxix., there are described as existing on the eastern side of the Taieri Plain "coarse, angular breccia beds, apparently of glacier origin, the age of which has never yet been clearly determined." These beds cover a good deal of ground, and range up to 800ft. in thickness. "At the back of Henley," says the report, "the deposit is composed of exceedingly angular material, often containing blocks of great size, 5ft. to 10ft. and 12ft. in diameter, and is but loosely compacted together, the irregular spaces between the confusedly-heaped angular blocks being often filled with finer material." This is a description of a glacier moraine, and of nothing else. These beds, it is stated, have been disturbed and invaded by volcanic rock; so also have the red gravels here. In Haast's "Report on the Formation of the Canterbury Plains" (1864)—Dr. Haast having in his mind but one glaciation, and clear distinctions could not be expected—there are one or two glacial deposits mentioned in such wise as to suggest that they probably belong to the red-gravel age, and if so are indices of the severity of the climate of that age. Writing of the earliest work and greatest extension of the glaciers of Canterbury, he says (p. 5), "The glaciers . . . began to fill all the existing valleys to the plains, and even advanced beyond, spreading in the plains in a fan-like shape. Of this occurrence, however, we have very little proofs, if it be not that the older glacier deposits in the bed of the Rangitata, several miles below the gorge, and some others rising above the plains between the Malvern Hills and the Waimakariri, belong to that period." As the Rangitata deposits are in "the bed of the river," they probably, as we shall see further on, are of red-gravel age. The other deposits alluded to are no doubt Little Racecourse Hill and Trigpole Hill, described on page 46 as morainic; and on page 47 Haast clearly refers them to some period antecedent to his Pleistocene glaciation.

If these morainic deposits do belong to the red-gravel age, they seem to show that that period was more severe than the later cold age. This is not in agreement with my observations in the South Canterbury lowlands so far, for I have found no signs of local glaciation within the red-gravel formation, while there are proofs that the same area was glaciated during the second cold age. It is, however, quite possible that the contradiction is only apparent. A less severe climate prevailing for a long time may produce longer glaciers, where glaciers are produced at all, than one which, whilst of sufficient severity to glaciate lower lands, persists but a short time.

I have not had time or opportunity to look through other reports for mention of morainic beds that may be of red-gravel age, but I have somewhere met with mention of "large angular blocks" in the drift of North Canterbury. The glacier relics of one age are apt to be destroyed or obscured by glaciers of a later and severer age—and there has been a severer age; but as there appears to have been a considerable amount of seismic disturbance in the interval between the two cold periods, moraines or other glacier beds of the earlier or red-gravel period may here and there have been lifted above, or otherwise shifted out of the way of destruction.

The total duration of the first cold age must have been very great, to permit of the accumulation of so massive a record of the work of frost by streams having only small drainage-basins, and the duration must have been all the greater, as the accumulation was certainly not continuous. Some of the clays were evidently for long periods persistent land-surfaces; in the Fairlie Creek downs there are two lignite-beds in the formation, and, I am informed, in the Pareora downs remnants of a forest or bush in petrified wood. I have not yet given much attention in the field to the evidences of variations of climate within the period, but, from what I have seen, I think it likely that a good deal of evidence may be obtained on this point.

If we compare the red gravels of South Canterbury with the later fans in the same localities, it is clear that the older formation, as to bulk, is much the more important of the two. This being so, we are compelled to ask, What has become of the related larger masses which must have been laid down by the larger rivers north of the Orari? The reply must be that they are buried under the later fans which form the surface of the plains; and I find in Haast's report, above quoted, some facts recorded which tend to prove, not only that the Canterbury Plains belong to two periods, but that the greater portion of the whole was laid down during the earlier period. In describing sections presented by vertical faces of the north bank of the Rangitata, the report says (page 39): "The shingle of the Pleistocene fans shows an equal change from the natural bluish tint to one of a rusty dark-yellowish colour, which coats the whole deposit. I have found in several rivers that the change from one colour to the other is often rapid, the dark-yellow shingle underneath being divided from the bluish at the summit by a very distinct line, sometimes with a small bed of loam between them, over which, at numerous spots, small watercourses are dripping down." Under the head of "Ashburton," page 40, Haast writes of terraces on the north bank, in the broad valley of the river, and says: "In some slips in these terraces a distinct line of demarcation is visible between the shingle and gravel of different colours, blue shingle in its natural colour lying above, with ferruginous beds of the same material beneath." On page 63 is an Appendix, a special report on the coast cliffs at the mouth of the Ashburton, which accords with my recollection of them, and shows clearly, to my mind, that these cliffs are wholly built up of the red gravels of the first cold age, the blue or grey gravels of the second cold age not having reached the present coast-line there. I do not know the coast-country between the Ashburton and Rakaia, but I venture to assert that investigation will show that the western margins of the swamps between the Ashburton and Rangitata, and between the Rakaia and Waimakariri, are, approximately, the eastern margins in those localities of the shingle-fans laid down during the last cold age.

The "distinct line of demarcation," visible between the upper and lower shingle in the Ashburton terraces, the "very distinct line" dividing the bluish from the yellow shingle in several rivers, the small bed of loam between them over which water drips (an old soil), these are marks we should expect to find at the junction of the surface of plains of the red-gravel age with later deposits upon them. Had the pioneer geologist of Canterbury recognized the meaning and importance of these marks, and of the difference of colour and condition of the gravels above and beneath them, he would have supplied quite another context to his italicized sentence (on page 16): "*From that moment the formation of the Canterbury Plains began.*" Indeed, he must barely have missed seeing the necessity for doing so, for (on page 46) he writes, under the head of "River Waimakariri," "On that part of the plain between the junction of the Kowai and the Gorge Hill, there is . . . . evidence . . . . that before the Pleistocene fan was formed older formations of a similar nature existed here." The Canterbury Plains, I conclude, not only belong to two periods, but the grey gravels of the later fans are only superficial, which brings them into proportion with the small and shallow fans of the smaller rivers of South Canterbury.

To explain the existence of the red gravels, to account for the severity of climate necessary for their production, we must suppose either that New Zealand was elevated some thousands of feet or that the cold was due to a general refrigeration of the hemisphere—a glacial epoch. I do not intend to do more on this head than to make one remark and offer one suggestion. In view of the proofs of glacier action since discovered in the mountains of southern Australia and southern Africa, together with the previously known proofs of mighty frost-work in Patagonia, the elevation theory could scarcely be so readily adopted or so vigorously supported now as it was fifteen years ago; and seeing that we have in New Zealand the records of two distinct periods of refrigeration, the more reason is there to look for the cause of either in conditions of a general rather than of a local nature. The suggestion I have to offer is that there is a class of evidence which might be usefully sought for, as calculated to finally settle the question of elevation, if found. We can have no direct proofs of great elevation, such as would be sufficient to produce severe climates on our present lowlands. But there might be found proofs that the country was not thus elevated while a severe climate prevailed. The recognition of a raised beach contemporary with the red gravels, or an interstratification of these gravels with marine beds, would give a datum line of first importance. Is any instance of either known? There is none in South Canterbury, for the country here is lower now than it has ever been since the red gravels began to be laid.

The red gravels being completed, there ensued a long period of time after which we find fan-building resumed under the influence of a second age of cold. The climatic history of the interval is not written here in any new deposits, but, and only vaguely, in alteration of the gravels previously laid down. The record tells clearly of a long lapse of time; but whether the climate was on the whole, or ever, as warm as or warmer, say, than our present climate, I know of no evidence to show. Possibly some information on this head could be obtained from the North Island, where, if I have not misunderstood some geological reports, portions of the Wanganui and Hawke's Bay country were submerged after the first cold period, which is registered there, as here, in red gravels. The fossils of the beds of submergence should give some intelligible evidence as to the climate during their deposition. Certainly the climate became warmer, for the process of fan-building ceased.

In this district—and was it not so in many other districts also?—the long warm interval was made more noteworthy by important seismic operations. The shingle-fans here were disturbed in various degrees near the ranges, and subsequently or simultaneously, probably the latter, and as a result of the same subterranean movements, volcanic action was set up at two points, on what are now known as the Timaru and Geraldine downs. At Mount Horrible, in the former case, an explosive volcano burst forth, which discharged dust and grit in such quantity as to bury the country at the present coast-line, seven or eight miles from Mount Horrible, to a depth of about 10in. Two miles inland, at the Harbour Quarry, the tuff is 4in. or 5in. deeper. At the south-west corner of Mount Horrible it is 2ft. deep, with no grit so coarse as at the coast. The explosive eruption was followed by an emission of lava, which consolidated into the well-known Timaru dolerite or bluestone. This rock is 100ft. to 150ft. thick at Mount Horrible, where it has been enormously cut away, and some of the streams near the coast are 40ft. to 50ft. thick, whilst others quite thin out there. The volcanic display at Geraldine was on a much smaller scale, and was limited to the emission of lava. At all events, I could detect no tuff beneath the rock where, on opposite sides of the field, the base is exposed. The two lava-fields are about fifteen miles apart at their nearest points.

These two lava sheets have played an important part for the geologist by preserving the land-surfaces of the time of the eruption, while subsequent denudation has provided numerous sections in which those surfaces can be studied. The complete removal of a considerable quantity of rock at the Timaru Harbour Quarry gave an additional and excellent opportunity for further observations on the tuff-covered soil.

With an exception to be mentioned presently, the Timaru dolerite seems everywhere to rest upon the red-gravel formation. At the coast and the Harbour Quarry the rock and its underlying tuff rest upon a dark vegetable soil, containing plant-remains in carbonized matter, and root marks; also worm-borings and bones of large birds. The tuff in places is pierced with blackened tubes, the vestiges of culms of grasses, and black prints of leaves have been seen in it. The subsoil is a gravelly clay, 1ft. to 2ft. deep, derived from decomposition of shingle, and not to be mistaken for a deposited silt, as pebbles are scattered at random through it to the very surface of the soil, these being doubtless the more refractory pebbles of the original shingle-bed. I have nowhere found a soil and subsoil of this description *within* the red gravels. The marks of persistent land-surfaces, previously mentioned, are in every case in surfaces of beds of clay or silt, deposited as such. (The bed of loam over which water drips, mentioned in Haast's report as occurring in some of the terrace sections, may be a soil of decomposition, a buried soil contemporary with that entombed by the Timaru dolerite.) The soil disclosed by the quarry-work at Timaru contains unmistakable worm-borings; but the fact that pebbles are found in the soil to the very surface seems to indicate that the worms from first to last had not been very numerous, as their operations tend to bury such things. In one spot the Geraldine lava rests upon bare red gravel, as though it here flowed over a watercourse swept clear of recent shingle, and the lower side of the rock is peculiarly splintered, as though it had flowed into water and been suddenly cooled. Elsewhere this lava sheet is seen resting upon a dark soil derived from the red gravels beneath. At one section the underside of the rock shows a semi-cylindrical cavity, presenting the appearance it might do if the lava had flowed over a prostrate log. I have nowhere found any signs of timber beneath the Timaru dolerite, but I obtained, from amidst the lava, a curious cast of a piece of charcoal from a stick about 2½in. in diameter.

The degree of decomposition of the gravels into soil and subsoil, before the lavas overspread them, is proof of long exposure to atmospheric and organic influences. I doubt whether any portion of the grey gravels of the plains has been decomposed into soil and subsoil to a greater depth or more thoroughly. Supposing the degree of decomposition to be equal, and to have been effected under similar conditions, then, whatever age may be assigned to the present plains now, an equal age must be assigned to the red-gravel surface at the time of the volcanic eruption. And this age is not the full measure of the lapse of time between the two cold periods. The dolerite is now covered with loess, which I believe to be one of the earliest products of the second cold age, and the lava was certainly exposed to atmospheric denudation for a long time before any loess was deposited upon it. If we may judge by the roughness of surface of the lower of two streams worked in one of the quarries, the surface of the fresh lava-streams was covered with minor rugosities. The dolerite appears to weather with extreme slowness, yet it was exposed after eruption, and before any loess fell upon it, long enough to permit the whole surface to be smoothed down, and the edges of the rude prisms into which the rock split on cooling to be rounded off, and the cracks in most cases to be widened into little gutters. There has been practically no alteration of the dolerite since. The loess goes hard down upon the rock, or a fine brown mud fills all crevices and forms a level-topped layer over it. It is only in small hollows or pits in the rock, which would early be filled with rain-wash, that the rugged surface of the fresh flow has been at all preserved.

A proof of the great absolute age of the red gravels is the degree to which they are oxidized from top to bottom. They are somewhat less altered beneath the dolerite, I think, yet there they are far more altered than the gravels of the later fans. That the dolerite did afford some protection from further alteration appears to be well shown by one interesting fact, which is also an index of the great age of the formation at the time of the eruption. The Timaru dolerite appears everywhere to rest on red gravels, except at the south-west corner of Mount Horrible. Near this corner one small exposure shows 12ft. or so of loess-like clay, with soil-surface covered by tuff. The clay rests upon rearranged sands, and these on fossiliferous sands, as in the Tengawai terraces. Exactly at the corner, tuff lies upon a few feet of silt and shingle, so loose, so fresh-looking, so unaltered, that they could be matched by river deposits only a few years old. This shingle must have been a river-bed at the time of the volcanic eruption, or rather at the time of the preliminary upheaval of the gravels, and its appearance has scarcely altered from that day to this. Curiously, this shingle and silt were not burned brick-red by the heat of the rock, as is the shingle elsewhere, to a depth of many feet. I can only suggest that the porosity of the then recent river-gravels allowed the moisture they contained to be easily driven off as the heat of the lava made its way down, so that when the burning heat reached the gravel, this being dry, it did not oxidize the iron in the stones. This river-bed is based upon yellow fossiliferous sands.

From the oxidation of the whole gravel formation, from the decomposition of its surface into soil and subsoil, before the lava overflowed it, and from the weathering of the surface of the lava before the loess of the second glacial period was spread upon it, we must conclude that the "interglacial period" of this hemisphere was of very great duration, measured even by geological standards of time.

So far nothing has been said of the enormous amount of denudation the red gravels have undergone since their disturbance. Previous to disturbance, of course, they would be liable only to terracing by the principal streams flowing over the fans. After disturbance, irregular elevation gave rise to new drainage-lines, and steeper falls gave power to smaller streams to perform excavating work. The red-gravel downs have been enormously cut up, but it is more than probable that the bulk of the work was done during the second glacial period, when these low grounds were undoubtedly glaciated.

If the red gravels are admitted to be the record, in what Professor Geikie calls a "peripheral area," of a glacial period in the Southern Hemisphere, the climatic experience of New Zealand corresponds with that of North America, where the proofs have been recognised of two great glacial periods, separated by a long interval of time, each of the glacial periods being broken by shorter intervals of ameliorated climate; whilst our experience does not correspond with that of Europe, where some observers recognise three distinct and separate glaciations in the Alps (*vide* Professor Geikie's presidential address, Brit. Assoc. meeting, 1889, on "Glacial Geology"). The discrepancy between the European and American record can hardly be real, and may arise from a greater value being assigned than should be, by the European observers referred to, to one of the breaks in the earlier or later glacial epochs. Similar breaks are registered in our red gravels, and also in the products of the later cold age, as they are in the North American glacial beds.

I trust that these statements and suggestions respecting the red-gravel, or drift, formation, and its nearer chronographical relatives, will be found interesting and useful. It may be said that I have given more opinions than facts; the opinions, however, are based upon facts, and I desired to make my paper suggestive rather than descriptive, to provoke further inquiry into the record of a severe, if not truly glacial, climatic period, which will well repay further examination.

Appendix.

[*Read 6th November, 1890.*]

In the "Handbook of New Zealand Mines," 1887, page 69, a short account is given, from the pen of Mr. Gordon, of large deposits of auriferous quartz-drift, with leaf-beds and silicified trees, in the St. Bathan's district, Central Otago. The same deposit is referred to as richly auriferous in the "Report on Goldfields," &c., presented to Parliament this year, pp. 76, 79, and 82. From these descriptions I think this drift must be related, chronologically and in the manner of its production, to the quartz sands and grits on the Tengawai and Hare, described in this paper as produced during the prevalence of a frostless climate in the period succeeding the upheaval of the Pareora marine-beds into dry land. I do not know whether the interior of Otago was submerged by the Pareora sea; if not, then the longer time was given for the production of the quartz-drift. The drift has been much disturbed. A question is, When did the disturbance take place? Was it contemporaneous with the disturbances and volcanic eruptions in South Canterbury which occurred during the interglacial period?

Art. XXXI.—*On the Timaru Loess as a Climate Register.*

By J. Hardcastle.

[*Read before the Philosophical Institute of Canterbury, 2nd October, 1890.*]

In a paper submitted to this Society a few months ago I had the honour to offer what I hoped would prove a useful provisional reading of the earlier of the recent geological formations of South Canterbury, viewed as records of climatic changes. The point then reached was the close of the interglacial period. I now propose to continue the reading, from materials provided by the second great cold age, the chief among them for its instructiveness being the loess of Timaru.

In a paper read last session, and published in the Transactions,* the conclusion was stated that the loess is an Æolian deposit, a heap of wind-borne dust, the dust being rock-meal wind-swept from areas of lowlands overflowed by rivers charged with glacier silt. This conclusion, I learn, has been adversely criticized by those well able to judge of the value of the facts and arguments stated in support of it, and, as the value of any reading of the characters contained in the loess depends upon the origin of the formation being correctly ascertained and admitted, I have looked over my paper to see where lies the error or weakness of my presentment of facts which in nature permit of no doubt that the loess is Æolian. I find that of the several characters described there is one, and it may be only one, which as far as I can see is quite inconsistent with any other theory, and unfortunately very little stress was laid upon this character. It is, however, twice briefly mentioned. It is stated in that paper † that the bands marking pauses in the process of deposition "curve in the spurs so as to be roughly parallel with the present land-surface;" and, further,‡ that these bands "are all flat or curved with definite relation to the present drainage-lines."§ I cannot but think that, had special attention been drawn to this feature, the result must have been to disarm adverse criticism of the "dust-heap theory." Not having done this before, I must take this opportunity of remedying the defect.

Every detail of the loess of Timaru emphatically denies that it is of marine origin. But if it existed under different topographical conditions most of the details might be held to be consistent with the "inundation" theories which have been proposed to account for loess deposits in Europe. By no exercise of the imagination, however, after as full an appeal to nature for inspiration as possible, can I conceive how, by any form of aqueous agency, each distinguishable layer could have been deposited upon the previous one in such a manner as to preserve the drainage-lines. Here the lines of surface-drainage, small and great, have been preserved throughout the process of deposition. Where there are rounded ridges or flattened ridges between gullies and hollows now, there have been rounded ridges and flattened ridges from the first. The hollows have not been carved out of a level continuous sheet of material. Every form of deposit of fine material by aqueous agency tends to level and smooth over the area of deposit.

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* Trans. N.Z. Inst., vol. xxii., art. xlviii.

† *Loc. cit.*, p. 407.

‡ *Loc. cit.*, p. 413.

§ Mr. T. Goodall, in a paper on the loess (Trans., vol. xix., art. lx.), also says, "These beds curve with the hill, and do not occur in flat beds as in marine deposits." He also gives a diagram showing the curvature.

This was not the tendency with the agent which built up the Timaru loess; on the contrary, the effect was to increase the unevenness. The bands of stratification curve with definite relation to the drainage-lines. It is easy to understand how such curves were produced, on the dust-heap theory. They are the resultants of the conflicting forces of equable deposition, and inequable denudation by contemporary rains, the latter having greater power on the slopes and surfaces near the drainage-lines. It appears to me that this curved stratification, the formation being superficial, undisturbed, and resting upon a level base, is a crucial test, and settles the question.

The loess being of Æolian origin, it necessarily follows that it belongs to a glacial age, for no other agent than ice could, in this latitude, produce material of this kind, and under such related conditions that the material could be spread out for winds to lift and bear it away to new fields of deposit. As we saw from an examination of the products of the first cold age, the Canterbury Plains were principally built up long before the loess period, but the seismic disturbances during the interval produced alterations in levels which we have few, if any, means of fairly estimating; and where those dust-fields were chiefly situated is a question it would be difficult to answer. The building-up of shingle-fans implies the overflowing of their banks by the fan-building rivers, and perhaps we should look to such action for the spreading-out of the dust which was swept over the higher lands by the breezes. In that case we should have the whole of the Canterbury Plains, and any contemporary extension of them eastward, by changing positions, as the immediate source of the dust. Against this idea, however, is the fact that the shingle of the fans appears to be free from glacier silt, and also the fact that the fans are traceable to, and appear on the whole to be contemporary with, the moraine-dams of the mountain lakes, while the loess must be older. It appears to belong to the whole of the second glacial period, and principally to the earlier stages and the culmination of its severity, rather than to the latest, the moraine and fan-building stage.

As described in my paper of last year, the loess contains marks of several pauses in its deposition, in bands containing (*a*) drought veins,* the product of a dry climate; (*b*) rust-granules, the product of a wet climate; (*c*) multitudes of birds' crop-stones, which I shall presently suggest have an interesting significance as an index of climate; and (*d*) at one level certain alterations of texture produced by extreme severity of climate. Deposited upon areas elevated above the reach of rivers, this

* Previously described under the name "evaporation veins."

growing dust-heap played the part of an observant bystander, taking notes of certain climatic phenomena as they successively arose. The record of the lowest separable layer, marked off by a band in which both drought-veins and rust-granules occur, may, I would suggest, be read as follows :—

1. A phase of cold, producing great icefields and glaciers in the highlands, which send down floods of sludgy waters, inundating the lowlands, and creating fields of dust, from which the winds picked up and deposited here a bed of loess up to 10ft. thick where the contemporary denudation was slight. (This is the thickest of the layers.)

2. A phase of improving climate, during which the glaciers diminished and the supply of dust ceased, probably in part through the trapping of the glacier silt in lakes or pools, occupying basins scooped out by the previously extended glaciers. The climate here continued wet, however, for even where the slope of the surface afforded good drainage the rust-granules characteristic of wet soils were formed.

3. The climate further improved, becoming dry enough in summer to crack the ground to the depth of a few feet, and drought-veins were formed.

4. The moist climate returned, the formation of drought-veins ceased, and that of rust-granules was resumed.

5. With increasing cold the glaciers again advanced, and the supply of dust was resumed, this recommencing the series.

If right in the main, this reading may be wrong by containing a redundant clause. There may have been but one phase, not two, of wet climate, giving rise to the production of rust-granules. If but one, there is some reason to suppose that it was related to the return of the cold phase rather than to the retreat of that phase. A ground for this supposition will be stated later on, in the suddenness of considerable improvements in climate.

The series of variations of climate registered in the first layer of loess appears to have been fully repeated but once. There are only two of the buried subsoils, so far as my observations show, that contain the drought-veins produced by dry climate cracking the ground, the second of these being near the top of the deposit. I have not been able to determine the exact number of marks of pauses in the deposition, but there are in one good section five or six distinct and a few indistinct ones. As the faces of the cuttings are coated with rain-wash it is not easy to count these soil-bands with certainty. As each of them indicates a long period when the supply of dust ceased, and as we trace the dust to an origin dependent upon a certain condition of climate, each of these bands registers an absence of that condition—in other words, an important alteration in the climate.

Towards the close of the loess record two new characters are introduced, the interpretation of which for a long time puzzled me completely. From 2ft. to 4ft. beneath the summits of the ridges the loess shows in weathered road- and railway-cuttings a projecting band 1ft. to 3ft. thick, the material in which differs from that above and beneath it only in being more compact, and thus resisting the weather better. The presence of drought-cracks nearly everywhere has enabled the rain to carve this band into elongated bosses. On the slopes of the spurs this character gradually gives place to another, which is quite unique in the formation. Where well developed, as on the slopes of the larger gullies, this consists of hard flaky layers, some rusty, some not so, some even whiter than the loess generally; the whole generally but a few inches, but in some places a few feet, in thickness, and frequently, or rather generally, separated into small roughly cubical fragments. The whiter portions look just like the "pugged" clay formed beneath landslips and seen where such slips have been sectioned in roadwork. The two related characters show more or less clearly in every spur in cliff and cutting at the coast, and the pugged layer in most of the sidling road-cuttings on the slopes of the gullies all over the plateau. The only explanation I can find to account for these characters is that they register the phase of greatest severity of the ice age to which the loess belongs—the second glacial period; that they show that the summits of the ridges at that time were compacted by a heavy load of ice, while the surfaces of the slopes were "pugged" by the ice creeping over them to form ice-streams in the gullies. Adopting this explanation, the extensive denudation of the dolerite and underlying gravels seen in the larger gullies and their branches becomes comprehensible; whilst it must be simply a cause of utter bewilderment at the time required, if we must believe this denudation was effected by the trifling surface-drainage now at work.

Knowing that in the discussions which took place some years ago upon the glaciation of New Zealand the view was strongly combatted that there had ever occurred such a degree of glaciation as to involve the lowlands of Canterbury, I have been the more cautious in adopting it. It is, however, well supported by plainer evidence in the immediate neighbourhood.

The map and descriptions of the icefields and glaciers of the great glacier period, in Haast's "Geology of Canterbury and Westland," can by no means show the full extent of the glaciation of Canterbury. The map shows, the text describes, only the larger glaciers originating in the Southern Alps. Besides these there must have been many minor snow-fields with their glaciers. One of these minor fields evidently existed on the north side of Mount Misery (otherwise Cave

Hill), immediately west of the Timaru plateau. This snow-field gave rise to a small glacier which, gathering towards the north, swept by east and south to the Pareora, along the western side of Mount Horrible (the summit of the Timaru plateau, 1,100ft.), and gouged away the mountain on that side, with its thick cap of dolorite upon soft marine-beds, into a precipitous face 800ft. or 900ft. high. This stream, joining another flowing from the upper Pareora country by the south of Mount Misery—rather a broad sheet of land-ice, perhaps, than a mere glacier-stream—gouged away the southern side of Mount Horrible and lower portions of the plateau in a similar manner. Moreover, the summit of Mount Horrible, though of no great area, yielded a glacier which, flowing down a slight slope northwards, scooped out on that side a wide yet ravine-like gully, this stream then joining that from Mount Misery. Mount Horrible is thus blocked out by precipitous faces on three sides, in a manner giving a western aspect justifying its name. No other agent competent to do the work could have operated here; no other agent operates in such a way; and, besides the general character of the denudation, there are a few other marks of glacier-work on the mountain, in perched blocks, and a small lateral moraine piled against the remnant of an enormous slip from the precipitous southern face. Having studied the enormous gouging of Mount Horrible, evidently the work of ice, I have no hesitation in attributing the two peculiar characters in the upper loess to the glaciation of this deposit. These marks, then, show that the severest phase of the second ice age occurred near its close. Another layer of loess was afterwards added, but it is of less thickness than earlier ones, and should, I think, be referred to the earlier stages of the retreat of the ice, as in later stages the glacier silt would scarcely escape being trapped by rock-basin lakes, which later on were filled with shingle.

Among the accidental constituents of the Timaru loess, the multitudes of bird-stones in most of the bands marking long-persistent land-surfaces are surely the most remarkable. Their distribution also is remarkable. According to my observations they are decidedly much more numerous at the coast than a couple of miles inland, and also more numerous at the north end of the coast cliffs than a few miles further south. So far the only good section of the whole deposit that has been made inland is the "stripping" at the Harbour Quarry, and here the bird-stones are few, certainly much less numerous than at the coast. The number and the partial distribution of the pebbles may be accounted for by the supposition (besides that of an arctic climate, otherwise found necessary) that the Timaru plateau never extended much further eastward than it does at present. We may then see in this well-drained north-eastern angle of the dolerite and loess plateau the mustering and alighting-ground of swarms of birds migrating to and from less frigid regions with each recurring year. I cannot see how the partial distribution is to be otherwise accounted for. But there is another difficulty. Sea-birds do not use gizzard-stones, their use is confined to granivorous birds, and these seldom or never discharge them. Are these multitudes of stones, then, a mortuary talus? If so, why their markedly greater number near the coast? I have never met with any statement on the subject, but I think it more than probable that birds about to take a long migratory flight will unburden themselves as much as possible before starting, including the discharge of their gizzard-stones. It is worthy of note that bird-stones are numerous in some places in the clefts in the dolerite, deposited there before the loess began to fall; and also that the loess in the upper portion, including the compressed and pugged layer and a few feet beneath it, is barren of them. From the last fact it is to be inferred, if the general explanation is correct, that the climate became too severe to allow the birds to visit this region.

In this connection must be mentioned that in the lowest layer of the deposit stones are to be found which could only have been used by large birds of the moa family. I have found an odd one or two higher up, and also fragments of bones; but in the lowest layer I have seen two nests, so to speak, of large stones. In my last paper on the red gravels, it was stated that bones of large birds have been found beneath the dolerite; therefore there is nothing to be wondered at in finding relics of such birds in the later formation. There is this curious fact, however, in connection with the majority of the pebbles in one of the nests referred to: that they were unquestionably picked up by the bird or birds from an exposed sea-beach. They are of the same or very similar rock material as those forming the bulk of the present sea-beach, *i.e.*, Waitaki shingle, and they have the discoid shape produced by the action of the waves on the beach. I have been very careful to make sure that these pebbles are really imbedded in the original deposit, and not merely surf-washed and mingled with slip stuff, cases of which can be seen all along the cliffs. A vague and unsatisfactory inference might be suggested from the fact stated, that the beach from which the pebbles were obtained was not far away, and, from this, the further inference that the land in that case could not have been at a much greater elevation than at present. In the second nest referred to, the pebbles were all well-rounded.

Before leaving the loess, I would suggest that the upward range of the loess on Banks Peninsula may be a peculiar evidence of the contemporary climate. I read that it extends only some 800ft. up the hill-sides. Why so? It cannot be that was the limit—*plus* the amount of any subsidence since—to which winds could lift the loess-forming dust. Does not this limit of height mark what was practically the limit of vegetation capable of entrapping and retaining dust—in other words, the snow-line?

If we suppose the ice retreated from the field of its greatest extension to the limits marked by the great lake-dams, we have to deal with a great amelioration of climate, and the change appears to have been as sudden as it was great. There is an absence of marks of gradual retreat over the country generally, and the great moraines have almost as definite a limit of commencement as of termination. The second great thaw, under the influence of which the glaciers retreated to something like their present dimensions (or it may have been further back), also appears to have been a sudden thaw. It was certainly very rapid, compared with the length of time occupied in building up the great terminal moraines. The fans, which originate from those moraines, also appear to have been completed by an extraordinary, one might say a cataclysmic, rush of water, not by ordinary river-action. The small terraces and gutters which make old river-beds rough travelling are absent from the surfaces of the fans, where these have not been smoothed over by a surface of soil. A sweeping rush of water would account for this. Probably, in some cases such a rush of water might be attributable to breaches in lake-dams, but scarcely in all cases. One of the most remarkable instances of the smoothing of the surface of a fan is that of the small fan of the Waihi (Woodbury), of which the material is, at the gorge, very coarse and bouldery. The river at its highest now is but a small stream, that could scarcely cover the levelled upper portion of the fan. It seems to me that this fan could only have been levelled in the manner it was (before subsequent terracing on one side) by a powerful rush of water. And there is no lake on any of its branches, but it drains a bulky mountain, which at the time glaciers filled the great lakes probably carried a heavy load of snow.

Much has been written about the great glacier period, but I do not remember having seen attention drawn to the sudden termination of the work of building the moraine dams. The compactness of those great terminal moraines, their small breadth in proportion to the length of the glaciers which piled them, suggests a corresponding steadiness of climate. This, however, may be misleading; the moraines may be the record not of a continuous and equable period of cold, but of a series of maxima of nearly equal intensity. If such was the case, evidence of the fact might be found in excavated moraines, such as has been described in the Nelson Province. Be this as it may, the cessation of the work of piling up the terminal moraines clearly points to the occurrence of marvellously sudden ameliorations of climate. The absence of marks of slow retreat—in morainic matter—of the ice from the lowlands appears to tell a similar tale of an earlier age. How such sudden changes were brought about is a question on which I can offer no opinion; but I think the condition of the alpine lakes, with their high and steep moraines, clearly proves that the ice retreated from them with great suddenness. If this were so, as it appears, the lesser changes registered by the loess may likewise have been sudden changes—that is, occupying but a brief time compared with the duration of each fixed phase.

Art. XXXII.—*On Glacier-motion.*

By J. Hardcastle.

[*Read before the Philosophical Institute of Canterbury, 2nd October, 1890.*]

The latest authoritative deliverances on the subject of the mode of motion in glaciers of which I am aware state that "the problem of the cause of glacier-motion cannot yet be considered to be satisfactorily solved," and "the solutions accepted are not perfectly satisfactory." Whilst endeavouring some time ago to work out a particular case of the problem, using as a principal factor a physical property of ice which underlay some interesting experiments of Professor Tyndall's—viz., its plasticity under pressure—I obtained what appeared to me to be a full, clear, and simple solution of the whole problem of ice-motion. When, however, I again referred to articles on the subject I found that my solution did not fit the alleged facts to be explained, in one important particular. It is asserted that "the top of a glacier moves faster than the bottom." The conclusion at which I had arrived was generally incompatible with this. There is no ground for impeaching the correctness of the observations from which that generalisation was drawn, yet the generalisation may be erroneous. It may be true of a part or parts only of a glacier that the top moves faster than the bottom; and, if this is so, a true theory, in order to explain those observations, should show to what limited extent, and under what circumstances, the surface of a glacier does move faster than the bottom.

Professor Tyndall's experiments, to which I have alluded, show that wet ice—that is, ice at and near its melting-point—behaves, under sufficient pressure, as a plastic or quasi-fluid substance. The ice at the bottom of a glacier is under both conditions—it is wet, and under pressure. I do not know what pressure is necessary to cause plastic flow in ice perfectly free to move, but it is not very great. Suppose we say, for the purpose of illustration, it is 100lb. per square inch, equal to the weight of a column of ice, say, 300ft. high. If, then, we have a portion of a glacier 400ft. deep, the base of which is perfectly free to move, the lower 100ft. will be forced to flow away by the weight of the 300ft. above. Supply a resistance to movement everywhere equal to 100lb. per inch, and the glacier must be 700ft. deep in order that the lower 100ft. may be squeezed away.

It appears to me that, taking the glacier as a whole, or any average cross-section of it, the ice at the bottom flows plastically under the weight of the ice resting upon it. In flowing it will obey, however tardily, the laws of hydrostatics, flowing from a region of greater to one of lesser pressure, and, obeying also the law of gravity, will flow preferably downhill. In other words, the glacier and the *névé*, or icefield, each consists of two mentally separable portions, moving in distinctly different ways. The lower portion is caused by the weight of ice above it to move as a viscous fluid; the upper portion remains solid, and is borne along by the living stream beneath, just as a mass of drift-ice or of logs is borne along by a river of water.

It is stated that "the surface-phenomena resemble those of a solid in a state of flow." But every description I have read (it has not yet been my good fortune to see a glacier) shows that this is true only of those portions of the surface which are encountering obstructions. Elsewhere the surface-phenomena, as described, are those of a solid in a state of floating transport. Crevasses indicate a spreading of the floating load, due to a spreading of the stream beneath: they are closed by subsequent compressions of that stream. Where the surface-ice encounters obstructions, such as a narrowing of the channel, a sharp bend in it, or an island, the force of the streaming ice beneath sets up horizontal pressures in the surface sufficient to produce plasticity in the ice immediately obstructed. All the described peculiarities of surface-movement are explicable as the consequences of the motion of a stream-borne load of a substance hard and brittle when free, but plastic under pressure.

According to this view it cannot be generally true that the surface of the glacier moves faster than the bottom. Nevertheless it must be true of a certain part or parts of each glacier. Glaciers either thin out near their terminations, or are dammed by high moraines. In the former case certainly, in the latter case usually, the lower part of the glacier will not have weight enough to maintain its base in a hydrostatic condition. The terminal end of a glacier is therefore a stranded solid, which acts as a dam to the flowing and floating ice above. The pressures which these exert upon the dam may be considerable, and, as the upper part of the dam will yield most readily, it will be pressed forward over its base. In respect of the stranded terminal portion of the glacier, then, it is true that the top moves faster than the bottom. Similarly, and for the same reasons, it is true of any other portion of a glacier which is "stranded," as on a shoal, or where it approaches a fall. But it is clear that such portions can form no large part of the total length of a glacier. Is it too much to assume that the observations from which it has been inferred that the upper strata move faster than the lower were made on some stranded portions of glaciers? I think not; for naturally more importance would be attached to observations which gave a positive than to those which gave a negative result. There is one observation by Principal Forbes which must always have been given great weight, in which he found a considerable acceleration of the upper ice in a vertical side of a glacier exposed as it flowed past a cliff. This, however, can be explained otherwise than by a general law that the surface moves faster than the bottom; and must be otherwise explained, since it is nearly everywhere seen that the surface does *not* flow, and that forces cannot be found to make it do so.

No theory of ice-motion which assumes greater mobility of the surface as a normal condition will explain the scooping-out of rock-basins or fiords. The theory here offered explains it readily, as it transfers the scene of greatest activity to the base of the glacier, and the deeper the ice the more energetic will be its action on the rock beneath.

So far as I can judge, this theory "fits all the facts." It may be summarized thus: Glaciers and icefields flow through the lower portions, being reduced to plasticity or quasi-fluidity by the weight of the upper portions, and the former in flowing away bear the latter with them. The pressure necessary to effect such reduction at any point, and therefore the critical depth of the ice at that point, depends upon the sum of resistances to hydrostatic movement at the base—chiefly upon distance to a point of no resistance, gradient of bed, and amount of obstruction presented by the form of the channel or course of flow.

Art. XXXIII.—*On the Microscopical Structure of the Ohinemuri Gold.*

By Dr. Rudolf Haeusler.

[*Read before the Auckland Institute, 4th August, 1890.*]

Plates XXXIII., XXXIV.

During my long residence in Ohinemuri I visited most of the mines, and many localities where gold and other minerals occur in more or less considerable quantity, with the view of collecting a complete series of microscopical specimens for a monograph to be published in co-operation with several continental mineralogists and chemists. The material accumulated during fourteen months affords good examples of almost every known variety of gold and silver, and a number of specimens which may help to throw light on some yet obscure points in connection with the origin and distribution of these metals. The subject bearing special relation to New Zealand mineralogy, these short remarks may be of interest to the members of the Institute.

To show the structure of the gold, and the various modes of occurrence in a pure or alloyed state, coloured plates are absolutely necessary, and the specimens have to be drawn on a very large scale; which methods could not be adopted in this paper, through want of space, and difficulties in the execution of the coloured illustrations. The granular or finely crystalline nature of the surface could consequently not be represented in all its minute details.

Nearly all the specimens were obtained by myself on the spot, to prevent any mistakes about the exact localities and nature of the rock and surrounding country. A few were picked out from prospects brought by miners and prospectors for microscopical examination, but only in those cases where full particulars were given, and where the composition of the material left in the dish showed the mineralogical character of the rocks or the loose *débris* in which the gold was deposited mechanically after the disintegration of its original matrix.

The ordinary process of washing out a prospect in the dish causes, of course, distortions, striation, or compression of the soft, delicate specimens, which, especially in the fine arborescent and filiform varieties, destroy most of the primitive shape and surface. Even the most careful manipulation produces often a slight flattening or scratching, which may easily be mistaken for imperfect crystallization, though under higher power the cause is generally easily detected. The gold found in loose *débris* has undergone many changes through mechanical action, and particles transported by water-currents are of course much worn—generally to such an extent as to make the original form unrecognizable. Whenever possible the particles of gold were left *in situ*, and figured in this position with a portion of the adhering quartz or other minerals.

It is not the purpose of this brief outline to treat in detail the many theoretical questions relating to the formation of gold and the causes of its patchy distribution throughout the gold-bearing region of this province. We are not yet in possession of a sufficient number of facts to answer any of those questions. "Where the gold is, there it is not; and where it is not, there it is," has been said with some cause of the Thames Goldfield, and we must be satisfied with this paradoxical explanation until further researches on the spot and in the laboratory allow us to come forward with substantial evidence.

Gold is very widely distributed within the boundaries of Ohinemuri. Probably all the minerals which are auriferous in other districts also bear gold in the Ohinemuri region. No careful examination of several species, which are generally very small, even microscopical, has yet been made. The mineral most productive of gold is iron-pyrites, and the microscopical investigations support the theory that most of the gold of the Thames and Ohinemuri districts was originally deposited as a constituent of the pyrites. It is invisible in the pyrites, but it becomes visible when decomposition takes place, though evidently not in the original (molecular?) form. The minute particles unite into granular or vermicular masses, which may be found in the crust of oxide of iron enveloping a nucleus of but incompletely-decomposed sulphide. Through some agencies not yet known, the gold set free is generally removed in a soluble state, and deposited, simultaneously with quartz, in veins, or, after the formation of quartz veins, in fissures, &c. Thin coatings on ferruginous minerals may have been produced through some electrolytical process. These delicate coatings were undoubtedly precipitates from solutions containing a considerable amount of gold and other minerals. A portion of the gold in quartz veins has apparently been deposited by mechanical means, though it is difficult to see how it could find its way through the compact rocks.

Most of the Ohinemuri gold is more or less crystalline. As crystals are always distorted or elongated, when free, or the faces slightly curved. In some cases this may have been caused through contact with hard fragments of quartz during compression of the rocks, or after its isolation. Mostly, however, the intact finely granular surface indicates that the crystals were formed in this imperfect condition. No perfect octahedron was discovered—generally but a small portion of a crystal projects from an irregular crystalline mass. A great number of crystal-faces always cover the more delicate arborescent forms of gold and silver. The incrustations of gold on quartz, due to infiltration in wide fissures, are distinctly crystalline.

An exceptionally fine specimen of dendritic gold, found by Mr. Reid, of Owharoa, near the Radical Mine, was covered with large projecting crystals, arranged with a certain regularity. In most branched specimens the crystals are spread over the surface without distinct order, though under low power the planes seem to be overlapping each other, especially when they are of nearly uniform size. Even a granular surface suggests crystalline aggregates under low magnifying-power, owing to the brightness of the protruding grains. Also, the apparently-corrugated surface of their laminæ, especially those filling narrow fissures in quartz, bear often a strange resemblance to crystalline structure.

It goes without saying that by breaking up auriferous quartz in the mortar the gold is very considerably changed, and but for the different angles and striation of the faces, caused by friction, and irregular protuberances, many pounded specimens might easily be taken for irregularly-developed crystals.

In a few instances the octahedral edges are salient, so as to form a distinct ridge. Twins are very rare, and the twinning obscure. Surface striation is occasionally seen on the larger faces. When the striation is not in accordance with the laws of isometrical crystallization it must be accounted for by contact with striated surfaces, quartz, hæmatite, or other crystals.

Traces of crystallization were also observed in the amalgam from a tunnel near Owharoa.

With the true crystals of gold and silver we meet occasionally specimens which resemble abnormally-grown crystals very closely, but which are, as measurements of the angles show, not isometric. The irregular growth and ill-defined outline make careful measurements very difficult. But few other mineral species were observed in their proximity, among which ironsand is the most common. How these irregular forms originated is difficult to explain. Most likely they are pseudomorphs. Further finds must be awaited before conclusions can be drawn as to their formation and the composition of the species, the forms of which they take through infiltration in cavities left after the dissolution of the contents.

Some of the arborescent forms are crystallized, the branches being set at an angle of 60° or 120°, corresponding with the dodecahedral angle. Others show no sign of crystallization, but simply a lichen-like arrangement of the branches. These are always argentiferous in a high degree, and their colour varies from light-yellow to pure silver-white. Figs. 48–50 show the three principal arborescent varieties.

Coarse, angular, often partly-crystallized specimens of gold occur principally in small pockets along the road leading from Owharoa to Waihi and Waitekauri. This gold is remarkably free of silver, compared with that obtained in the mines at Owharoa. The sharp edges prove clearly that it was not carried a long distance; but tunnels driven in the hill-side led to no satisfactory result. It is to be hoped that further prospecting will be done in this very promising locality.

Granular gold is the most common in Ohinemuri. The best prospects were washed out from soft *débris* near the Hauraki camp, Karangahake, which showed all the different modifications. Figs. 1 and 2 illustrate typical specimens. They are probably derived from a highly ferruginous rock, not unlike that successfully worked in the Woodstock Mine. The particles are often very minute, globular or elongated, but with rounded ends, often filamentous in the form of a rosary, or botryoidal, &c. These forms appear to be limited in their distribution to veins rich in iron-ore, and the so-called "blue veins," which, when oxidized, disclose the gold often to the naked eye. Extremely small almost spherical particles are present in almost all the blue veins, especially those containing a fair percentage of silver. Treatment with acids shows that the gold is present in a very fine state, though when exposed to oxidizing agencies comparatively large agglomerations of grains are seen. It is likely that the gold exists in most pyrites in molecular form, and that during the process of decomposition the molecules join, forming these tubercular aggregates. Figs. 32–35 show the grains of gold in decomposing pyrites. When the oxidation is not sufficiently far advanced to render the mineral friable, the gold necessarily does not come in contact with the mercury in the battery. In the tailings fragments of an ochreous colour containing gold are often found, which accounts for the great discrepancy between the assayed and crushing value of the ore. Roasting and the chemical processes lately tried on the Thames and Ohinemuri Goldfields will eventually save the greatest part of this gold.

Enormous quantities of iron-pyrites, which we may suppose were auriferous, have entirely disappeared, leaving but the walls of quartz. It is clear that the gold they contained was deposited in other places. Borings at the lower levels will no doubt lead to its discovery in very rich veins.

Larger masses of gold, irregular in shape but with a smooth surface, similar to alluvial nuggets, are found occasionally. A specimen about 4 millimetres in length was washed out of a creek near Mackaytown. Another from Owharoa shows indication of crystallization (fig. 51).

Filiform gold is found in all auriferous deposits, though only in small isolated individuals. The threads are bent or twisted in various manner. They contain a high percentage of silver, and some pass into pure silver. Parts of the surface are finely crystalline, but generally of a somewhat dull appearance. Thin, long filaments often radiate from compact masses.

Laminæ are rarely found in Ohinemuri. The best locality I know is the Waterfall Creek, near Owharoa, which also yielded a few grains of platinum. The scales of gold are much worn, and were probably washed out from the boulders on the bank of the creek. The fact that those boulders contain coarse gold, platinum, silver, mercury, and cinnabar ought to tempt miners to prospect the back country.

Vermicular masses of gold, with smooth or finely-granulated surface, are found in ochreous veins, and are evidently the product of disintegration of argentiferous "blue veins:" often they occur with solid masses, or form parts of them. They appear to have been formed under peculiar circumstances, different from those to which the other varieties are ascribed.. They either traverse the ironstone or form a partial envelope. In very few cases a kind of regular arrangement was noticed (fig. 30), which may be the result of imperfect crystallization. These vermicular specimens were always more or less argentiferous. Figs. 30, 31, 37, 38, 39, show the different varieties.

The crystal of quartz, fig. 29, contains cavities of irregular contour, thus differing from most cavities from the same district, which are very fine, and run parallel with the main axis of the hexagonal prism, always near the centre of the crystal, with what I take to be exceedingly fine particles of gold. The specimen is so far unique, so that the nature of the enclosed matter could not be ascertained without risk of loss or destruction.

A natural amalgam occurs near Owharoa, in a short tunnel driven by Mr. Louis Dihars in the side of a hill. A loose boulder which we broke up in the drive showed a brilliant surface, due to millions of very minute globules of mercury. Some of them were saturated with gold and silver, and crystal-faces were visible. Streaks of cinnabar traversed the quartz. Unfortunately, but one rich boulder was discovered, but it was sufficiently large to indicate the presence of remarkably rich mineral deposits in localities which yet await thorough prospecting.

In conclusion, I may say that the microscope indicates all through Ohinemuri the existence of a number of most valuable minerals, many of which are left unnoticed by the prospectors, who, as a rule, concentrate their attention on gold. The establishment of the School of Mines at the Thames affords every facility for acquiring a thorough acquaintance with the mineralogy of the goldfields. It is to be regretted that recent failures, and still more dishonest transactions, have brought discredit on such a rich and extensive goldfield as Ohinemuri, which must necessarily become some day one of the first gold-producing districts of the world.

EXPLANATION OF PLATES XXXIII., XXXIV.

Plate XXXIII.

Figs. 1, 2.	Granular gold.
Figs. 3–15.	Gold in quartz-veins.
Figs. 16, 17.	Incrustation on hæmatite.

Plate XXXIV.

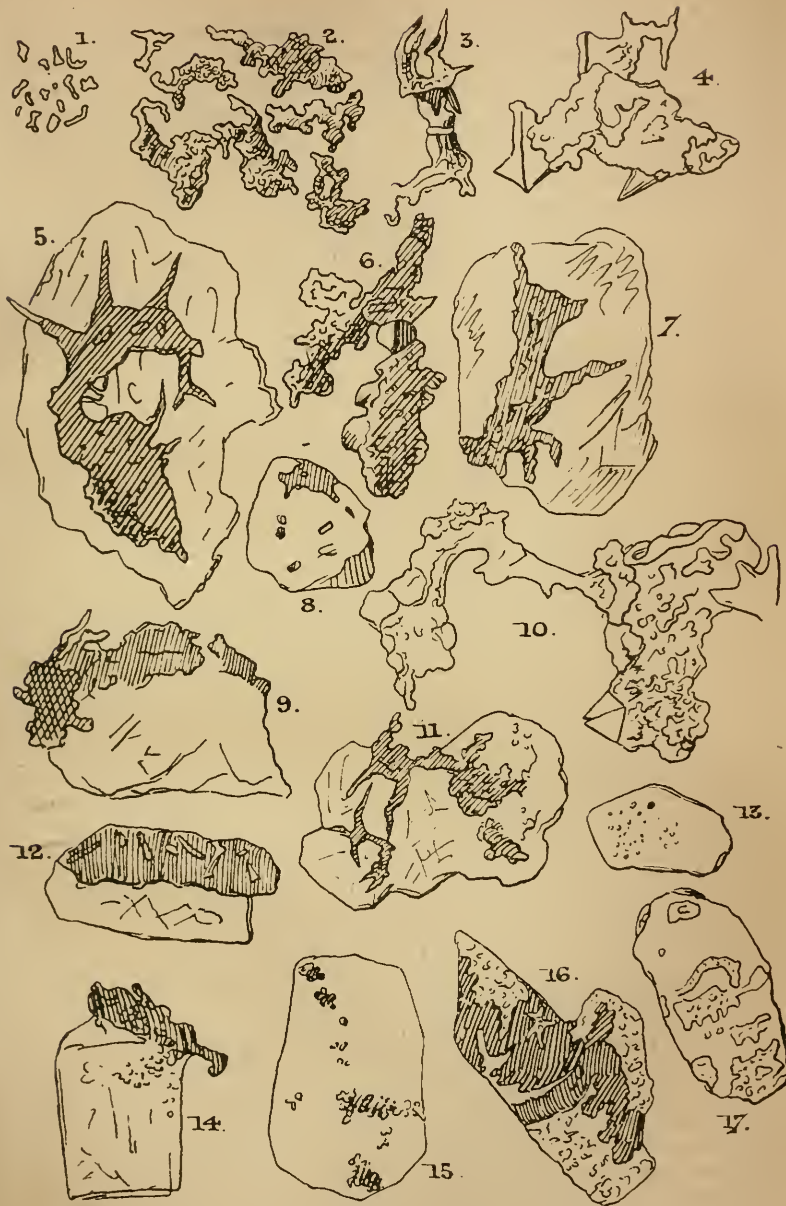
Figs. 18–28.	Crystals of gold, and pseudomorphs.
Fig. 29.	Crystal of quartz enclosing gold (Owharoa).
Figs. 30, 31.	Vermicular gold in ironstone (iron-oxides).
Figs. 32–35.	Granular gold in decomposed iron-pyrites.
Fig. 36.	Surface-coating of gold on iron-nodule.
Fig. 37.	Vermicular gold.
Fig. 38.	Compact gold in ironstone.
Fig. 39.	Thick coating of gold on ironstone.
Figs. 40, 41.	Gold in decomposing iron-pyrites nodules.
Figs. 42, 43.	Filamentous gold.
Figs. 44, 45.	Granular gold.
Figs. 46, 47.	Filiform gold.
Figs. 48–50.	Arborescent gold.
Fig. 51.	Compact gold with octahedral planes.
Fig. 52.	Stellar gold on quartz and iron-oxide.

Art. XXXIV.—*On the Relation of the Kidnapper and Pohui Conglomerates to the Napier Limestones and Petane Marls.*

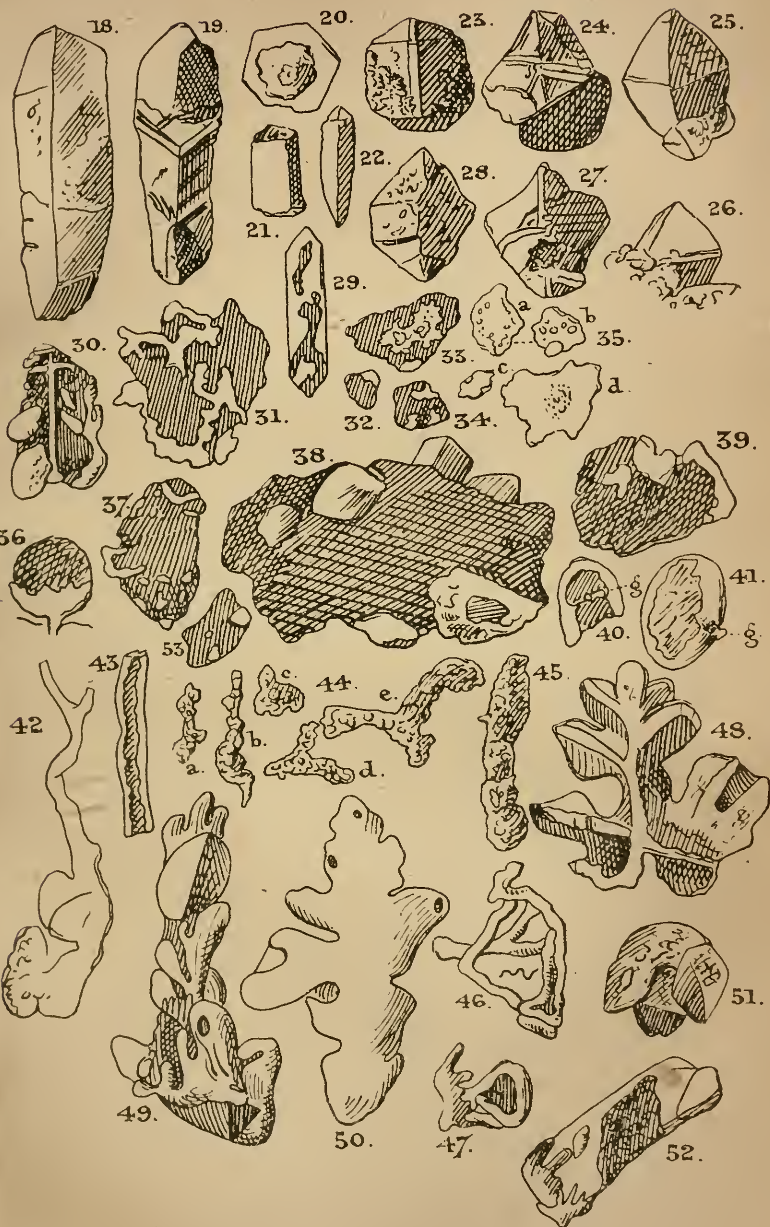
By H. Hill, B.A.

[*Read before the Hawke's Bay Philosophical Institute, 13th October, 1890.*]

The Progress Report No. 18 of the Geological Survey, for the years 1886–87, and published in the latter year, contains a special descriptive account of the geology of the eastern counties of the North Island, by Mr. McKay, F.G.S., the Assistant Geologist. Being interested in the district referred to, and having also written somewhat upon portions of the same district, I have read the report with a good deal of pleasure, and I may also say profit. To those acquainted



R.H.del. MICROSCOPIC STRUCTURE OF GOLD.



R. H. del. MICROSCOPIC STRUCTURE OF GOLD.

with the topographical features of the district the report is well worth perusal, although at the outset I must confess my inability to assent to some of Mr. McKay's conclusions, more especially with respect to his classification of the rocks extending from Cape Kidnappers to Pohui, midway between Napier and Tarawera, including the Napier limestones and what Mr. McKay terms the "Petane clays."

I am naturally loth to dissent from any of the conclusions arrived at by officers connected with the Geological Survey, as their much wider experience in field geology gives them an advantage that far outweighs any special knowledge I may possess of the topography and otherwise of this immediate district. In the present instance, however, the wide divergence of opinion held by officers who have been connected with the Survey from time to time as to the stratigraphical relation to one another of the rocks in question causes me to think that the more light that can be thrown on the subject the sooner will it be possible to harmonize the varying and opposite conclusions of the different observers. Hence the main object of this paper will be to describe and correlate as well as I am able the surface-rocks of a district within a specified radius from Napier, with the view of showing that Mr. McKay's classification, as stated in his report, is untenable. And in order to do this I propose to work back inductively from the present plane of denudation, with its mountains, hills, plains, and valleys, to the plane of denudation immediately preceding it, so as to show the stratigraphical sequence of certain rocks that are now classed much older than I think can be warranted by the evidence available, whether stratigraphical or palæontological.

The district to which the paper will be limited for descriptive purposes is the area embraced within the Hawke's Bay river-system, and which extends curiously from the 39th to the 40th degree of south latitude—that is, from a little to the north of the Mahia Peninsula to a little beyond Bare Island, south of the Kidnappers. These boundary-lines include the whole of Hawke's Bay County, a large part of Wairoa County, and small portions of Waipawa and Patangata Counties.

Along the western boundary of this district the rocks generally are of Palæozoic or Mesozoic age, the Ruahine mountain-range being composed, in its highest parts, of a compact, fairly coarse, and indurated sandstone, and having a strong likeness to the New Red Sandstone to be found in some of the midland counties of England. Compact gritstone and pudding-stone are also met with in some places on the range; but these rocks are comparatively rare, being seen in the upper streams of the Manawatu and Waipawa Rivers, but nowhere else, as far as my own observations have gone. Flanking these sandstones, and in places found in connection with them, are quartzite rocks with traces of copper, iron, and other metals; whilst fine bluish compact sandstones and slates —the latter showing true cleavage-planes—make up what may be termed the supplementary range that runs parallel to the main axial range from the Manawatu Gorge to the Whakarare Mountains. The slates and sandstones continue to the north as far as the 39th parallel, but I have not seen the sandstones characteristic of the Ruahine Range beyond Kereru in a northerly direction.

If we now follow the Tukituki River—which is the most southerly river in the district under notice—from its source to the sea—that is, from west to east—the following rocks will be met with by the way: 1, Compact sandstones (Ruahine); 2, slates; 3, limestones; 4, blue fossiliferous clay-marls; 5, shingle- and pumice-deposits corresponding with the Kidnapper beds; 6, limestone; 7, Ruataniwha river-gravels; 8, Te Aute limestones; 9, chalk-marls; 10, blue clay-marls (Patangata); 11, Kidnapper pumice- and conglomerate-beds.

Along the northern boundary of the district, beginning in the west—say, at Tarawera, on the Napier–Taupo Road—the following rocks are crossed: 1, Pumice-deposits overlying slates; 2, slates (Maitai); 3, limestones and fossiliferous brown clays; 4, grits and blue clay-marls; 5, limestone; 6, sands and conglomerates (Pohui beds); 7, limestones; 8, blue clay-marls; 9, limestone (outliers); 10, coarse sandstone, with thin bands of blue clay interbedded.

Along the eastern boundary—that is, by way of the coast—the exposures are clear and distinct, and the rocks are as follows: 1, Blue clay-marls with pumice-band; 2, Te Aute limestone (black reef); 3, Kidnapper shingle-, pumice-, and conglomerate-beds; 4, alluvial plain, with shingle-beach, to Napier; 5, Napier limestones, separated by clay-marls; 6, shingle-beach to Tongoio, with isolated limestone outliers covered with shingle- and pumice-clays; 7, limestones and marls, Tongoio to Moaeangiangi; 8, blue clay-marls, with pumice-band; 9, limestone outliers (Nuhaka); 10, coarse sandstones, as in 10 above.

And this distribution of the rocks, the oldest by the western boundary of the district, and the youngest towards the east, well represents the general slope of the country, or true plane of denudation, at the present time, seeing that all the rivers run eastward and pour their drainage-waters into Hawke's Bay.

From what has already been stated with regard to the existence of sandstones and of slates with two cleavage-planes along the western watershed, it will be easily inferred that the rivers are mostly great shingle-carriers, especially in times of flood, and that the vast deposits of shingle to be met with in the limits of the bay between the Kidnappers and Te Mahia represent some of the products of that carriage within a comparatively recent period.

The Tukituki, Mohaka, and Esk Rivers are perhaps the greatest shingle-carriers, and within the basin of each of these rivers large deposits of shingle are to be met with. Of the Esk River it may be remarked that its carriage of shingle is not from the mountains, as in the case of the others, but from immense deposits of shingle-conglomerate between the Kaiwaka and Maungaharuru Mountains, and to which reference will shortly be made.

The present river-valleys represent fluvial deposits that have accumulated since the time when the river-system of Hawke's Bay was, in the main, similar to what it now is—that is, since its slope or drainage-area was generally eastward. But this slope for drainage purposes was not always in this direction, for it can be proved by the most complete evidence derived from the rocks in this same district that the plane of denudation which immediately preceded the present one, certainly between the parallels of 39° and 40°, extended from north-east to south-west. And, curiously, the evidence to prove this statement is derived from the distribution of shingle-, sand-, and pumice-deposits that are traceable in a great measure in the vicinity of the river-basins already named.

And now for the proofs :—

Flanking the slates that form the lower ranges along the western portion of the district there is the remnant of an old limestone deposit. In most places, as I have elsewhere remarked, this limestone has been washed away, in some cases with portions of the underlying blue clay-marls. But wherever this is the case the area has been reoccupied by shingle, pumice, clays, and allied deposits.

These beds are clearly exposed in the Makaretu, Tukituki, Waipawa, and Manganuku Rivers, that flow over the Ruataniwha Plain. No doubt this plain was at one time entirely filled in with these same beds from east to west. Similar beds are traceable to the north-east through Kereru, and thence onward to Pohui. At the Waipukurau, Waipawa, and Maraekakaho gorges remnants of the linking of these beds with the present river-beds are to be found; and the terrace-gravels of the Geological Department, as seen at Waipawa, Waipukurau, Patangata, and other places, are simply the remnants of a transitional period, when the drainage to the south-west, across the Ruataniwha Plains, was dammed back at Norsewood by deposits from a rising area to the westward, and breaches were made in the limestones in the places named above, and the drainage from the west and north-west began to flow as at present, though at a much higher level.

But the shingle-conglomerate and other deposits of this old plane of denudation are not merely found flanking the Ruahine and Kaiwaka Mountains: similar deposits are very largely developed near Pohui, on the Napier–Taupo Road, and are found flanking the Maungaharuru limestones and occupying a large valley in that district as far as the 39th parallel. These conglomerates and allied deposits spread over a great extent of country, and they occupy the entire valley from Wairoa, *via* Pohui, to the Seventy-mile Bush.

For a long time it had been a great puzzle to me to account for the existence of extensive deposits of a somewhat indurated sandstone, pumice, and conglomerates, especially about Pohui and to the north-east of that place. There are no slates or fine sandstone rocks to the east or north-east of Pohui in the direction of the Mohaka River. At Tauranga-kuma, fifteen miles or so further to the west, and overlooking Tarawera, the Maitai slates, belonging to the Carboniferous system, are met with for the first time when proceeding from Napier; but between the two places there intervene the Maungaharuru limestone range, the Mohaka River valley, certainly 900ft. in depth, and the Te Hauroto limestones, clays, and grits. That there has been a break in the Maungaharuru Range the Te Waka scarp is a sufficient proof. There is, however, no trace of shingle, that I am aware of, on the range at a greater height than 350ft. above the present bed of the Mohaka River.

But the great conglomerate area in the vicinity of Pohui must be accounted for, and that from a source of origin corresponding to the products. Now, the only possible district from which the deposits could have been derived lies still further to the westward than the districts named; and I am of the opinion that the filling-up of the Pohui valley and surrounding country was brought about by the same processes that are now at work bringing their loads of *débris*—shingle, pumice, &c.—from the west to the east. Those who are acquainted with the Ruahine and Kaiwaka Mountains are aware there are great breaks in them, through which pass the Mohaka, Nga-rurora, and Tutaekuri Rivers. These breaks correspond to the present system of drainage.

From the mountains named there formerly extended a vast area of limestone country: in fact, limestone, towards the close of the Tertiary period, seems to have been the only rock exposed in the whole of the district, with the single exception, perhaps, of the chalk-marls in the hills known as the Alps, at Kaikora. At the time to which reference is now being made, the Kaiwaka and Ruahine Mountains, as separate ranges, or as ranges at all, did not exist. The watershed of the south-east portion of the country, known as the Taupo volcanic zone, was primarily to the east; but when the rivers—or river, in preference—reached the more indurated and less broken and denuded limestones towards the east, it was diverted to the south-west and south-east, in the direction of an area of depression caused by the progressive elevation of the mountain-ranges named above. This was the period of extreme volcanic activity, and it was the period likewise of great denudation. Great floods appear to have been a special characteristic of the period, by which means vast quantities of the same kind of products were moved scores of miles from their place of origin, and deposited in the most extensive beds, and in perfect conformity with other beds of entirely different material.

This difference of material in the composition of the bedding implies either a change in the direction of the drainage-area, or greater floods at special periods, because the shingle-deposits, although they are interbedded with beds of pumice as pure as the pumice on the Taupo plain, or with greyish-blue clays and lignite-beds, are not structurally of igneous origin, although they might have been thrown from volcanic orifices, just as shingle and blue clays were thrown out during the Tarawera eruption. As pointed out above, these deposits cover a wide extent of country; but, wherever found, they simply occupy the place of limestones and clay-marls, as may be easily demonstrated by reference to the surrounding rocks in cases where the pumice and conglomerates are traceable.

With the exceptions of the Kidnapper beds on a large scale, and a few minor deposits at the mouths of the Esk, Mohaka, and Wairoa Rivers, all the shingle- and pumice-deposits are found at a comparatively high level. For example, between the Kaiwaka Hill and Pohui, on the Napier–Taupo Road, where these conglomerates, sands, pumice, and other beds are largely developed, they are met with at an average height of from 600ft. to 800ft.

Between Pohui and Maraekakaho the country, except where the limestones and marls remain, presents one vast accumulation of these deposits, and they continue past Hampden and throughout the entire length and breadth of the Ruataniwha Plain, and onward into the district known as the Seventy-mile Bush. As already pointed out, the latter plain is simply a remnant of the old valley-plain of denudation, when the whole surrounding country was filled—absolutely filled—with enormous deposits of shingle, blue volcanic clays (?), and pumice, brought down by the rivers that ran in this direction towards the close of the Tertiary and the commencement of the Post-tertiary period.

The River Manganuku, that runs along the east of the Ruataniwha Plain, and joins the Waipawa River just below the Waipawa–Hampden Bridge, rises in the pumice and conglomerate hills between Maraekakaho, Kereru, and the Guavas Station. Along the left bank of that stream there is a range of hills, running north-east and south-west, ten miles or more in length, composed of nothing but the Kidnapper pumice- and conglomerate-beds; and, in order to test the stratigraphical position of these beds, I have been over within the last month the entire country between Kaikora and Hampden, and there is no doubt whatever as to the position the beds occupy in relation to the limestones and clay-marls.

These pumice and conglomerate hills, I believe, are classed as limestones by the Geological Survey, but I shall have occasion to say more upon this point presently, when dealing with Mr. McKay's classification. In some places hereabout the pumice is a salmon-colour, as at the Kidnappers in certain beds, and is exactly similar to the vast accumulation one sees at Tauranga-Taupo, and other places on the eastern side of Lake Taupo. Now, if a line were taken from the top of the pumice and conglomerates forming the hills on the Hampden–Maraekakaho Road to similar deposits that flank the mountains along the western watershed of the district, it would link together the old area in this direction once occupied by deposits corresponding in every particular with those at Kereru, Dartmoor, Okawa, Pohui, Wairoa, Redcliffe, Kidnappers, and a dozen other places. Further, all those beds would be in the same general plane, except, perhaps, the Kidnappers, which I have shown in a former paper read before this society* to be connected with a subsiding area that has taken place at a comparatively recent date.

And now, before referring to the points in Mr. McKay's classification of the rocks in this district to which exception is taken, it will be well to summarise what has already been stated by me:—

1. The present watershed of the district under notice is to the west, and the slope or present plane of denudation to the east.

2. This plane of denudation is of recent date, as is shown by the gullet-like valleys through which the rivers run, combined with the absence of alluvial plains in connection with the several river-basins.

3. Except towards the west, all the rocks across which the present rivers flow are younger Tertiaries or Post-tertiaries.

4. The so-called high-level gravels of the Geological De-

* Trans., vol. xxii., pp. 436–7.

partment, as seen at Waipukurau, Waipawa, Kaikora, Patangata, are simply the remnants of the transitional period linking the present plane of denudation with the one immediately preceding it.

5. The river-system that preceded the present one was towards the south-west and south-east; the watershed was yet further to the west and north-west than the Ruahine Mountains.

6. The accumulation of shingle-deposits at Norsewood from the westward, consequent on the elevation of the Ruahine and supplementary ranges, threw a barrier across the drainage-area to the south-west, and the limestones to the eastward of what is now the Ruataniwha Plain were broken through.

7. Remnants of the old river-beds, as they broke through the limestones, are to be found in the terrace-gravels or transitional gravels, as explained in No. 4.

Hence it will be observed that all the shingle, conglomerates, pumice, lignite, and attendant clays found throughout the district are classed by me as belonging to two distinct periods only—viz., a recent one, still incomplete, with its transitional deposits of high-level gravels; and one corresponding to the Kidnapper pumice and conglomerate deposits, and which I ventured some time ago to place as the youngest of the Pliocene deposits, and as closing the Tertiary period.

Now, in order to show clearly and fully the wide divergence between Mr. McKay's classification and my own, and between his present classification and a former one, I shall make extracts from his reports, and then summarize those extracts, as representing the classified arrangement of the rocks in this district by the Geological Department.

1. On page 192 of the Geological Reports, 1886–87, appears the following, respecting the Kidnapper beds: "From Cape Kidnappers westward along the south shore of Hawke's Bay Tertiary beds . . . . continue to the first point inside the cape, and are there overlain by Te Aute limestone. . . . . Superimposed on these, but *unconformable* to the limestones, a great thickness of conglomerates, sands, and clays succeeds. . . . As these beds follow the Te Aute limestone . . . I had formerly supposed them to *succeed these limestones conformably, and to be the same as the Esk and Rangimapapa conglomerates and pumice*-sands which *underlie the Petane clays;* but the past year's work has shown that similar gravels on the north bank of the Tutaekuri River, near Taradale, rest on a denuded surface of the Petane beds, and I therefore consider them to be of Pleistocene date."

2. Page 193, Scinde Island: "Notwithstanding this change of the name, I refer all the beds in Scinde Island to the Wai-

patiki beds, which clearly *overlie the Petane clays and sands.*" Here the Napier limestones are placed above the Petane clays, as seen in the inner harbour; but, although this classification has been made, Mr. McKay is clearly doubtful on the point, for he says a little further on, "Whatever the ultimate conclusion arrived at may be, there seems no likelihood that the lower limestone in Scinde Island will be referred to the Pareora system of Hutton."

3. Page 200, younger Pliocene, Petane series: "This series includes—(*a*) Mahia beds, consisting of pumice-sands, sands, and clays, overlying the limestones on the west side of the Mahia Peninsula; (*b*) the Waipatiki beds, including an upper and a lower shelly limestone, parted by a series of sandy clays and pumice-sands; (*c*) the Kaiwaka beds, which comprise the typical Petane clays and sands, and the pumice-sands, conglomerates, and brown sands of the Esk Valley and Kaiwaka Creek."

4. Page 205, older Pliocene, Pohui series: "This includes the triple sandstone conglomerate and other beds of Rangimapapa Hill, and the Pohui grey and brown sands, ... also the shelly limestones of Te Whaka and the Maungaharuru Range, and, as a consequence, to this should be referred the Te Aute limestone in the southern part of the district."

5. Pages 206–7, Rangimapapa beds: "These beds have not been proved fossiliferous in the district south of the Mohaka [River (?), 39th parallel]. On the north bank fossils have been obtained from what should be the same beds. The collection . . . . consisted mostly of recent shells."

6. Page 202, Petane clays: "These are best known . . . along the north and western shores of Napier Harbour. . . . . To the south-west they extend across the Tutaekuri into the Ngaruroro Valley, in which they form characteristic strata underlying the Petane limestones. . . . . Farther to the south-west the clays overlying the Te Aute limestones along the eastern side of the Ruataniwha Plain *may belong to these beds;* but in this case the lower members of the *Kaiwaka beds would have to be considered absent, as also would the Rangimapapa and the Pohui beds.*"

(The italics in the quotations are my own.)

From the foregoing extracts the sequence of the younger and older Pliocene rocks of this district is as follows, according to the Geological Survey authorities:—

Older Pliocene.

I. Pohui series.
   1. Te Aute limestones.
   2. Pohui grey- and brown-sand beds.
   3. Rangimapapa triple conglomerates.

Younger Pliocene.

II. Kaiwaka series.

4. Sandy clays, brown sands, and conglomerates, underlying and alternating pumiceous sands, shales, and conglomerates.
5. Pumice and sandstone conglomerates of Esk Valley below Kaiwaka Creek.
6. Petane clay-marls and brown sands.

III. Waipatiki series.

7. Lower Petane limestones.
8. Pumice-sands and sandy clays.
9. Petane upper limestone.

IV. Mahia series.

10. }
11. } Mahia pumices and blue sandy-clay beds.

Pleistocene.

12. Kidnapper conglomerates and pumice.

It will be seen from this summarized classification how very widely separated are the two readings of the Kidnapper conglomerates to which Mr. McKay refers on page 192 of his report. The conglomerates were classed as conformable to the Te Aute limestones in the first instance, and, simply because similar beds are met with at Redcliffe, near Taradale, resting, as Mr. McKay rightly interprets, on the Petane clays, they are at once separated from the limestones by the other beds, and they are further transferred from older Pliocene, or Upper Miocene, to Pleistocene, and this for no other reason than that they are found at Redcliffe on the top of rocks representing the Petane clays. In the Kidnapper beds the fossils can be shovelled up from several bands that intervene between the limestones and the pumice; but all the shells are recent, and correspond more closely with those found in the artesian beds underneath the Heretaunga Plain, and which were described in my second paper on artesian wells, a year ago, than with the fossils in the limestones below them.

Before the present classification was made by Mr. McKay I had directed attention to the then classification adopted by the Geological Survey authorities, in which the Kidnapper pumice- and conglomerate-beds were made to pass underneath the Scinde Island limestones. The recent classification, as pointed out above, has separated the Kidnapper pumice- and conglomerate-beds from the limestones on which they rest by a very great gap indeed; but it seems to me that the difficulties in the way of harmonizing the stratigraphical arrangement of the rocks in this district have been increased very much thereby.

Let it be remembered that the Te Aute limestones, so Mr. McKay says, are at the Black Reef within eight miles of Napier, and that between the Scinde Island limestones and those at the Black Reef, on which the Kidnapper beds rest, there intervene, or ought to intervene according to the amended classification of the Geological Department, no less than eight beds, corresponding to the Pohui and the Kaiwaka series.

At Taradale, four miles from Napier, the Petane beds occur, and the Petane limestones overtop them where the conglomerates are absent. There is certainly not a trace of any intervening beds between the Napier or Scinde Island limestones and the Te Aute limestones, or between the latter limestones and the Petane clays, and exactly the same difficulty arises here which Mr. McKay saw would follow his squeezing process, where, in the sixth extract I have made from his report, he says that "the clays overlying the Te Aute limestones along the eastern side of the Ruataniwha Plain may belong to these beds; but in this case the *lower members* of the Kaiwaka beds would have to be considered absent, as also would the Rangimapapa and the Pohui beds." Now, if Mr. McKay is willing to recognize the clays on the eastern side of the Ruataniwha Plain, and which overlie the Te Aute limestones, as belonging to the Petane clays, why may he not consider the same as being possible in the case of the Petane clays at Redcliffe? But, whether he does so or not, the fact remains that in order to make his classification work it is necessary to consider all members of the Pohui and Kaiwaka beds as absent in this district as in the Ruataniwha district.

The limestones at the Black Reef dip underneath the Heretaunga Plain in the direction of Redcliffe, and it is certain that up the creek near the Black Reef, where the conglomerates, &c., are absent, the Petane clays are largely developed. The same thing occurs over the entire district. If the denudation has been very great the clays have gone, and the lower limestones have the pumice and conglomerates resting on them, whilst if the denudation has not been excessive the conglomerates, &c., rest upon the blue clays; but in the latter instance some of the former beds are absent. At Napier the upper limestones have been worn away in places by the denudation resulting from beds corresponding to the Kidnapper conglomerates. At Petane the same thing has occurred; and, in fact, the rule holds good over the whole of the district.

With regard to the Petane clays, I would point out, with all due deference to Mr. McKay, that these clays have their equivalents—identical as to material and identical as to fossils—on Scinde Island, and that these clays are found with the marls separating the upper and lower limestones, just as they are met with in the Waipatiki Creek, but without a trace of pumice, as stated in the official report. I have lately passed over the entire country between Tongoio and the Waipatiki Creek, and between the latter place and Moaeangiangi, and at the end of November last year I had the opportunity of going in a steamer from Mohaka to Moaeangiangi and Arapawanui, thence to Waipatiki and Tongoio, keeping close in shore the whole way. As far as I could judge after most careful observation, there appears to be no unconformability between any of the beds belonging to the series, and I agree entirely with Mr. Cox in this matter. The blue marls and clays which form the entire cliffs from Mohaka to Moaeangiangi are the lowest beds of the series. They are seen to underlie the limestones at Moaeangiangi, and they disappear a little to the south of Arapawanui. These are overlain by bluish-brown sands, followed by limestones corresponding to the lowest of the Napier limestones. At the Waipatiki Creek blue and brown clay-marls rest on the limestones, and these are followed by limestones, the arrangement being exactly similar to that seen between Sturm's Gully and Breakwater Point on Scinde Island.

For myself, I cannot see any distinction between the limestones at the Black Reef, Scinde Island (lower), Lower Waipatiki, and Te Whaka near Pohui, and the evidence in favour of contemporaneity appears to me as overwhelming. They all rest upon bluish-brown sands, which run into the underlying blue clay-marls, just as they are seen at the Kidnappers proper, at Moaeangiangi, at Maungaharuru, at Patangata, and in the district between Hampden and Maraekakaho. These blue clay-marls all trough in the direction of Hawke's Bay, as I have elsewhere indicated, and as Sir James Hector pointed out years ago. The entire series of limestones and interbedded clays are succeeded or were succeeded by the series belonging to the Kidnapper pumice and conglomerates which have been here described.

And that this arrangement as to the stratigraphy of the rocks in this district is the correct one, we have, in further proof, the facts gathered from the numerous sinkings for artesian water that have been made on the Heretaunga Plain, as also at Napier, Petane, and Puketapu. To the north and north-west of the Napier Hills, sinkings have been put down to a depth of 400ft., and the lower Napier limestones were struck at that depth a little beyond the Petane end of the Ahuriri bridge. This is exactly what might have been expected from the dip of the limestones in this direction. A well put down in May of the present year at Mr. Torr's, Petane Valley, to a depth of 100ft., simply passed through the shingle- and sand-beds full of brackish water which are met with along the sea-beach from Awatoto to Napier at a similar depth. The Napier marls or Petane clays are on either side of this valley, whilst the limestones are seen topping the hills in every direction. At Greenmeadows, near Taradale, Mr. Gilberd put down for Mr. Tiffen, so recently as March of the present year, a tube-bore to a depth of 600ft. I had pointed out on two different occasions, in papers read before this society, that the place chosen was outside the artesian water-bearing area; yet the sinking was proceeded with, and, though no water was reached, it proved to be of great scientific value, as it connected the lower beds in the well with the blue clays at the Kidnappers, which undoubtedly pass underneath the limestones at the Black Reef. In this sinking no traces of conglomerates or sands other than pumice-sands were met with, blue papa or blue clays being the only rock passed through during the sinking below the first 150ft. Now, this sinking is within a mile and a quarter of the Redcliffe conglomerates, and it is within half a mile of the upper pumice-deposits belonging to the Redcliffe bed. There were no signs of the Pohui conglomerates—triple conglomerates—and brown-sand beds, or even of the Kaiwaka beds that are held by the Survey to underlie the Petane clay-marls and brown sands, and which come between the latter and the Te Aute limestones in the official report of the Geological Department.

Let it be kept clearly in mind that the limestones at the Black Reef, inside of the Kidnappers, are recognized in the report as belonging to the Te Aute, or, which is the same thing, the Te Whaka limestones. The blue sands and blue clay-marls of the Kidnappers proper are seen to pass underneath these limestones, and are certainly met with in the 600ft. sinking at the Greenmeadows, near Taradale, to which reference was made above. Near the latter place the Survey recognizes the existence of Petane clays, with the Redcliffe conglomerates atop of them. Corresponding conglomerates also rest upon the Petane clays behind the Kidnappers, half a mile or so to the south-east of the Black Reef, just as they rest on the limestones at the latter place.

But the question arises as to the whereabouts of the intervening beds—the Pohui and Kaiwaka sands and conglomerates of the Geological Survey. There is no trace of them in the vicinity of the Kidnappers, just as there is no trace of them on the east side of the Ruataniwha Plain and surrounding district. They cannot be traced by means of deep sinkings either at Napier, Petane, Taradale, or Puketapu. Neither in the depths below nor in the exposed rocks above are any traces of the Pohui and Kaiwaka beds found, other than as represented in the Kidnapper, Redcliffe, Maraetaha (inner harbour), and Petane conglomerates, sands, and pumice-deposits. Are we to suppose that these Pohui and Kaiwaka beds which are structurally similar to the Kidnapper and Redcliffe beds, and are found resting on similar limestones and clays, were deposited, the former at the commencement of the Pliocene period, the latter at the commencement of the Pleistocene, as stated by the Geological Survey? Such a classification is contrary to every geological fact in this district, and it opens up difficulties which cannot be harmonized either by the aid of stratigraphical or palæontological evidence. Mr. McKay, by a single stroke of his pen, removed the Kidnapper conglomerates from resting conformably upon rocks classed as Upper Miocene, and as passing underneath the Scinde Island limestones, to an unconformability, as of Pleistocene age, and, of course, much younger than the Napier limestones. Had a similar course been adopted with regard to the Kaiwaka and Pohui conglomerates and sands, which, curiously, Mr. McKay first classed with the Kidnapper conglomerates, the alteration would have enabled the rocks of this district to be read without difficulty. As remarked at the outset, the official report of the Geological Department is full of interest, and had the Kidnapper conglomerates, together with the Kaiwaka and Pohui beds, been simply removed from Upper Miocene to Lower Pleistocene, this paper would not have been written.*

Art. XXXV.—*Note on the Eruptive Rocks of the Bluff Peninsula, Southland.*

By Professor F. W. Hutton.

[*Read before the Philosophical Institute of Canterbury, 7th August, 1890.*]

The structure of the Bluff Peninsula has been lately described by Mr. James Park in a report to the Director of the Geological Survey of New Zealand.† It is composed partly of sedimentary sandstones and slates, which are referred by Mr. Park to the Te Anau series, from lithological characters, and partly of eruptive rocks which have usually been called syenites.‡ There are also diabasic-ash breccias, which, as Mr. Park points out, prove that volcanic activity was exhibited during the period of deposition of the sandstones. In fact, Bluff Hill is the stump of an old volcano.

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* See map of the district, Trans., vol. xx., pl. xviii.

† "Reports of Geological Explorations," 1887–88, p. 72, with map and sections.

‡ Dr. C. Forbes, Quar. Jour. Geol. Soc., vol. ii., 1855, p. 522; Hector, in Otago Provincial Gov. *Gazette*, 5th November, 1863; Hutton, Reports Geol. Expl., 1871–72, p. 102; Geology of Otago, Dunedin, 1875, p. 41; Hamilton, Trans. N.Z. Inst., vol. xix., p. 452.

A few years ago I examined two rocks in my possession, from the Bluff Peninsula, and found one to be an enstatite diorite, the other a hornblende porphyrite.*

Last summer I had an opportunity of visiting the Bluff for a few hours, and I then collected other specimens of rocks, of which I offer short descriptions.

Hornblende Diorite. From Bluff Hill.

A coarse-grained, granular, light-grey rock, composed of black hornblende and greyish-white feldspar, the latter usually the more abundant. Specific gravity = 2·835.

Section.—The feldspar is entirely plagioclase, in plates about 0·035in. square, or in broad laths 0·046in. long by 0·022in. to 0·03in. broad, and well twinned. The hornblende is allotriomorphic, greenish-brown, strongly pleochroic, and partly decomposed to a pale bluish-green, slightly pleochroic, fibrous chlorite. Magnetite is not in great quantity, and is generally associated with the hornblende. There is a little pyrites.

Enstatite Diorite. From Bluff Hill.

A fine- to medium-grained, granular, dark-grey rock, composed of black hornblende and colourless feldspar in nearly equal quantities. Specific gravity = 2·88.

Section.—The feldspar is entirely plagioclase, in crowded, well-twinned crystals, from 0·01in. to 0·05in. in length, and from 0·007in. to 0·001in. in breadth. The hornblende is brownish - green, moderately pleochroic, the polarisation colours not brilliant. Augite occurs in quite subordinate quantity to the hornblende; pale-greenish in colour, and forming intergrowths with the hornblende; not pleochroic, and with brilliant polarisation colours. Enstatite is in small quantity, intergrown with the hornblende; it is moderately pleochroic, changing from bluish-green to brownish-red; in ordinary light it is yellow-green. The polarisation colours are not brilliant. Magnetite occurs in crystals and in masses; it is nearly always associated with the ferro-magnesian minerals.

Hornblende Porphyrite. From Green Hills.

A dark greenish-grey, fine-grained rock, with porphyritic crystals of hornblende scattered through it rather abundantly. Specific gravity = 2·901.

Section.—Ground-mass holocrystalline, composed of grains and crystals of feldspar and brown hornblende, with some chlorite. The porphyritic minerals are plagioclase and hornblende. The former is much altered. The hornblende is brown, and partly idiomorphic. There is a little magnetite and pyrites.

* Jour. of Roy. Soc. of N.S. Wales, vol. xxiii., 1889, pp. 128 and 129.

OLIVINE GABBRO. From Bluff Hill.

A rather coarse-grained, dark-grey, granular rock. Specific gravity = 2·916.

Section.—Plagioclase in broad laths and plates composes about one-half of the rock; the other half is ferro-magnesian minerals. Diallage is allotriomorphic, pale-purple in colour, and forms ophitic plates enclosing the plagioclase and olivine; in places it is decomposed into chlorite. The olivine is colourless, in rounded crystals, much decomposed on the margins and in cracks; it is not abundant. Magnetite is in small quantity. There is also a little pyrites.

GREENSTONE ASH. From Green Hills.

Fine-grained, dark-green rocks, sometimes laminated with finer and coarser materials. These rocks are the diabasic ash of Mr. Park. Thin sections show them to consist of minute angular fragments of feldspar, much decomposed, but chiefly orthoclase, abundantly infiltrated with chlorite. There is no quartz. Pyrites occurs commonly.

ART. XXXVI.—*On the Murchison Glacier.*

By G. E. MANNERING.

[*Read before the Philosophical Institute of Canterbury, 4th September, 1890.*]

Plate XXXV.

INTRODUCTORY.—SOME REMARKS ON THE PRINCIPAL NEW ZEALAND GLACIERS.

IT is a strange fact that the average New-Zealander knows but little of the physical features of his own country. It is strange that he knows still less of its great mountains and glaciers, and of all the marvels of nature which immediately surround them; but it is stranger yet that there should lie hidden for so many years a glacier of such extent and importance as the Murchison, whose ice was trodden for the first time in the summer of last year. It is also interesting to note that almost all scientific explorations and records concerning our essentially alpine mountains have been made by foreigners or visitors to our shores.

The principal New Zealand glaciers on the eastern side of the main range are situated in the very heart of the Southern Alps, and comprise those at the head-waters of the Rangitata River—namely, the Havelock, Clyde, and Lawrence Glaciers;

those at the head-waters of the Godley River—the Godley and Classen Glaciers; and those at the head-waters of the Tasman River — the Mueller, Hooker, Tasman, and Murchison.

Amongst the names of men who have first explored these glaciers, that of von Haast naturally occurs to us, and the records he has left of his work will always be regarded as a valuable tribute to science and a lasting memoir of his indomitable energy and perseverance in opening up the orology of our magnificent chain.

The Rangitata glaciers were first visited in 1860 by the Hon. J. B. A. Acland and Messrs. C. G. Tripp and Charles Harper; and in 1861 von Haast made his first journey to the same quarter.

In 1862 von Haast explored the head-waters of the Godley and Tasman Rivers, traversing parts of the Godley, Classen, Hooker, Mueller, and Tasman Glaciers, and observed from the last-named the Murchison Glacier, which lies in the great valley on the eastern side of the Tasman, enclosed by the Malte Brun and Liebig Ranges.

Some few years later, however, these glaciers were more thoroughly explored by Mr. E. P. Sealy, of Timaru, who in one instance—viz, that of the Godley Glacier—crossed the saddle at its head, which leads to the West Coast.

In still more recent years the more important observations of note are those of the Rev. W. S. Green in 1882, of Dr. von Lendenfeld in 1883 on the great Tasman Glacier, and of the Government surveys, conducted by Mr. Brodrick, of the Godley, Classen, Mueller, and Hooker Glaciers.

Von Lendenfeld's work on the Tasman is that of the most scientific interest, and his book (published in German) is, I believe, a valuable work to those interested in glacial phenomena, whilst the map which he made is (with the exception of one glaring error—viz., the course of the Linda Glacier) a wonderfully correct and beautiful chart of the glacier and its tributaries and surrounding peaks.

Some observations for altitude, taken at the terminals of the Rangitata glaciers by the Hon. J. B. A. Acland during a course of twenty years from 1860, are very interesting, and tend to show that the glaciers are receding. The more interesting of Mr. Acland's observations go to show that in 1866 the altitude at the terminal face of the Clyde Glacier was 3,239ft., and that the point above, where the clear ice was lost in the moraine, was 1,057ft. higher. In 1867 this point was 980ft. above the terminal, and in 1871 only 752ft., thus showing a shrinkage of 305ft. in altitude between these two points in a period of five years. In 1880 Mr. Acland again visited the glacier, but, while being unable to take any measurements, he remarked a great difference in the appearance of the glacier, which led him to believe that the shrinking was still going on. My own casual observations on the Tasman, Hooker, and Mueller during the past five years bear this out in a decisive manner.

NARRATIVE OF THE EXPLORATION OF THE MURCHISON GLACIER.

It was on the 10th of January of the present year that Messrs. Arthur Harper, H. Montgomerie-Hamilton, James Annan, and myself started from our camp at the eastern base of Mount Cook—close to the Ball Glacier—for the Murchison, whose valley-mouth joins the eastern side of the Tasman Glacier opposite to this point.

Crossing the Tasman Glacier—here some two miles or two miles and a half wide, and mostly covered with morainic detritus—we ascended to a height of 500ft. or 600ft. on the shoulder of the Malte Brun Range, to get a glimpse up the valley from an advantageous point. From here, however, we could but discern the bed of the Murchison River and part of the terminal face of the glacier, some four miles distant; the major part of the glacier-face being hidden by the spurs abutting from the Malte Brun Range. Our object was to work our way to the head of the Murchison Glacier, climb over the saddle depicted on the various maps, into the Tasman Glacier, and so on down to our starting-point, and thus make a complete circuit of the Malte Brun Range. We were provisioned for two days, and favoured with fine weather.

Descending to the bed of the river, we wended our way up the flat. The bed of the river occupies almost the entire surface of the valley, and is composed of unusually small gravel, which has been spread out with remarkable evenness, and is threaded in all directions by streams from the glacier. The incline of the river-bed is very slight, and is probably caused by the lateral part of the Tasman Glacier blocking the whole of the mouth of the valley, and acting as a dam to the shingle, which would otherwise be washed down, leaving the coarser detritus to form a bed at a steeper angle.

About two miles up the valley an immense boulder-fan is met with, formed by a talus of denuded rocks from the Malte Brun Range, and this is accompanied by a fine waterfall, having its source in a secondary glacier in the heights above; and above the glacier again a snow-clad peak (probably one of the peaks of Mount Chudleigh) appears. The whole scene presents a picture of great beauty. Here we lunched, and spent some time examining the interesting features of the spot.

By constant action of the water a cylindrical groove has been worn in the solid rock some 6ft. or 8ft. in depth, 10ft. or

12ft. across, and about 80ft. in height, so that the water descends, as it were, through a half-funnel, and with such force as to project a constant shower of spray (strange to say) in one particular direction only—viz., that immediately opposite the back of the cylinder. Under this spray some plants frequenting the locality (notably the *Myosotis*) flourish in the abundant moisture, whereas beyond the sphere of its influence they seem but indifferent specimens by comparison; whilst other varieties, not requiring such a constant state of moisture, are affected in a contrary direction, and struggle in vain to rival their brother-specimens on the mountain-side close by.

To this glacier and fall we have affixed the name of "Burnett," in honour of the only man who had previously visited the valley, and whose sheep-run is most contiguous to the locality.

An infinite variety of subalpine flora is found in the Murchison Valley, and at this time the slopes were gay with the rich blossoms of *Ranunculus*, *Celmisia*, *Myosotis*, and the golden heads of many varieties of the Spaniard. The valley would carry a large number of sheep during the summer months if it were possible to get them up; but I should imagine the risk of having them snowed in during the autumn would be considerable, even were it practicable.

At this point the course of the valley trends to a more northerly direction, the compass reading about north-east. Soon we arrived at the terminal face of the glacier, which by aneroid measurement determined the altitude at 3,700ft. above sea-level. Von Haast gives the figure as 3,540ft.; but it is strange that he makes no mention of a visit to the spot in his work. Possibly he estimated the height from observations taken at the spot where the river joins the Tasman Glacier.

The lower part of the glacier is all moraine-covered, and presents a wall about 200ft. in height blocking the whole of the valley, which appears to be about a mile and a half to two miles in width at this part. The moraine is composed of unusually large polyhedral masses of rock, piled up in mounds and ridges in a state of the wildest confusion, amidst which very few outcrops of ice can be detected. This moraine is one of the roughest I have seen.

Wending our way up the western side of the moraine, we soon arrived at the junction of a second large glacier descending from the Malte Brun Range on our left. This glacier lies in a double basin in the mountain-side, and pours down a steep declivity, bearing with it quantities of morainic matter from above, and, like the Burnett Glacier, is accompanied by a waterfall descending (in this case for some hundreds of feet) from its south-western portion. After obtaining His Excellency's permission, we have named this glacier the Onslow

Glacier, in honour of the present Governor of this colony. Here we spent the night, wriggling into our oiled-calico sleeping-bags, on a bed of small gravel in a hollow of the moraine at the junction of the two glaciers, where, though running some risk from falling stones from the ice-slopes on two sides of us, we were protected from the cold breeze which blew up the valley.

We were early aroused in the morning by the persistent attention of several keas, as they hopped around us and even pecked at our sleeping-bags, so tame and unaccustomed to man are they in these parts. Once more shouldering our torturing swags, we proceeded on the western side of the moraine, and ere long descried a third glacier (of the second order), nestling in a comparatively low saddle on our left, and further ahead still a fourth and very large tributary glacier, coming down with a grand sweep into the main body of the Murchison. At first we thought this glacier to be the Murchison itself, as it appeared to compare somewhat with the maps; but on cutting our way up its gigantic lateral ice-slope we discovered our error, for there, a mile away east across the moraine, lay the clean ice of the glacier we had come to explore. The glacier we were now on we named the Cascade Glacier, as its form in its descent from the heights of Malte Brun resembles that of a cascade.

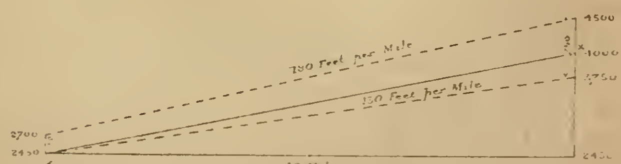
In an hour's time the clear ice was gained; but we were soon in trouble amongst a maze of crevasses on attempting to cross to the opposite side. This system of crevasses appears to be caused by the flow of the ice being faster on the western than on the eastern side, owing to the immense body of ice brought into this portion by the Cascade Glacier and several similar ones situated parallel to it, and farther north, on the Malte Brun Range.

The eastern side shows very little lateral moraine, for the western declivities of the Liebig Range do not carry such large quantities of ice as the slopes opposite, and denudation is consequently not so great. This fact is worthy of notice, for a similarity occurs in the case of the Tasman Glacier and the western slopes of the Malte Brun Range. I also understand from Mr. Burnett that the eastern slopes of the Liebig Range, at the head of the Jollie River, are clothed with considerable glaciers, whilst still further north (beyond Mount Jukes, which divides the watershed of the Jollie and Cass Rivers) the Huxley and Faraday Glaciers supply the head-waters of the Cass River.

After a futile attempt to cross these crevasses at right-angles to their trend, we struck up the ridges of ice which lay, like the leaves of a half-opened book, between them, until we had reached their extremities, and then struck across to the western side of the glacier, where we ascended to a point of observation and studied the view before us. Looking in the direction from whence we had come, a magnificent panorama was presented, for we were in full view of the major part of the Malte Brun Range with all its glorious peaks and glaciers. We also noticed that the only distant point visible from this spot was the upper part of Mount Sealy, situate at the northern end of the Ben Ohau Range. The topmost peak of Mount Sefton we had observed from a point farther down the valley. Turning our attention northwards, we began to realise more than ever the immenseness of the Murchison, and at the head of the eighth or most northerly tributary glacier from the west we discerned what we concluded must be the saddle leading into the Tasman. From this saddle a large rocky spur descended into the Murchison, *the head of which appeared to be just round its point.* The Liebig Range, on which we now were, soon assumed a northerly and then north-westerly direction, enclosing in the curve several tributary glaciers, one in particular, situate at the centre of the curve, being of considerable magnitude.

We now decided to stay out for another night, and make every effort to cross the saddle we had noted, and find a sleeping-place in the rocks on the Tasman side before nightfall. We pressed on up the middle of the glacier, endeavouring fruitlessly to identify the Malte Brun peak or Mount Darwin, whose aspects from the other side were well known to me. When abreast of the saddle we altered our course abruptly and made for it. Crossing a small medial moraine (which took its rise at the end of the rocky spur already mentioned, and was noticeable by its mathematically direct course —indeed, it presented from a distance the appearance of a straight metalled road), we were soon floundering across a perfectly level sloppy field of ice, which was entirely undrained by crevasses, and then commenced the gentle ascent of snow-slopes in soft and dangerous condition. We roped up, to avert danger from covered crevasses, amongst which we began to thread our laborious way. The work was very arduous, and this, added to the fact that one man was suffering extreme distress from exhaustion, and another from an over-worked sinew in the leg, made us almost despair of reaching the saddle. To add further to our troubles, a thick mist began to creep over the saddle, accompanied by a keen wind, and we stood in some danger of avalanches, owing to the loose condition of the snow. By dint of the exercise of much perseverance, and by the aid of many rests, however, we ultimately succeeded in zigzagging upwards amongst a perfect labyrinth of *bergschrunds* and crevasses, and at last crept up the final pinch to our goal.

MAP OF THE MURCHISON GLACIER.



Dotted lines indicate Surface & Bed of Glacier
× Position of Ice Cave

G L M del

C H P lith

Topographical.

The scene on the other side of the saddle was enveloped in mist, but after a few moments the fog vanished as if by magic, disclosing directly at our feet a large glacier, with a strange peak immediately opposite to us. We expected to gaze on Mount De la Bêche, Mount Green, Mount Elie de Beaumont, and the Hochstetter Dome, and all the well-known features at the head of the Tasman, and it was not until we suddenly discovered that the flow of the glacier below us pursued a course to our right (whereas the Tasman would have shown a directly opposite course) that we realised we were in full view of the true head of the Murchison Glacier, which commenced at our left, and led down a valley in an easterly direction, curving round the rocky spur (a saddle in which we were now on), and eventually assumed a south-westerly course. The total length of the glacier we estimated at from twelve to sixteen miles—probably nearer the latter figure—and its width from a mile and a half to two miles on the average, thus making it second in size only to the great Tasman Glacier.

We ascended to some rocks on our right, 300ft. above the saddle, and here, building a small cairn, deposited a record of our ascent. From these rocks, looking in a direction north by west, over the top of the strange peak directly opposite, can be seen what can hardly be any other mountain than the Hochstetter Dome, whose summit two of us had trodden in the previous autumn. The double dome of snow is a unique and almost unmistakable landmark seen from the Tasman, but I have never observed it before from an immediate southerly standpoint; yet we were agreed as to its identity: and, if we are correct in our conclusion, then glaring errors exist in von Haast's and von Lendenfeld's maps, and also in that issued by the Survey Office in Wellington for the use of tourists.

I am well aware of the danger of making topographical assertions when one is not acquainted with some knowledge of surveying, and where all distances have to be estimated, and the fixing of well-known peaks is uncertain; and I base all my remarks on the topography of this part on the assumption that the peak we observed north by west from our standpoint is the Hochstetter Dome. Did space permit I could adduce many reasons for the assumption, apart from the fact that the peak is well known to me from the Tasman, and that no mountains similarly capped exist in the vicinity.

This, then, being the case, the point on which we now stood must be on the eastern slopes of Mount Darwin, which *with* the Malte Brun Range is encircled by the Murchison and Tasman Glaciers. At the left of the conspicuous peak over which the dome is visible, a comparatively low saddle is situated, which must be the true Tasman Saddle, and at the right of the peak another saddle, which must lead into the Whymper Glacier, on the West Coast watershed.

Speaking on this point—viz., the orographical features of the Liebig Range—von Haast says, "Between the Tasman and Murchison Glaciers lies the bold and picturesque Malte Brun Range, appearing like an island, the Murchison Glacier having at no distant date joined the former, and thus surrounded this lofty snow-capped ridge. From Mount Darwin, the convergent range still continues its southern direction, where . . . . in the Liebig Range the glacier-sources of the River Cass . . . . are situated." According to our observations, of course, it will be seen that Mount Darwin has no connection with the Liebig Range, neither is it on the main range, but is enclosed, *with the Malte Brun Range*, by the Murchison and Tasman Glaciers.

Following with the eye the summits of the Liebig Range from the point of its divergence from the main chain, a short distance east of the Whymper Saddle, a fine array of peaks and glaciers presents itself. Situate in the big bend of the range is one mountain of toothlike form, which presents a remarkably imposing appearance, and seems to drain into the Classen Glacier from its opposite slopes; whilst just to the east of it is situate a low snow-saddle, possibly leading into that glacier. I cannot find this peak marked on any map extant.

Even supposing our conclusions regarding the topography of this locality to be wrong, there must be ascribed a far greater importance to the Murchison Glacier and Liebig Range than that given to it on any existing map. Our aneroid gave the height of our standpoint as 8,300ft., but this would probably be some hundreds of feet in excess of the true height. From the appearance of the saddle leading into the Tasman, and the crevasses around its base, we considered that it might prove impracticable even to a well-equipped alpine party.

The Return-journey.

Coming down to the saddle again, a decision to return by our upward route was quickly formed, for our distressed man was lying exhausted on the snow, and suffering from a severe attack of vomiting. Some people call this malady "mountain sickness," believing it to be brought on mainly by rarity of the air, and it is an evergreen subject for discussion amongst climbers; but most practised mountaineers incline to the belief that the sole cause of it is undue exertion when out of training: and in this case such a conclusion would be justifiable, for the subject affected had not been a week off 'board-ship, and was in anything but a fit condition for such exertion as we had undergone.

We had but three hours of daylight left, but made good time down, keeping to our upward tracks, and, with the exception of a lucky escape from a small avalanche which crossed our path behind us, and an occasional half-tumble into a thinly-covered crevasse, reached a point beyond the junction of the Cascade Glacier an hour after dark, where we bivouacked for the night, and next morning dragged our weary limbs out of our sleeping-bags at 4.30 a.m., and reached the Ball Glacier camp on the Tasman by noon.

Owing to shortness of provisions and the distressed condition of our party, it was imperative that we should return to camp as soon as possible, so that our topographical observations from our highest point were necessarily hurried, and I submit my suggestions with some diffidence, though we ourselves feel satisfied that they will be verified by future surveys.

Points of Scientific Interest.

The points of scientific interest which arise in an excursion of this nature are manifold, and the Murchison Glacier, with its immediate surroundings, offers a splendid field to the student or lover of nature.

To the geologist it exhibits sections laid bare for thousands of feet, and illustrations of the action of water, in its various forms of snow, frost, rain, ice, or stream, are plentiful on every hand. One can trace the history of a stone from the point of its denudation as an angular and many-sided block, through all its rough usage, grinding, and attrition during its years and years of travel down the glacier, and imagine it being gradually rolled over and over amongst its fellows, until, many decades after, it is brought up, rounded and smooth as a marble, by the Tasman Glacier, which bars its further course.

The many boulder-fans and tali of *débris* one meets with in the lower part of the valley naturally lead one to think of the history of their formation, which is, I believe, mostly accomplished by the agency of snow, and not so much by that of water as is popularly supposed. In the winter-time all the gullies that supply these fans are filled with snow (which is subject to a certain extent, and under certain conditions, to the same laws which govern the motion of a glacier), and, as denudation of the rocks proceeds, the detached fragments are precipitated on to the surface of the snow, and glide—where the angle of the descent is steep enough—and are carried down by snow-slips and avalanches in the spring-time, and deposited as the snow melts in the summer.

Fans composed of small shingle one can see being built up by water during flood-time almost anywhere, but these immense blocks cannot have been coaxed or wheedled down by the comparatively small trickle of water which meanders amongst them. The western side of the valley is particularly rich in illustrations of the deposition of rocks by snow.

To the botanist a field both novel and various is offered, whilst the artist might find scenes of the rarest beauty and grandeur.

To the entomologist many kinds of insects not met with elsewhere abound. The grasshopper family predominates, but several kinds of butterflies are to be seen. The insects which I have observed at the highest altitudes are a black butterfly (*Percnodaimon pluto*), with yellow spots on the wings, whose flight is sluggish and heavy; and a black weta (*Hemideina*), having a body 1in. in length, but with hair-like antennæ nearly 2in. long. These latter insects are found far above the snow-line, and appear to exist where even lichens are rarely met with. But the ubiquitous blue-bottle (*Calliphora*) soars even higher, for I have seen these flies at over 9,000ft., in places where the snow-line would be 4,000ft. below. Some very fine green lizards (*Naultinus*) are also to be found in the locality. I have seen a specimen, I should think, 18in. long.

Standing at the head of the Murchison Glacier one can read the history of its marvellous conception and growth—from the crystalline snowflake to the dull and absorbent condition, then into the *névé*, and by gradual infiltration, refreezing or regelation, and consolidation, into the glacier "granule," and by continued pressure into that hard black ice which one meets with in the middle and lower parts of a glacier, laden in lines from well-defined sources with its burden of millions of tons of rocks, shed by denudation from the adjacent mountains, and being borne on with slow but irresistible force to their resting-places on the lateral or terminal moraines.

The theory of glacier-motion naturally occurs to one in such a locality; and this subject opens out a large field for scientific observation and thought, which it would be imprudent to encroach too far upon in a paper of this nature. My own reading and observation lead me to think that the only theory worthy of credence is that of gravitation and pressure from above, and, in some instances, lateral pressure through contraction of the bed of the glacier. It has always struck me that the motion of a glacier may be most aptly compared to that of water in the bed of a river, that flows slowly in places, and is broken up and flows more swiftly over places where its bed inclines at a steeper angle from the horizontal. From careful observations by many men of note, it is well known that over beds inclining at the same angle a greater body of ice will flow more quickly than a lesser—an axiom which holds good with water. The simile is a favourite one of Tyndall's, Geikie's, and Forbes's, but is of very ancient origin amongst glacier writers.

The altitude of the Hooker Glacier at its head is 8,580ft.; at its terminal face, 2,882ft.; length, seven miles; and width, nearly one mile; and its average descent per mile, 665ft. Mr. Brodrick has endeavoured to obtain some idea of the rate of its progress at a point near the terminal face, and his observations give an average summer rate of 4·33in. a day. Allowing for the retarded winter motion, the result for the year would probably be brought down to under 4in. a day.

The altitude of the head of the Murchison would probably be 6,500ft., though the ridges on either hand are something like 8,000ft., and its terminal 3,600ft.; its length, say, is fourteen miles, and width a mile to a mile and a half; and the average descent per mile, 207ft. Assuming Mr. Brodrick's measurements of the Hooker to be correct, if we took the Murchison by comparison we should probably arrive at a much slower rate of progress. But, of course, this is little better than guesswork, for we cannot, except at the terminals of these glaciers, form any sound estimate as to their depth. Only in some places, where their lateral parts are laid bare whilst passing a gorge in the mountains at their sides, or by measuring the depth of their crevasses, can we hope to glean some insight into the question.

By the former method I have attempted in a rough way to arrive at a conclusion regarding the depth of the Tasman Glacier at a point some ten miles from the terminal face, where a large section of the ice is laid bare, showing in a most interesting manner a stratification of the ice, and the distortion it has undergone during its downward journey. On the surface of the glacier at this point the aneroid gave a reading of 4,500ft., and at the foot of the exposed ice of 4,000ft., and here was formed an ice-cave by the entrance of a mountain-torrent at a steep angle of descent from the slope of Mount Chudleigh, in the Malte Brun Range. One could penetrate downwards into the cave for a short distance only, owing to darkness, danger from falling ice, and from the impetuous nature of the torrent; but it is reasonable to estimate, from what observations I could make, that another 100ft. of thickness could be attributed to the ice, making 600ft. for certain. Now, the outlet of the river is 2,450ft. above sea-level, and the surface of the glacier at the point in question 4,500ft.; therefore the ice could not exceed in thickness the difference between these figures, or 2,050ft. But we must consider the slope of the glacier-bed. That of the surface of the glacier inclines on the average from the terminal face (250ft. above the outlet of the river) at 180ft. per mile. As the glacier advances to its melting-point it no doubt decreases in depth, despite the fact that it is protected from the rays of the sun to a large extent by the load of detritus which it carries; and the probabilities are that, if we could by any means get at the bed of the glacier ten miles from its terminal, we should find that 130ft. per mile would be sufficient to allow for the rise of the valley-bottom, in which case we could add another 150ft. to our 600ft. arrived at, making the depth of the glacier 750ft. at a point close to its side; and it is only reasonable to suppose that the bed of the glacier would dip towards its centre, so that probably a still greater thickness obtains in its middle portion. I imagine it would be a very difficult matter to obtain measurements of the depth of crevasses, as their sides are seldom or never quite vertical for any great depth.

The stratification of glacier *névé* is a further subject of interest, and whilst in the upper part of the Murchison we were favoured with a view of some sections of consolidated *névé* which had been disturbed by avalanches, exposing very markedly the stratification and strata of impure snow which accumulate on the level of each season's surface from dead insects and impurities and floating matter in the atmosphere during the warmer months of the year. Whether the strata in this instance marked the summer and winter seasons, or were occasioned by shorter periods of fine weather and snowfalls alternately, I am unable to say.

[Note.—In January, 1891, the Government survey of the Murchison Glacier was completed, confirming the topographical conclusions contained in this paper as correct.—G. E. M., Christchurch, 17th March, 1891.]

Art. XXXVII.—*On Avian Remains found under a Lava-flow near Timaru, in Canterbury.*

By H. O. Forbes.

Communicated by the Secretary.

[*Read before the Philosophical Institute of Canterbury, 6th November, 1890.*]

Plate XXXVI.

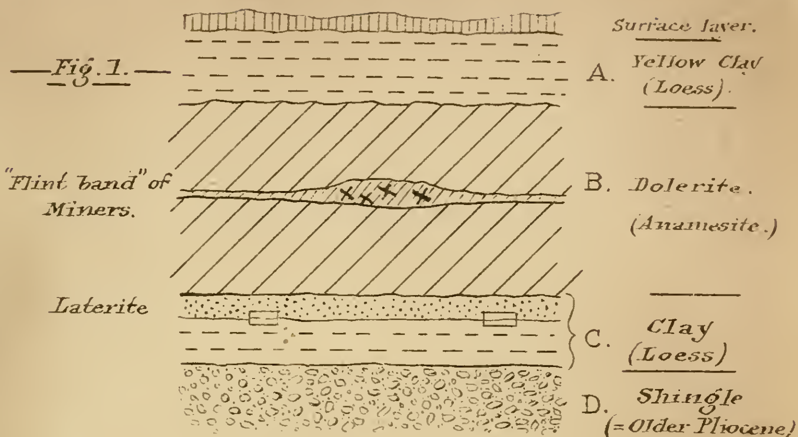
At the end of last year I received information that some avian bones had been found under a lava-stream near Timaru. On the 3rd February of this year (1890) I paid a visit to the district. Mr. Hogben, head master of the Boys' High School, had the goodness to meet me at the Timaru Railway-station, and afterwards to introduce me to Mr. Stubbs, the Secretary of the County Council, by whom these bones were first observed and their discovery publicly intimated, and at whose office in town I examined the specimens he had collected. Of these, the largest, nearly 8in. in length, were undoubtedly portions of *Dinornis* bones of one of the greater forms; but to what species they belong I was unable, on so cursory an examination, to determine; nor were the fragments, indeed, in many cases, in identifiable condition.

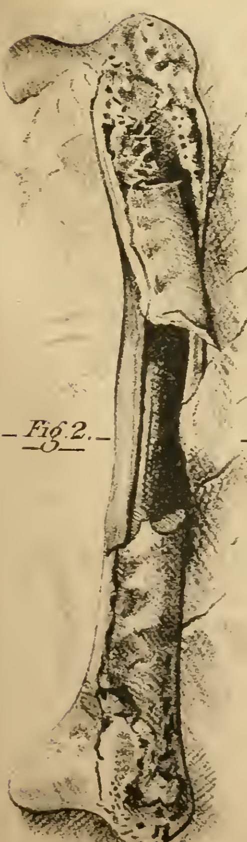
These fossils were discovered in the ravine of the Gleniti, an affluent of Saltwater Creek, which is in turn a tributary of the Otopara, in what is known as "Number-Two-Mole Quarry," because out of it that breakwater of the Timaru Harbour works was being constructed. Mr. Hogben and Mr. Stubbs obligingly accompanied me to the locality, distant from the town a mile or two in a south-south-westerly direction. There I met the manager of the works, to whom my thanks are due for his kindness in explaining to me the operations that had been going on for the past two years, and the character of the rocks and strata he had cut through. Some account of my observations on this occasion and of the bones found ought, I feel, to be put on record in the Institute Transactions.

The quarry formed a crescentic excavation, commencing at the front of the escarpment of the ravine, some 40ft. or 50ft. above the level of the stream, and had in its centre been worked out northwards to the depth of about 150ft. The section exposed at the time of my visit had continued all the way from the quarry-front with little alteration. The accompanying sketch (Pl. XXXVI., fig. 1) shows in a diagrammatic form the succession of the strata, and will render intelligible the description of the beds, which occur as nearly as possible at the same levels on both sides of the ravine. The uppermost layer, A, is composed of tenacious yellow clay, and forms the surface of the ground in this district. It presents all the characters of the clay flanking the Port Hills, near Christchurch, and is, I believe, the formation designated by the name of "loess" by my predecessor, Sir Julius von Haast. This stratum extends to a depth of from 26ft. to 28ft., and is supported on a deep dolerite belt, B, which is the *raison d'être* of the quarry. For a few inches at its top and bottom surfaces the dolerite presents a more vesicular and slag-like character than the rock composing the bulk of its intervening mass, which is fine-grained and crystalline. Through its centre runs longitudinally a band of still finer grain, more highly crystalline and more brittle than its over- and underlying portions. The quarriers had given it the name of "flint-band," from its hardness, and because, when blasted, it broke up into small fragments, which presented sharp fracture-edges, and emitted a "clink" like phonolite, or the clang of flint-chips, when struck. The width of this band varies in different parts of the division, B, from 2ft. at its widest gibbosities to a seam of such linear dimensions as to be difficult to trace, till a little further along it widens out, and then tapers off again. Without a closer than the ocular examination which I could alone give it, I could detect little difference in mineral composition in these two portions. In some places pockets of fine clay in thin laminated plates, intersected by cleavage-lines, ran perpendicularly through the dolerite-bed. These pockets exhibited no signs of change from heat, and must therefore be of age subsequent to the dolerite overflow. They occurred in the middle or towards the base of the stratum, and in one place extended down to the laterite. After careful examination I detected cracks in the dolerite leading to its surface, by which it was evident that the loess-bed above, while being deposited, had supplied in the form of liquid mud the packing (subsequently slightly compressed) for the fissures and vacuities which had occurred in the lava-flow beneath. This dolerite-bed, which is about 42ft. to 45ft. in thickness, rests on the third stratum, C, which must have been at the date of the lava-flow the surface of the ground. The lower surface of A gives no evidence of having suffered from the effects of heat, so that it is apparent that the dolerite band is non-intrusive.

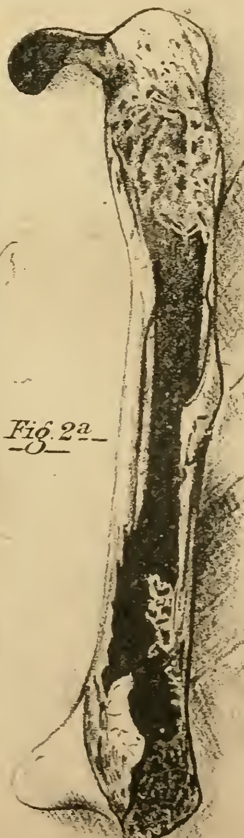
The belt, C, is composed of consolidated clay, presenting many of the characters of the present uppermost bed of loess, and is from 6ft. to 7ft. in depth. The surface-layer contains a few rounded red pebbles, and appears to have suffered a change which looks like fusion for about $\frac{3}{4}$in. below its upper surface. It does not present any recognizable evidences of having been deposited under water. It exhibits, on the contrary, wherever I have examined it, the characteristics of the Banks Peninsula deposit, with the peculiar tubuli seen in the loess, and, as in it, the surfaces of these tubuli are coated with what to the eye (without chemical examination) is a hardened gelatinous silicate, but what may perhaps be an extremely fine deposit of indurated mud. Besides the small tubuli there are many impressions of a large size, varying from $\frac{1}{2}$in. to $\frac{3}{4}$in. in diameter, whose sides are incrusted with an extremely thin, black, but non-carbonaceous substance, not improbably an iron-compound. These, from their section and irregular form, are evidently the empty moulds of roots or branches. This layer, C, at its junction with the dolerite, has been converted, for depths varying from 11in. to 14in., into laterite from the heat of the lava-stream in its incandescent state.

—Fig. 1.—





—Fig. 2.—



—Fig. 2a—

—Fig. 3.—

H.O.F. del. C.H.P. lith.

To illustrate Paper on Avian Remains.

The quarry-face does not exhibit the bed, D, next below the clay; but the manager of the works showed me where he had sunk a pit in the floor of the quarry, the *débris* of which was lying on the surface as a heap of red shingle and gravel, which was met with a few feet below the surface, and continued as far as his digging extended.

The quarry has been worked to obtain rock in large blocks for the breakwater; and to this end blasting has been carried on from long tunnels driven at right angles into the face of the quarry in bed C, underlying the dolerite. During the driving of these tunnels, partly in its softer portion below the laterite, and partly also in the laterite itself, the osteological remains which Mr. Stubbs showed me appear to have been found, and certainly those found later on by Mr. John Miller, the foreman of the blasting operations. This intelligent quarryman was good enough to permit me to remove to Christchurch for some weeks, for examination and identification, the bone-fragments he had exhumed. He showed me also the site of the tunnel in which he had discovered them. I was not myself fortunate enough to find any identifiable bones, or see any of them disinterred; but from amid the excavated clay I picked out a few chips showing undoubted osseous structure resembling that of the bones already found.

Most of the bone specimens were in a perfect state of preservation, and those of them that had been imbedded in the clay below the laterite looked, when cleared from their matrix, no older than the best-preserved moa-bones from caves or from turbaries. A few seemed to have been subjected to a greater or less degree of calcination. The collection made by Mr. Miller contained the following recognizable portions:—

1. The right femur (fig. 2) of a species of *Apteryx* indistinguishable from *Apteryx australis*. This specimen is imbedded in the lower part of the laterite layer, and appears to have suffered somewhat from heat. It is the most perfect of the bones recovered yet. It is entire except for the loss of part of the wall at its outer face—whereby its internal texture is revealed—and for a slight deformity due probably to pressure.

2. A portion of the distal end of a tarso-metatarsus of a species of *Dinornis*, which might have belonged to *D. curtus*.

3. The proximal end of a tarso-metatarsus of a species of *Dinornis*, which might have been owned by *D. curtus* or *D. didiformis*.

4. A fragment (fig. 3) of the pelvis of a species of *Dinornis* smaller than those to which 2 and 3 belonged, which fits very well with the corresponding part of *D. oweni*.

Besides these specimens there was—

5. A portion of bone, ¾in. in length, remarkable for the smallness of its medullary cavity and for the density and thickness of its walls — a fragment which I am in doubt whether to assign to a bird or to a reptile without the opportunity of microscopic examination. If it be a bird's bone it is neither a moa's nor an *Apteryx's*.

Some time after my visit to Timaru Mr. Hardcastle, of that town, was kind enough to send me a block of the dolerite having imbedded in it a portion of a pseudomorph of a round block of wood, originally measuring, he tells me, 15in. long by 1½in. in diameter, which had been entombed in the lava-stream.*

As I have remarked above, the *over*lying bed, A (which I find it difficult to distinguish by any marked characters from the bed *under*lying the dolerite), presents all the characters of the clay-deposit on the hills of Banks Peninsula. The origin of this clay in different parts of Canterbury has been ascribed (1) to marine deposit at the mouths (it is suggested)† of "the great rivers;" (2) to the same agencies by which Richthofen has explained the vast deposits of loam—the loess—in China—namely, by subaerial denudation and (chiefly) by the accumulation of the dust carried by the wind across the land, which is retained by the grass, whose roots also, in decaying, assist in raising the level of the ground.

To the marine origin of this formation I am entirely opposed, as it appears to me too extraordinary that a clay capable of preserving the fine tubuli (supposed to be the vacant moulds of decayed roots) should not have preserved a single stray leaf or a fern-frond; and that a current which was dropping down heavy moa-bones here and there should not also have deposited a branch or a fern-stem, or small pebbles in its course; and that there should be so remarkable an absence of unmistakable water stratification. That portion of Professor von Haast's theory which ascribes the accumulation of this loess to subaerial decomposition of the underlying volcanic rocks appears to me to be the sounder theory. But that it owes much of its depth to windborne dust seems to me very improbable, for the loess occurs abundantly on the seaward as well as on the landward side of the hills. In his "Geology of Canterbury and Westland," page 356, von Haast, speaking of the strata traversed in the construction of the Lyttelton tunnel, observes, "This bed of loess changes gradually before we reach the volcanic rock to a true slope-deposit, consisting of fragments

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* This has been submitted to Sir James Hector for analysis at the Colonial Laboratory.

† Hutton: Trans. N.Z. Inst., vol. xv., p. 413.

of rock more or less rounded, the lines of junction being often impossible to trace owing to the decomposition of the volcanic rocks immediately below the slope-deposits." This atmospheric decomposition is certainly to a great extent the true, and personally I believe almost the sole, explanation of this formation on Banks Peninsula, and I feel confident that it explains also very largely that occurring at Timaru. In numerous places on Banks Peninsula is to be seen the volcanic rock, with its external surface for some distance down absolutely converted into clay *in sitû*, and requiring only a touch of the fingers to cause it to fall down and mingle with, and be indistinguishable from, the clay, already fallen, covering the surface of the hill. Below this entirely-decomposed layer the rock is seen to be greatly weathered, rotten, and yellow, and only not disintegrated; further down it is less and less changed, till the unaffected rock is reached. This decomposed rock, as clay, becomes under the varying atmospheric changes now a viscid fluid, now a hardened clay, constantly gliding downwards. One has only to traverse or sail round the peninsula to see on every hill-face the most marked evidences of this continual downward movement, in the wave-like terraces, and in the scars or breaks in the surface caused by these landslips, which are constantly increasing mechanically the depth of the deposit on the lower parts of the hills, while the chemical action of the atmosphere is incessantly keeping up the supply not only in the parts exposed to the air, but also in the rocks below the deposit. These incessant landslips, sometimes extensive, but more generally of no great magnitude, are, I feel confident, the cause of the stratification—in my opinion, the *false*-bedding—which has been observed by Professor Hutton in a section near Lyttelton. In a considerable section recently (November, 1890) re-exposed at the Farnley brickfields, at the base of the Port Hills, not far from Christchurch, the stratification-lines, which on close examination reveal none of the certain marks of water-bedding, are most distinctly seen to correspond with the demarcation-lines of different landslips. These landslips, the higher gliding over the lower, would, as is evident, entomb whatever object might be on the surface; and thus can be easily explained the presence in deep layers of moa-bones, &c., and the rootlets of plants.

Both Professor Hutton and Dr. von Haast have remarked on the absence in these Canterbury loess-deposits of the "loess-babies," or marly concretions, seen in the loess of China. I do not myself see the significance of their presence or absence; but I may mention here that I have gathered many hard marly nodules of curious shapes in the Banks Peninsula deposit since I went to reside on its hills.

In the Gleniti quarry section I could detect no stratification in the uppermost stratum, A, nor in the bone-bearing bed, C; and I believe the upper deposit certainly to be due in chief part to the decomposition of the underlying dolerite going on for a long period. The same explanation should apply to the lower also. I can see no evidence of its being other than a subaerial formation. There is evidence also, I think, strongly pointing to the dolerite outflow having been laid down not, as Sir Julius von Haast has thought, under the sea, but on a land-surface.

I come now to determine the *age* of this bone-bearing bed. According to Professor Hutton,* "there is no trace of volcanic action having taken place in the South Island during this [the Wanganui] system or later." As the "Wanganui system" is referred in the same paper to the Pliocene period, it follows that the age of the bones below the lava-sheet at Gleniti must be, according to Professor Hutton, of Miocene age. The bed underlying the bone-bed is, as I have already said, a rough red shingle which belongs, with little doubt, to "the Moutere gravels" that underlie the Canterbury Plains—that is, the alluvial fans. Professor Hutton† considers these gravels to belong to "the upper part of the [Pareora] system." In the classification, however, adopted by the Geological Survey, the Moutere gravels are assigned to Pliocene age.‡ The clay overlying them may therefore probably be of newer Pliocene, or even Pleistocene age. Volcanic activity would consequently appear to have continued in the South Island, as it has done in the North Island, down to times much later than Miocene.

Mr. Mantell found in 1848 a fragment of a bone, impossible of certain identification, but supposed to be bird's, and from its size a moa's, in a *septarium* from Moeraki Beach, in Otago; but, as reptilian bones have since been obtained from the same horizon, it was probably of this nature. The bones described in the present paper are, however, the first that can be ascribed without hesitation to *Dinornis* and *Apteryx*, and are the oldest *certain* remains of these interesting birds.

Note.—The report "On the Geological Formation of the Timaru District, in reference to obtaining a Supply of Water," illustrated by sections, made to the Provincial Council of Canterbury in 1865 by the late Sir Julius von Haast, may be consulted for geological sections of the strata exposed in the neighbourhood of the Gleniti Valley.

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* Quart. Jour. Geol. Soc. Lond., p. 217.
† *Loc. cit.*, p. 209.
‡ Rep. Geol. Surv., 1878–79, p. 3.

DESCRIPTION OF PLATE XXXVI.

Fig. 1. Section of strata in Gleniti quarry.
Fig. 2. Femur of *Apteryx australis*.
Fig. 2a. " " showing internal structure.
Fig. 3. Fragment of pelvis of *Dinornis*, sp.?

Art. XXXVIII.—*Note on the Disappearance of the Moa.*

By H. O. Forbes.

Communicated by the Secretary.

[*Read before the Philosophical Institute of Canterbury, 2nd October, 1890.*]

Major Mair, in an interesting paper on the disappearance of the moa in vol. xxii. of the Trans. N.Z. Institute, makes, on page 71, the statement that he is a "supporter of the belief that the Maoris never had any personal knowledge of the moa." Major Mair so intimately knows the history and literature of the Maoris, and their habits and modes of thought, that one—especially one like myself, who has had time as yet to acquire only a small amount of experience of New Zealand things—can scarcely hope to contribute any suggestion on the subject of the history of the moa which has not occurred to this specialist.

The following short argument, however, which has weight with myself, may, I hope, be found not too trivial to be considered and refuted, if found wanting, by Major Mair.

Last year I had the satisfaction of making a very complete exploration of a recently-discovered cave on the property of Mr. Monck, near Sumner. A general description of the cave and of the more obvious finds in it has been given in a paper read before the Institute last year by the President.* The exploration was conducted under my own direction by two very trustworthy workmen, over whom in my absence Mr. Monck—who evinced the greatest interest in the progress of the work, and who has deposited in the Museum all the worked implements found—very kindly kept a superintending eye. The facts are these: The cave, it is acknowledged, has been closed since before the advent of Europeans to Canterbury, and how long before it is impossible to find out. The condition of the cave on entry gave all the appearance of having been untouched since the last dwellers in it left it. Its entrance was covered over by a very extensive landslip, which evidently fell during their absence, as no human

* Trans., vol. xxii., art. v., p. 64.

bones were discovered in it. Quarrying operations have been carried on amid the material of this landslip for between twenty and thirty years. These operations, on reaching last year the live rock of the hills, disclosed an aperture, through which a lad squeezed himself into the cave. On its floor were found implements in wood and in greenstone, half-burned pieces of timber, and fire-making apparatus, so lying as to give the impression that when its occupiers left they intended to return. The greenstone objects were beautifully made, while the implements of wood, such as the canoe-baler, the paddle, and the fragment of a paddle-handle, exhibit ornamentation characteristic of the Maoris. On the floor of the cave were found also numerous largish fragments of moa-bones, partly burned and partly broken, scattered round the last fireplace, or found on the floor of the inner caves. In the kitchen-midden in front of the cave were found many fish-hooks and barbed spear-tips made of bone from the same birds. On the surface were picked up several bones of more than one individual of a species of swan. *Just* below the surface of an untouched part of the midden I myself picked out pieces of moa-egg shell, each with its internal epidermis perfectly preserved. The question therefore stands thus: The moa-egg shells, being among the refuse of the feasts of the quite recent occupants of the cave, are the remains, it is legitimate to argue, of eggs they had eaten. There is no purpose I can think of, subject to Major Mair's correction, for which the Maoris could have used pieces of rotten eggs; for, exposed on the ground or buried under the soil with their contents, these eggs would soon burst and break up into fragments. It may be inferred, consequently, that these eggs were found by the cave-dwellers in a more or less fresh condition, and were brought into the cave for food purposes. If they were sufficiently fresh for food, I need not point out that the birds that laid them were, or could have been, still living, and probably were so, and that the bones from which the frequenters of this cave made their implements, were as likely to be obtained directly from living birds, or from birds which they might have killed. It may be suggested that eggs of moas might have been found sufficiently whole to be used for utensils. The fragments that I found had not been so used, as is demonstrated by the epidermis of the interior. In the other Sumner caves the remains of moa-eggs were abundant in the kitchen-middens, and were found in such positions as to suggest that they had been used for food.

The black swan (*Chenopis atrata*)—the only undomesticated swan in the country—was introduced into New Zealand from Australia a number of years after the settlement of Canterbury. The bones of the swans found in the Sumner cave were also left there by the feasters who ate the moa-eggs, and they too were therefore contemporaneous with the moa.

The figure of a dog carved out of wood was also found in the cave. A good figure of it will be found in the President's paper* to which I have already referred. The Maori dog must therefore also have been contemporaneous with the moa and with the now non-indigenous (if not extinct) *Chenopis sumnerensis*.

The fishing family or families who ate the moa-eggs, and who last occupied the Sumner cave, were, as far as the style of their ornamentation and handiwork can decide for us, as much Maoris as those who executed the ornamentation of the objects and implements which are exhibited in our museums, labelled "Maori;" and they were Maori, in contradistinction to a ruder people who have been named moa-hunters, as is testified by their highly-executed and polished greenstone work.

How long ago it is since the Maori and the moa were living together I have as yet elicited no evidence from the Sumner cave explorations. Much still remains to be done in the determination of the extensive osteological material obtained. When this work has been accomplished some more light may perhaps be thrown on the question of which this note forms the subject.

Art. XXXIX.—*On a Deposit of Diatomaceous Earth at Pakaraka, Bay of Islands, Auckland.*

By Alexander McKay, F.G.S.

[*Read before the Wellington Philosophical Society, 13th February, 1891.*]

Last March I examined the geology of the district surrounding Pakaraka, Bay of Islands, Auckland, and in the course of this work 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.

Of this I brought samples from the upper surface and from about 1ft. 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 1ft. from the surface of the deposit. Such being the result of the examinations made by him, on my describing the conditions under which the deposit had accumulated, by way of explanation of the facts Mr. Maskell

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* Trans. N.Z. Inst., vol. xxii., p. 70, pl. ii.

suggested that probably an older diatomaceous deposit had been denuded for supply of the lower part of that under description, and in which only fossil forms are found, while the higher and last formed were manifestly due to diatoms (of recent forms only) which had lived and died within the area wherein their remains had accumulated. But this is not the only explanation that may be advanced, and, this not disposing of all the objections to it, before advancing any of my own I deem it necessary to describe more closely the position of the deposit and the conditions under which it has accumulated.

Between the valley of the Kawakawa River (which from Pakaraka lies to the east and south) and the fall westward into the Hokianga River the drainage is carried by the Waitangi River into the Bay of Islands. Between Waimate and Ohaeawai on the west, to the hills south-east and east of Pakaraka, and thence east and north to Black Bridge, the upper Waitangi basin approaches to a circular form, and, with the exception of the volcanic cones within it, may be described as a depression surrounded by hills on all sides. Before the outbreak of the late Tertiary volcanoes, Cretaceo-tertiary beds covered most of the area from Turntable Hill to Waimate and from Black Bridge to the southern watershed. Probably the earliest eruptions began in late Pliocene times; but, although at different places the volcanic forces must have been active during the Recent period, there are not now (except in the neighbourhood of Ohaeawai, where yet there are thermal springs) any signs of activity. From Waimate a number of crater-cones encircle the western and southern limits of the Waitangi watershed. The most beautiful and perfect of these is Paeroa, situate—or rather, built up—on the southern side of the Pakaraka Plain.

Prior to the first eruptions of Paeroa, the site of the future mountain was a nearly level plain extending from Ohaeawai east through Pakaraka to the north-west of Turntable Hill and the range of hills of which it forms a part. The cone itself, and the lesser scoria hills that lie at its base to the north-east and east, are chiefly, if not wholly, scoria, which appears as a coarse breccia or scoria-ash of finer grain. The solid lava-streams from this crater lie on the south and south-west sides of the mountain. To the east, for the distance of a mile from its base, the scoria-beds form numerous small hills, and together form a ridge of higher ground, the eastern end of which abuts against a higher ridge of Cretaceo-tertiary rocks and a second volcanic cone which has arisen in that direction. This barred the flow of water which originally had its course to the north between the site of Paeroa and the Cretaceous hills to the eastward. Barred thus, the waters from the hills to the south-east passed the southern base of Paeroa and joined the eastern branch of the Waitangi west of the crater.

But the lava-flows of later date choked this outlet also, and in this manner formed the lake to the south-east of Paeroa. This has no visible outlet, and without question its surplus waters for the most part escape through the barrier of loose scoria-blocks and scoria-ash that lies to the north of the lake and east and north-east of Paeroa itself.

Several heavy springs, evidently drainage from the lake, appear at low levels among the scoria hills described. Of these, that which most concerns us at the present time appears from a brecciated rocky face half a mile east of Pakaraka House. It opens into a small nearly circular depression less than an acre in extent. On the north side of this the waters escape by a narrow passage, which has either been cut or usurped by the stream in its course north to join the larger creek, which in that direction flows north-west along that boundary of the Pakaraka Flat. In summer and during dry weather the amount of water issuing from the underground channel is very limited; but after a continuance of wet weather it is considerable, and not merely fills the narrow channel cut through the little patch of level ground below the outlet, but floods the whole basin to a depth of 3ft. or 4ft. When dry weather again sets in the basin is drained, and then there is left on the grass, ferns, and stones which form the bottom and sides of the basin, a white or greenish deposit of what on examination proves to be mainly diatoms. What of this falls on the bottom and level parts of the little grass-covered basin is soon washed through the grass and indistinguishably added to a thick deposit of the same material which has in this manner been accumulating since first the underground waters filled the basin.

On the stones and fern-fronds which are under water when the basin is full, the green living diatoms are deposited, forming a coating from ⅛in. to ½in. thick, according to circumstances. This deposit round the margin of the basin soon bleaches white on the surface, but is found to be green immediately below the surface. According to Mr. Maskell it is almost wholly composed of living forms of *Diatomaceæ*. Very probably the same species would be found among the grass-roots, and for the first few inches into the deposit filling the basin itself. Unfortunately, I 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 deposit in the middle of the basin is 6ft. to 8ft. thick, and was exposed by the cutting-down of a cattle-track crossing the creek at this place. I 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 samples were forwarded to England, and examined by one of the chief authorities on diatoms, whose decision was in accordance with the conclusion Mr. Maskell had already arrived at.

Such are the facts of the case, and such the conclusions arrived at by competent authorities. And yet I am not satisfied that the true explanation has been hit upon; and here I venture a theory of explanation to which objections may possibly be raised as grave as those which lie against Mr. Maskell's theory, yet they are in a different category: and I have written this paper so that the Society may have an opportunity of debating the probabilities of each.

Considering the conditions under which the diatomaceous deposit has accumulated, it is reasonable to expect that recent forms of diatoms would be found in the lowest, as well as the highest, beds of the deposit; and it is certainly surprising that the upper beds, or latest part of the deposit, should be wholly composed of recent species which are absent from the middle and lower parts. It is quite a possibility that the fossil species forming the bulk of the deposit have been derived from an older deposit, either forming the bed of the lake or now buried beneath the scoria hills to the east of Paeroa. But it seems to me 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 channel were deposited in the little basin whence the specimens were obtained. And, as the deposit is entirely composed of fossil species to within 1ft. of the present surface, the introduction or appearance of living forms is of very recent date.

As, however, the whole deposit is 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 are, it seems extraordinary that throughout the deposit there is not a mixture of fossil and living species.

Taking these facts into account, I 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 a different stock, and in this way would avoid the necessity of hypothecating an older deposit, the existence of which has not been proved, and, at the same time, accounting for the separateness of the living and extinct forms as they are found in the higher and lower parts of the deposit.

P.S.—I would here add that, as the surface-layers are formed wholly of living forms, and all are extinct at about 1ft. from the surface, it seems reasonable to suppose that at, say, 6ft. from the surface other and quite distinct species may be found. And, as Mr. Williams informed me he dug into the deposit to a yet greater depth without passing through it, other and quite distinct species, it is probable, will be found in the first-formed and lower part of the deposit.

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 of the deposit, since, if it is 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 my theory on the subject.

III.—BOTANY.

Art. XL.—*A Description of some Newly-discovered Indigenous Plants, being a Further Contribution towards the making known the Botany of New Zealand.*

By W. Colenso, F.R.S., F.L.S., &c.

[*Read before the Hawke's Bay Philosophical Institute, 14th July and 14th November, 1890.*]

Class I. DICOTYLEDONS.

Order I. Ranunculaceæ.

Genus 3.* **Ranunculus**, Linn.

1. *R. muricatulus*, sp. nov.

Plant small; rootstock perennial, short, very thick, with many long descending rootlets. Leaves 10–20, sub-rosulate, radiately-spreading, equal in length, closely appressed to the ground, broadly ovate or sub-orbicular in outline, 1½–3 lines diameter, tips obtuse, bases truncate, usually 3-lobed; lobes nearly equal, their tips obtuse rounded, sometimes sub-acute and notched, green, with purplish margins, 3- (sub 5-) nerved, nerves simple, slightly hairy on upper surface more so beneath; hairs long, white, straight, extending beyond margins; petioles ½in. long, slender, sulcated, purple, very hairy, their bases glabrous, membranous, much dilated and clasping. Scapes, usually 1–3 to a plant, slender, erect, 1½in.–3in. high, purple, with darker spots, very hairy; hairs white, closely appressed above, with muricated bases, patent below. Flower ½in. diameter, spreading. Sepals 5, purple, scarcely half the length of petals, spreading, ovate, tips obtuse, strongly 1-nerved, the 2 (or 3) outer ones with broad filmy white edges, very hairy, hairs white, with large muricated bases, extending beyond tips and margins. Petals 5 (very rarely 6), linear-oblong, obtuse, golden-yellow, shining, purplish on outside, with darker purple streaks on nerves, 5–7-nerved, nerves branching above; gland near base large, extending across petal, truncate, free,

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* The numbers attached to the orders and genera in this paper are those of them in the "Handbook, Flora of New Zealand."

margin crenulate. Anthers numerous, broadly elliptic. Stigmas hooked, finely papillate. Achenes in a small round head, about 12, glabrous, sub-orbicular, turgid.

Hab. High, dry, open plains, Tahoraiti, south of Dannevirke, County of Waipawa; flowering early in October; gregariously scattered, presenting when together, and the sun shining, a neat pleasing appearance, from their star-like brilliant yellow flowers; 1885–1890: *W. C.*

Obs. This little plant, I confess, has much puzzled me, and that for a long time—ever since my first detecting it, six years ago—as it certainly approaches *R. multiscapus*, Hook., very closely. It differs, however, from that species in several particulars: as in its common manner of growth, stellate and closely appressed to the ground, smaller and more simple leaves, fewer scapes, purple sepals, remarkably long white hairs, with their very conspicuous muricated bases, on the calyx lobes,—a prominent and invariable character that could not have been overlooked by Hooker. In this spring season (1890) I visited those localities much earlier than I had ever done before, and so saw this neat but humble plant (with several other lowly harbingers) in all its glory.

Genus 4. **Caltha**, Linn.

1. *C. marginata*, sp. nov.

A small tufted, rather slender, glabrous perennial herb; rootstock thickish, with a few (6) radical leaves, and short 1-flowered scape. Leaves spreading; blade green, 4–5 lines long, broadly elliptic, much-veined, deeply emarginate, largely cordate and auricled at base, with the obtuse auricles turned up and closely appressed to the surface of the leaf; margins broadly cartilaginous and pale, irregularly and distantly crenulate; petioles brownish, $\frac{3}{4}$in.–1in. long, dilated at base into large membranous sheaths. Flower $\frac{3}{4}$in. – 1in. diameter; scape half as long as petioles, stoutish, dark-brown. Sepals 5, linear acuminate, margined, purple on the outside, pale-yellowish within, margins thickened, white. Stamens few, short; anthers elliptic. Carpels few; style short, stout, shining, slightly hooked.

Hab. On secondary summits of Ruahine Mountain-range, east side, County of Waipawa; 1890: *Mr. A. Olsen.*

Obs. A species evidently closely allied to *C. novæ-zealandiæ*, Hook. (discovered by me on the same range, but much higher up); but this is a smaller plant, and differs in several characters: as in the shape of its leaves, which are also crenulate and largely margined, their cartilaginous margins being conspicuously pale; in its narrower and purple sepals, which are also margined; and in its fewer stamens.

Order XXII. Leguminosæ.

Genus 1. **Carmichælia**, Br.

1. *C. suteri*, sp. nov.

A very dwarf, glabrous, slender, twiggy shrub, 2in.–2½in. high, with numerous close-curved and erect, forked, and simple branchlets 1in.–1¾in. long, $\frac{1}{20}$in. wide, compressed, narrowly sulcated, tips obtuse, with small broadly-triangular scale-like bracteoles at lateral notches on stems, acute, pale and sub-ciliated. Leaves not seen. Flower solitary (large for plant), 4 lines long, "red-violet (turning somewhat greenish in drying)." Peduncle (proper) 2 lines long, slender, glabrous, pale, jointed on to a green stalk 3–4 lines long. Calyx-teeth large, broad obtuse, tips black, the margin between them slightly ciliolate, with 2 small distant bracteoles appressed at base, their edges cilio-fimbriate. Standard broadly orbicular, 2½ lines wide, slightly notched; wings large oblong, their tips broad rounded; keel sub-orbicular (expanded), tip very obtuse, deeply notched; ovary glabrous; style penicillate. Pod large, sub-oblong-lanceolate oblique, 7½ lines long (including beak), nearly 3 lines broad, corrugated; beak 1 line long, straight, sometimes slightly curved, acute. Seeds 7, small, reniform, sub-terete, smooth, symmetrical, unicoloured, pale dusky-purplish.

Hab. South Island, "near Mount Cook Hermitage, alt. 2,540ft.!; creeping upwards over stones amongst tussocks:" *Mr. H. Suter*, in lit., 1890.

Obs. A delicately-formed small species, nearly allied to *C. uniflora*, Kirk, but differing from that species in its much larger flower and pod, glabrous peduncle, obtuse black calycine teeth, &c., the pod being the largest of all the species known to me. It is named after its kind and liberal discoverer, Mr. Suter, a skilled scientist, who also, during his short sojourn there at the Hermitage, discovered several other small and interesting alpine plants, some of them being also described in this paper.

Order XXIII. Rosaceæ.

Genus 4. **Acæna**, Vahl.

1. *A. macrantha*, sp. nov.

Herb perennial, prostrate and sub-ascending, much-branched; main branches and root stout, woody. Leaves numerous, 2in. long, obovate (in outline), imparipinnate, membranaceous, dark-green; leaflets 5 pairs, distant, glabrous above, slightly strigosely hairy on midrib below; the upper pairs sub-sessile, broadly oblong, deeply serrate, tips truncate 3-toothed; lower pairs very small, sub-orbicular, petiolulate; petiole ½in.–1in. long, hairy, base much dilated, with a pair of long spreading linear bracts (or stipules) at upper corners—one at each corner. Peduncle naked, stout, erect, striate, sub-angular, red, 2½in–3in. long, hairy; hairs white, appressed; sometimes a very small leafy bracteole midway, very rarely two. Heads globular, 1in. diameter. Flowers dark-green; calyx-tube densely woolly-hairy; hairs long, white, 4 erect stout spreading spines, 1 at each corner, dark-red, glabrous, shining, 5–6 lines long, tips barbed, barbs white, with 4 (or more) rays. (The spines at flowering are shorter than the corolla, but soon gain their full length.) Petals 4, large, glabrous, oblong-lanceolate, spreading, 3-nerved, tips thickened, sub-acute and sub-apiculate; margins and tips becoming red in age. Stamens 2, slender, curved, largely exserted (also style); anthers small, globular, bright-yellow. Style large, stout, dilated, pinnatifid-plumose. Receptacle very small, sub-hemispherical, muricated.

Hab. On open plains, Tahoraiti, south of Dannevirke, County of Waipawa; 1886–90: *W. C.*

Obs. A species remarkable for the dark-green colour of its leaves and large petals; also, the deep red (port-wine colour) of its large heads of stout glabrous glistening spines, which give it a striking specious appearance, and serve to distinguish it from its congeners at first sight. It also grows much more compactly together than the allied indigenous common species, and is a scarcer plant.

Order XXVI. Droseraceæ.

Genus 1. **Drosera**, Linn.

1. *D. flagellifera*, sp. nov.

Plant small, slender, gregarious, perennial; roots long, thickish. Leaves few from one plant radical, erect, 1½in.–2in. long, scarcely 1 line wide, linear very acuminate, forked, often twice forked; circinnate in growth, glabrous below, very glandular above; glands red, sessile on upper surface, with long irregular stalks at margins, and very long at tips of leaves. Petiole slender, 2in.–3in. long, glabrous, reddish-green. Scape very slender, 8in.–10in. high, erect, glabrous, red. Flowers at top, 9–12 in a small branched cyme of 2–4 branchlets, usually 3 on a branch; pedicels 2–3 lines long, with a long linear bracteole, its tip truncate and laciniate, curled and appressed at the base of each branchlet. Calyx half as long as corolla, dark-green (black when dried), finely muricated or sub-rugulose; lobes oblong, truncate, largely and unequally laciniate, 3-nerved, nerves much-branched above. Corolla spreading, flat, 8 lines diameter, white (when fresh); petals distant, slightly concave, very membranous, sub-obovate, much truncate, the margins of tips crenulato-denticulate. Stamens 5; anthers orange-coloured. Styles 5 (or more) much-branched and forked, their tips (stigmas) irregularly shaped, broad, obovate, cuneate, lobed, emarginate, obtuse. Fruit, immature.

Hab. Margins of streamlets, low open grounds, south of Dannevirke, County of Waipawa; December, 1890: *W. C.* (Apparently very local.)

Obs. A species allied to *D. binata*, Lab. (an Australian plant), but certainly distinct in many important characters; very much so from the plate of that species with dissections given in "Nov. Holl. Plant." Also, from description of the northern form of *D. binata*, as given in the "Flora Nov. Zel.," which plant (writing from memory of it) is a much larger and stouter one. This plant in drying stains the papers used red.

Order XXVIII. Myrtaceæ.

Genus 2. **Metrosideros**, Br.

1. *M. aurata*, sp. nov.

Young branches terete, glabrous (as, also, leaves); bark reddish, slightly and closely rugulose or wrinkled. Leaves oblong- and sub-oblong- lanceolate, obtuse, 1in.–1¼in. long, 5–6 lines broad, decussate, light-green, erect, slightly spreading, sub-coriaceous, shining; margins thickened and recurved; profusely and irregularly covered with circular glandular dots of 2 sizes, some of them dark-red on the under-surface; veins diagonal, sub-parallel, distant, indistinctly forked near margins; midrib stout, flattened below, not prominent; petioles short, $\frac{1}{10}$in. long, stout, red, glabrous, sub-rugulose, swollen at base. Flowers terminal on tips of branches, erect in small loose cymes of 7–12, the outer ones usually 3, and 2, together, sometimes solitary as the others; peduncles decussate, 2–2½ lines long, with a pair of very small leaflets at base; pedicels short or 0, the calyx-tube (ovary) gradually forming them. Calyx-tube infundibuliform, 6–8 lines long, sub-terete, obsoletely ribbed, pale-green with a yellowish tinge, glabrous; lobes 5, large, sub-orbicular, concave, yellowish-green, glandular dotted; margins membranous and minutely denticulate. Petals yellow, large, sub-orbicular, concave, veined, minutely dotted with glandular dots; margins finely and closely lacinio-ciliolate; scarcely clawed but thickened and obsoletely veined at base. Stamens numerous, very slender, sub-½in. long, terete, wavy, spreading; at first expanding yellow, but soon becoming light-red; anthers small, oblong, yellow. Style longer than stamens and much stouter, terete, tawny-reddish-yellow; stigma slightly sub-capitate and narrowly margined, ovary deeply sunk within calyx-tube, indehiscent.

Hab. "Collingwood"; 1890: Communicated by *Mrs. S. Featon.*

Obs. This peculiar and elegant flowering species of *Metrosideros* I lately received (with other botanical specimens) from Mrs. S. Featon, of Gisborne, who had then recently obtained it from Collingwood. It is allied to *M. florida*, Sm., but differs from that species in several characters,—besides those striking ones of its yellow petals and their sub-laciniate margins. In outline its petals approach those of *M. robusta*, A. Cunn.; but these of this species are more largely veined and dotted. Specimens bearing mature fruit are much desired.

Order XXXIII. Umbelliferæ.

Genus 1. **Hydrocotyle**, Linn.

1. *H. nitens*, sp. nov.

Plant perennial, small, creeping, forming dense spreading mats; stems slender. Leaves glabrous, shining, green, broadly orbicular, 2–3 lines wide, basal sinus deep, 5-nerved, 6-lobed; lobes imbricate above, each 3-crenate-toothed; teeth large, broad, and sub-acute; sinuses shallow, their bases rounded and clear; petiole 1in.–1½in. long, erect, with a few weak long hairs at top close under leaf, usually 1 leaf and 1 peduncle rise from each node, about 1in. apart on the stem. Stipules membranous, broadly triangular, margins entire, pale-brown. Peduncle slender, erect, nearly as long as petiole, glabrous. Umbel 5–8-flowered; flowers shortly pedicelled, pedicels increasing in length in fruit. Involucre 5 short oblong concave scales, their tips rounded, with 1 smaller similar scale at the base of each pedicel. Petals dark-pink, oblong, concave, tips rounded, incurved. Styles long, deflexed, diverging. Fruit very small, oblate-globular, turgid; mericarps $\frac{1}{20}$in. diameter, 1 rib on face, back sub-acute; commissure deep; light-brown.

Hab. Forming large close-growing patches, or beds, sides of streamlets in plains, and in low shaded woods, near Dannevirke, County of Waipawa; 1887–90: *W. C.*

Obs. A very pleasing plant in its general appearance, from its numerous small neat and regular close glossy green leaves.

Genus 2. **Pozoa**, Lagas (*Azorella*, Lam.).

1. *P.* (*A.*) *elegans*, sp. nov.

A small perennial delicate herb of compact growth, densely tufted; stems simple, erect, slender, striate, succulent, glabrous, 3in. high, sometimes (but rarely) shortly proliferous. Leaves radical, 2–3-foliolate, 1in.–1½in. diameter; leaflets orbicular, 4–6 lines diameter, thin, obscurely 3–4-lobed, roundly crenate, margins cartilaginous; petiolules slender, 3 lines long; stipules large, broad at base, much fimbriate; petiole (also scape) slender, 2in.–2½in. long, pale-green. Peduncles 4–5 lines long, stoutish, springing from top of petiole under leaf. Umbels 2-3, in round heads, 20–30-flowered; pedicels 1 line long. Involucre many-leaved, leaves long linear, 1-nerved, tips very obtuse, involute. Flowers rather large for plant, showy, dark-purple; petals sub-obovate; rhomboid, tips acute; calycine lobes similar in shape, but much smaller. Stamens long, incurved; anthers globular. Fruit (immature) slightly ribbed.

Hab. South Island: "Sealy Range, altitude 6,000ft., the complete plant forming a big bunch or rosette with many flowers."—*Mr. H. Suter*, in lit., 1890.

Obs. This is evidently a very pretty and symmetrical little alpine plant, differing much in general appearance from the other described species, but possessing affinity with *P. trifoliolata*, Hook., also with *P. microdonta*, mihi, here following. I have received four good specimens from its kind discoverer, all very much alike, which (he says) he "got from one plant." To be in keeping with the genus in the "Handbook, Flora N.Z.," I retain *Pozoa*, though I prefer *Azorella*, to which older genus Bentham has removed it.

2. *P.* (*A.*) *microdonta*, sp. nov.

Plant perennial, very slender, glabrous; stem 1ft. (or more) long, filiform, prostrate, creeping, purplish, rooting at nodes 2in.–3in. apart; roots very long, capillary, white. Leaves 2–6 at each node, erect, 3-foliolate; leaflets equal, distant, divergent at right angles, sub-oblate-orbicular or sub-flabelliform, each 3–4 (sometimes 6–7) lines diameter, margined, minutely and regularly serrulate under lens; tips truncate and unequally cut and 5–6 crenate-lobed; lobes rounded, each mucronate at extremity of vein, 3-nerved, green, membranous, soft, much-veined, with a few scattered white succulent erect hairs on veins of upper surface and at margins; petiolules 1½–2 lines long; petioles slender, 3in.–5in. long, purple, channelled. Stipules small, with 3–4 rather long and stout succulent ciliæ. Peduncles springing from common petiole, one-third below leaflets, sometimes 2–3 from one point, ½in.–1¼in. long. Umbels (sometimes two unequal umbellules) 2–4- (rarely 6–10-) flowered, their stems stout. Involucral leaves 1–2 lines long, linear-ovate acuminate, lacero-ciliate. Flowers small, shortly pedicelled, 1½ lines diameter, calyx and petals forming a regular star; calyx-teeth small, membranous, broadly triangular, abruptly acuminate. Petals distant, spreading, very membranous, narrow sub-rhomboidal, abruptly acuminate, acute, with sometimes a minute irregular lobe, or tooth, at lateral angle, 1-nerved, margins minutely sinuate-crenulate, whitish, purple-dashed. Fruit oblong, turgid, ribs obsolete.

Hab. Forming large close-growing patches, or little beds, wood south of Dannevirke, County of Waipawa; October, 1889–90: *W. C.*

Obs. A species near *P. trifoliolata*, Hook. (to which I had, at first discovery, assigned it), but very distinct in several characters, in both leaves and flowers.

Order XXXIX. Compositæ.

Genus 9. **Cotula**, Linn.

1. *C. venosa*, sp. nov.

A slender weak sub-erect herb, clothed with long fine silky white hairs, especially on young leaves and flowering stems, 6in.–8in. high; generally with 1 main slender stem below, much-branched above; roots long and filiform. Leaves few, distant, scattered mostly on the lower parts of branches, $\frac{1}{2}$in.–$\frac{3}{4}$in. long, broadly oblong or obovate in outline, pinnatifid with 2–3 pairs of lobes on sides; lobes sub-lanceolate, simple, entire, sometimes with 1 small lobule on the upper edge of the larger lobes; margins thickened; tips acute, sub-mucronate, thickened, white; the apical portion of the leaf broad, 3-lobed, lobes equal; much veined, also the winged rachis and petiole; veins intramarginal; 2 pairs of small lobe-like stipules at base of petiole. Heads small, 2 lines diameter, spreading, solitary, terminal on long slender naked peduncles or tips of branches, 3in.–4in. long, simple, erect, 2–5 rising from a main branch. Involucral scales sub 2-series. Scales broadly oblong, the centre green, with a strong percurrent central nerve, and other nerves branching, their margins being very large membranous pellucid white, delicately and closely reticulately veined; edges of tips minutely sub-sinuate denticulate, soon becoming black. Ray-florets in two rows, pedicelled; corolla 0; achene obovate, apex simple retuse; a few fine short hairs in the centre on both sides; margins thick, broad, glabrous; styles spreading. Disk-florets cylindrical, 4-toothed; teeth broad, eglandular; pedicels long.

Hab. Forming small patches in open woods south of Dannevirke, County of Waipawa; 1890: *W. C.*

Obs. A species very near to *C. australis*, Hook., but differing from that plant in several particulars: as in its great hairiness, in the smaller size shape and markings of its leaves, in its larger heads, in its different flowers and achenes, and, particularly, in its beautiful and curious involucral scales.

Order XLII. Ericeæ.

Genus 2. **Pernettya**, Gaud.

1. *P. nana*, sp. nov.

A small low shrub of matted growth; main stems prostrate under ground, implexed, slender, woody, rooting, blackish; branches numerous, short, ¾in.–1½in. high, erect, simple, sometimes (but rarely) forked, glabrous. Leaves few, small, rather distant, alternate, petiolate, oblong-lanceolate sub 2 lines long, obtuse, thickish, glabrous, dark-green above, paler below, their tips white, minutely mealy; lateral margins sub-sinuato-denticulate, usually having 2 minute obtuse teeth on each side (when young each with a minute patent hair at its tip), few-veined, veins white and mostly simple, and sometimes possessing the mealy appearance of the tips, as also the teeth; petioles short, stoutish, red. Flowers (large for plant) terminal at tips of branchlets, 3–4 together sub-corymbose; peduncle sub 2 lines long, stout, glabrous, thickened at top, 2–3 bracteolate at base, with a larger bracteole near the top. Calyx glabrous; lobes broadly ovate, acute, cut nearly to base, margined red and finely ciliolate, single-veined, enlarging with the fruit in its growth. Corolla white, broadly campanulate or cup-shaped, 3½ lines long, 3 lines wide; lobes short, their tips broad obtuse recurved, each triplinerved; stamens nearly exserted, anthers appearing at sinuses of lobes; filaments long (length of style), obspathulate acuminate, 1-nerved, white, slender, smooth, minutely and distantly tuberculate (*sub lente*); anthers oval, light reddish-brown, 2-awned; awns short, stout, spreading, sinus broad; style erect, stoutish, pink, persistent; stigma glabrous, slightly tuberculate. Hypogynous scales oblate-orbicular, emarginate. Fruit globular, minutely puberulent, 2 lines diameter, 5-grooved, angles rounded; the tip depressed, umbilicate; light-coloured dashed with pink streaks.

Hab. South Island: on the ground, hills near Mount Cook Hermitage; forming large patches, of densely compact growth; January, 1890: *Mr. H. Suter.*

Class II. MONOCOTYLEDONS.

Order I. Orchideæ.

Genus 9. **Corysanthes**, Br.

1. *C. orbiculata*, sp. nov.

Plant small, 1in.–1½in. high, erect; a large sheathing bract at base of stem, and a long acute half-clasping one at base of ovary, 3 lines long. Leaf single, thin, 6–8 lines long, generally elliptic-cordate, sometimes somewhat broadly cordate, lateral margins straight; tip rounded, apiculate; petiole short, 1–1½ lines long. Flower solitary; dorsal sepal thin, very long, ¾in., lanceolate acuminate much overhanging, many-nerved; tip recurved; brownish-purple dashed on outside with linear purple dots; lateral sepals and petals narrow filiform, ½in.–¾in. (sometimes 1½in.) long, sub-erect, 1 line broad and 1-nerved below; lip dark purple-red, orbicular, 4–5 lines diameter, apiculate, margin entire, but under lens minutely and regularly denticulate, much-nerved; nerves distant, forked at tips, and extending to margin. Ovary narrow-oblong, ½in. long, striate, brownish.

Hab. South Island: "Mount Cook, Black-birch Creek Valley;" 1890: *Mr. H. Suter.*

Obs. Although I have received good dried and mounted specimens of this pretty little plant from its kind discoverer, they are not well fitted for minute microscopical dissection, having been too severely pressed. But this plant differs from our described New Zealand (and Australian) ones, in its thin elliptic and straight-edged leaf, and in the large orbicular and entire lip of its flower.

Class III. CRYPTOGAMIA.

Order I. Filices.

Genus 5. **Hymenophyllum**, Sm.

1. *H. truncatum*, sp. nov.

Sub-prostrate, depressed, thickly overlapping, matted, quite glabrous; roots slender, creeping. Fronds 1½in.–2in. long, broadly ovate and sub-deltoid, of a pleasing light-green colour (reddish-tinged in age), 3–4 pinnatifid. Pinnæ alternate; main rachis and secondary rachises much-winged; wings crisp; segments numerous, close, linear, sub-secund, inclined below surface of rachises, serrate; serratures large, distant, blunt; tips truncate, dilated, 2–3-toothed, sometimes fork-veined and emarginate; veins not extending to margins. Cells dusky, distinct, irregular, of various shapes and sizes, with wide darker intercellular passages between; their centres pellucid, irregular in shape; larger by sides of veins, and very small and more regular in form and compact at margins, giving the segments a thickened sub-marginal appearance. Stipe 1in.–2in. long, dark-brown (also rachis and secondary rachises), narrowly winged to base, with scattered red hairs when young; involucres few on frond, confined to upper pinnæ, usually solitary, or 2 (rarely 4–5) on a pinna, and only showing on the upper side, full, supra-axillary, very large, broadly sub-orbicular, or orbicular-flabelliform, paler green than and of different substance from the frond; valves large, free three-fourths of their length, vertical, their upper portion usually curved and compressed while young, but afterwards gaping; margins entire and sub-sinuate; cells distinct, irregular in size, but mostly quadriform (parallelogrammic), disposed in longitudinal parallel lines, their centres dusky, their edges thickened, dark. Receptacle small, included; capsules few at the base.

Hab. Plentifully on the trunk of a large tree, in a thicket, south of Dannevirke, County of Waipawa; 1887–90: *W. C.*

Obs. I. This fern has caused me a deal of labour and research, extending over several years, arising from my never having detected it bearing fruit until this year (1890). In some of its characters it is allied to *H. multifidum*, Sw., but in others it is very distinct from that species as described, and especially from that of the typical specimen with illustrations and dissections, given in Hook. and Greville's "Icones Filicum;" its fruitful fronds are very rare.

II. If I mistake not, I found this same fern 40–45 years ago in the *Fagus* woods on the secondary western summits of the Ruahine Mountain-range, completely covering the ground with its thick perennial matting. I assiduously sought for fruiting specimens on every journey thither, but was always unsuccessful.

[Mounted specimens of all these plants were also shown at those two meetings.—*W. C.*]

Art. XLI.—*An Enumeration of Fungi recently discovered in New Zealand.*

By W. Colenso, F.R.S., F.L.S., &c.

[*Read before the Hawke's Bay Philosophical Institute, 14th November, 1890.*]

In the autumn of this year I again sent a lot of Fungi to Kew, London (with other plants, both Phænogams and Cryptogams), which I had discovered at various times during the last four years in my visits to the dense forests and deep glens of the Seventy-mile Bush district, County of Waipawa; a few of them also being from Napier. Several of them were forms that were new to me, although I knew some of their genera and allied species. Altogether they numbered nearly one thousand separate packets, containing also a much larger number of specimens, but several were duplicates, and, indeed, three to four times repeated, having been obtained in different states, at different seasons of the year; and, while some of them were common (locally), others were extremely rare.

I sent them to Kew, to the Director of the Royal Botanic Gardens, Mr. W. T. Thiselton Dyer, C.M.G., &c., in order to get them determined, if possible, by the eminent fungologist, Dr. Cooke, who had so very kindly done so much for some former lots, collected in the same localities. I have very recently received from the Director at Kew a long and complete valuable list of a portion of the same (those already determined), and this I purpose now laying before you, omitting only those species which were already known, and described in the "Handbook, Flora of New Zealand," and also in my two supplementary papers of newly-discovered Fungi published in vols. xvii. and xix. of the Transactions. And, as on former occasions, I shall classify them thus:—

1. Foreign Fungi, already described, but not before found in New Zealand.

2. Indigenous species wholly new to science, true *species novæ*.

From these lists you will learn that, out of the large number of specimens of Fungi last sent by me to Kew, a total of 132 species are new to the New Zealand flora, and of these only five species have been determined as new to science.

FUNGI.

Section I.—Foreign Fungi already described, but not before found in New Zealand.

(1.) *Of Genera* known to inhabit New Zealand, as published in the "Handbook."*

Genus 1. **Agaricus.**

1. A. (Lepiota) mesomorphus, *Bull.*
2. A. (Tricholoma) rutilans, *Fr.*
3. A. (Omphalia) stellatus, *Fr.*
4. A. (Omphalia) anthiceps, *B. and C. prox.*
5. A. (Omphalia) fibula, *Fr.*
6. A. (Pleurotus) applicatus, *Fr.*
7. A. (Pleurotus) algidus, *Fr.*
8. A. (Pleurotus) guilfoylei, *B.*
9. A. (Pleurotus) salignus, *Fr.*
10. A. (Pleurotus) flabellatus, *B. and Br.*
11. A. (Pleurotus) subsupinus, *B.*
12. A. (Pleurotus) scabriusculus, *B.*

* The numbers attached to genera in this list are those of the same genera "Handbook, Flora of New Zealand."

13. A. (Pleurotus) tasmanicus, *B.*
14. A. (Pholiota) mutabilis, *Fr.*
15. A. (Pholiota) pudicus, *Fr.*
16. A. (Flammula) tilopus, *Kalch.*
17. A. (Flammula) chrysotrichus, *B.*
18. A. (Flammula) hyperion, *C. and M.*
19. A. (Naucoria) temulentus, *Fr.*
20. A. (Naucoria) semiorbicularis, *Fr.*
21. A. (Naucoria) melinoides, *Bull.*
22. A. (Naucoria) fraternus, *C. and M.*
23. A. (Naucoria) nasutus, *Kalch.*
24. A. (Collybia) nummularius, *Fr.*
25. A. (Collybia) distortus, *Fr.*
26. A. (Collybia) laccatinus, *B.*
27. A. (Collybia) velutipes, *Fr.*
28. A. (Crepidotus) mollis, *Fr.*
29. A. (Paneolus) fimiputris, *Fr.*
30. A. (Mycena) atrocyaneus, *Fr.*
31. A. (Mycena) epipterygius, *Fr.*
32. A. (Galera) tener, *Fr.*
33. A. (Armillaria) melleus, *Fr.*

Genus 2. **Coprinus.**

1. C. micaceus, *Fr.*

Genus 3. **Hygrophorus.**

1. H. niveus, *Fr.*
2. H. miniatus, *Fr.*

Genus 4. **Marasmius.**

1. M. vaillantii, *Fr.*
2. M. spaniophyllus, *B.*
3. M. exocarpi, *B.*

Genus 5. **Lentinus.**

1. L. zealandicus, *Sacc.*
2. L. lepideus, *Fr. affinis.*
3. L. hepatotrichus, *B.*

Genus 7. **Panus.**

1. P. tahitensis, *Reich.*
2. P. incandescens, *B.*

Genus 10. **Polyporus.**

1. P. squamosus, *Fr.*
2. P. lætus, *Cke.*
3. P. grammocephalus, *Berk.*
4. P. leprodes, *Rost.*
5. P. (Hispidi) setiger, *Cke.*

Genus 13. **Hydnum.**

1. H. niveum, *Fr.*
2. H. coralloides, *Fr.*
3. H. udum, *Fr.*

Genus 15. **Thelephora.**

1. T. fastidiosa, *Fr.*

Genus 16. **Stereum.**

1. S. ochroleucum, *Fr.*
2. S. pannosum, *Cke.*
3. S. illudens, *B.*

Genus 17. **Corticium.**

1. C. ochraceum, *Fr.*
2. C. sulfureum, *Fr.*
3. C. auberianum, *M.*
4. C. scutellare, *Fr.*
5. C. nudum, *Fr.*

Genus 18. **Cyphella.**

1. C. alboviolascens, *Fr.*

Genus 20. **Clavaria.**

1. C. misella, *B. and C.*
2. C. contorta, *Fr.*

Genus 25. **Secotium.**

1. S. czerniavii, *Mont.*

Genus 30. **Lycoperdon.**

1. L. sericellum, *B.*
2. L. gunnii, *B.*

Genus 46. **Puccinea.**

1. P. lychnidearum, *Lk.*
2. P. violarum, *Lk.*

Genus 47. **Uredo.**

1. U. compositarum, *v.* celmisiæ.

Genus 51. **Stilbum.**

1. S. vaporarium, *B. and Br.*
2. S. pellucidum, *Schr.*

Genus 60. **Peziza.**

1. P. margaritacea, *B.*
2. P. sarmentorum, *B.*
3. P. (Lachnea) cubensis, *B.*

Genus 65. **Asterina.**

1. A. effusa, *Cke. and Mass.*
2. A. subcuticulosa, *Cke.*

Genus 68. **Hypocrea.**

1. H. citrina, *Fr.*

Genus 69. **Xylaria.**

1. X. allantoidea, *M.*
2. X. zelandica, *Cke.*

Genus 70. **Hypoxylon.**

1. H. coccineum, *P.*

Genus 74. **Sphæria.**

1. S. mammæformis, *P.*

Genus 77. **Erysiphe.**

1. E. communis, *Lk.*

(2.) *Of Genera first published in "Transactions N.Z. Institute," vols. xvii. and xix.*

Hymenochæte.

1. H. kalchbrenneri, *Mass.*
2. H. tabacina, *Fr.*
3. H. mougeotii, *Fr.*

Calocera.

1. C. stricta, *Fr.*
2. C. guepinioides, *Fr.*

Trichia.

1. T. superba, *Mass.*

Mucor.

1. M. phycomyces.

Helotium.

1. H. sublenticulare, *Fr.*
2. H. claroflavum, *Gr.*

Polystictus.

1. P. sector, *Ehr.*
2. P. sanguineus, *Fr.*
3. P. tabacinus, *Mont.*
4. P. hirsutus *v.* cinerascens, *B.*

Rossellinia.

1. R. mammoidea, *Cke.*

Hemiarcyria.

1. H. rubiginosa.

Poria.

1. P. hyalina, *B.*, var.
2. P. corticola, *Fr.*

(3.) *Of Genera not before found in New Zealand.*

Sphæridium.

1. S. candidulum, *Sacc.*

Sporidesmium.

1. S. lepraria, *B.*
2. S. polymorphum.

Pistillina.

1. P. stilboidea, *Cke.*

Dactylium.

1. D. macrosporum, *S.*

Coleosporium.

1. C. fuchsiæ, *Cke.*

Lophadermium.

1. L. culmigenum, *Fr.*

Aleurodiscus.

1. A. oakesii, *B. and C.*

Trametes.

1. T. epitephra, *Berk.*, var.

Physarum.

1. P. leucopus, *Fr.*
2. P. lividum, *Rost.*

Fusarium.

1. F. elongatum, *Cke.*

Merulius.

1. M. corium, *Fr.*

Gibbera.

1. G. pulicaris, *Fr.*

Illosporum.

1. I. carneum, *Fr.*

Cintractia.

1. C. axicola, *Berk.*

Phyllachora.

1. P. junci, *Fr.*

Taphrina.

1. T. aurea, *Fckl.*

Cystopus.

1. C. candidus, *Lev.*

Pleospora.

1. P. euonymi, *C.*

Trichoderma.

1. T. viride, *Fr.*

Mylitta.

1. M. australis, *Fr.*

Ramularia.

1. R. obliqua, *Cke.*

Castoreum.

1. C. radicatum, *Cke. and Mass.*

Endothia.

1. E. gyrosa, *Fr.*

Peniophora.

1. P. velutina, *Fr.*

Spilocæa.

1. S. pomi, *Fr.*

Section II.—Species novæ.

Asteromella myriadea.
Craterellus insignis.
Læstadia hepaticorum.
Uromyces azorellæ.
Uredo acacia.

To these I add three *species novæ* lately described by me* (as forming part of the aforesaid collection sent to Kew) :—

Hydnum novæ-zealandiæ, *Col.*
Geaster coriaceus, *Col.*
Peziza (Lachnea) spencerii, *Col.*

* Trans. N.Z. Inst., vol. xxi., p. 79, and vol. xxii., pp. 451 and 458.

Total number of additional species of genera known to inhabit New Zealand	100
Total number of species of genera hitherto unknown in New Zealand	27
Total number of indigenous *species novæ* (three of them belonging to genera not before known to exist in New Zealand)	5
Total number of species new to our New Zealand flora	132

Two striking facts will here immediately arrest our attention (the same, too, as were quite as noticeable on the former occasions above mentioned) — viz., (1) the large number of Fungi here in New Zealand that are identical as to both genera and species with those of England and other western countries, a few of them being almost cosmopolite; (2) the small number of truly indigenous *species novæ*. And that those Fungi that are at present undiscovered will still continue to be found bearing pretty nearly the same ratio I have little doubt.

Another fact worthy of notice is the large number of genera not hitherto known to inhabit New Zealand. From the preceding list it appears there are no less than twenty-nine genera new to this country, many of them at present possessing but a single species; yet, as several of those genera contain a large number of species in other lands, it is but reasonable to suppose that the number of each genus will be largely augmented here.

Art. XLII.—*Descriptions of New Native Plants, with Notes on some Known Species.*

By D. Petrie, M.A., F.L.S.

[*Read before the Otago Institute, 13th May, 1890.*]

1. *Olearia fragrantissima*, sp. nov.

An erect compact twiggy shrub, 8ft. to 20ft. high; trunk 6in. in section or less; branchlets flexuous, grooved.

Leaves alternate, narrow-elliptic or lozenge-shaped, acute and slightly apiculate, thin, 1in. to 1½in. long, green and nearly glabrous above, clothed below with delicate rather loose grey tomentum; veins distinct.

Heads sessile on very short lateral branches, in sub-racemose fascicles of 10 to 12, with a cottony bract at the base of each head, smelling strongly and sweetly of apricots and peaches.

Involucral scales in two series, cottony on the back and edges, the inner longer and more membranous; florets 5 to 8, yellow, the outer series shortly ligulate; corolla sub-tomentose at the top.

Achene hispidly silky.

Hab. Otepopo; Dunedin (Vauxhall and Saddle Hill); Taiaroa Head; Catlin's River.

This species has been hitherto confounded with *Olearia hectori*, Hook. fil., under which name it was noticed by me in the "Transactions of the New Zealand Institute" (vol. xvi., p. 393). Until last spring the flowers of *Olearia hectori* were unknown to me, and, so far as I am aware, to all other botanists. They are now found to be very like those of *Olearia virgata*, Hook. fil., and to differ very widely from the raceme-like inflorescence of the present species. The alternate arrangement of the leaves should long since have suggested its specific distinctness, but this point of difference was somehow overlooked. The present species of *Olearia* is perhaps the most attractive of all the native shrubs of New Zealand, and its strong and delicious perfume is sure to make it a favourite plant for gardens and shrubberies. The flower clusters, though of a pleasing yellow tint, are rather small, but their great fragrance makes ample amends for their want of show. Like the other species of the genus, it is readily propagated by cuttings placed in a warm shady border. Some of the localities assigned to it in my notice above referred to apply to the true *Olearia hectori*, Hook. fil., and not to the present species. The time of flowering is November and the earlier part of December.

2. *Olearia odorata*, sp. nov.

An erect, much-branched, twiggy shrub, 6ft. to 10ft. high; branchlets strongly divaricating, terete, with numerous shallow grooves.

Leaves fascicled or in opposite pairs, on short usually opposite aborted lateral branchlets, $\frac{1}{4}$in. to $\frac{7}{8}$in. long, sub-sessile, narrow-obovate or almost linear-spathulate, rounded at the apex, coriaceous, green and almost glabrous above, densely clothed below with nearly white cottony tomentum.

Heads in small clusters of 5 or fewer, on the aborted lateral branchlets; pedicels short, rather stout, tomentose; involucral scales usually in 3 series, the outer series shorter than those within, the innermost half the length of the heads, viscid, puberulous, dark-brown; florets numerous (30 or more), the outer series shortly ligulate, the ligule more or less streaked with purple, the top of the corolla in the disc-florets viscid and puberulous. Achenes silky.

Hab. Maniototo Plain (at Sowburn and elsewhere); Upper

Manuherikia; Upper Clutha basin, as far south as Moa Flat.

This species like the last is strongly scented. It is closely allied to *O. virgata*, Hook. fil., with which it has been hitherto confounded. From this it is sufficiently distinguished by its stouter terete (not square) branchlets, differently veined leaves, viscid and widely different involucral scales, more numerous florets, longer achenes, much larger and broader leaves, and later season of flowering. Throughout the Upper Clutha basin *Olearia virgata*, Hook. fil., flowers in November; while the present species flowers in February or the last days of January, when the traveller's attention is attracted to wayside plants by their sweet but cloying perfume. It is a common plant throughout the Upper Clutha basin on alluvial flats and the lower slopes of the mountains, everywhere growing side by side with *O. virgata*, Hook. fil. It is a true upland plant, being nowhere found near the coast, so far as I have observed.

3. *Myosotis goyeni*, sp. nov.

Root perennial, woody, rather slender. The whole plant rather closely clothed with short stiff appressed white hairs, which give it a grey tint. Radical leaves tufted, 1½in. to 3in. long, linear-spathulate, acute, broadest near the apex (⅓in.), equally hispid on both surfaces, the narrow petiole more than half the length of the entire leaf. Cauline leaves numerous, scattered, similar to the radical, but in the upper ones with broader and shorter petioles.

Flowering-stems several, branched or simple, ascending, rather stout, the upper third naked, 5in. to 10in. long. Flowers in a simple or forked raceme 2in. long or less, large and showy, nearly sessile. Calyx deeply divided into 5 linear-subulate divisions; corolla tubular, dilated upwards, ½in. to ¾in. long, ⅓in. wide at the limb, which is divided into 5 large rounded lobes; the tube of the corolla pale yellow, the limb almost pure white. Stamens sessile on the tube a little above the middle. Style slender, slightly longer than the corolla-tube. Nuts four, large; mature forms not seen.

This species was first found, several years ago, by Mr. P. Goyen, F.L.S., at Arrowtown. I have gathered it also in the Cardrona Valley, and at the bluff on the east side of Lake Hawea. It flowers late in November, and has a very attractive appearance on the steep bare rocky or shingly faces which it appears to affect. It is very close to *Myosotis albo-sericea*, Hook. fil., from which it differs in the larger size of all its parts, the stouter, longer, and more branched flowering stems, and the much larger pale-yellow or nearly white flowers. In *M. albo-sericea*, Hook. fil., the whole plant is silvery-white with silky hairs, the flowers are a rich sulphur-yellow, and the flowering stems are slender and invariably simple. The description of it in the Appendix to the "Handbook," though drawn up from a single specimen, accords perfectly with a considerable suite of specimens in my herbarium. It is a very rare plant, and is now almost extinct at the only known habitat near Cromwell. The present species grows in great profusion in most of the localities where I have observed it. It stands drought very well, and is well worth cultivating.

4. *Glossostigma submersum*, sp. nov.

A minute herb, with very slender intricate stems, creeping, and rooting at the nodes. Leaves opposite, but sometimes fascicled from non-development of the internodes, linear, faintly one-nerved, entire, glabrous, $\frac{3}{16}$in. long. Pedicels as long as the leaves, axillary, very slender, borne alternately on opposite sides of the creeping stem.

Flowers very minute, stamens two.

Hab. Lake Waihola. This curious little species grows on the shores of Lake Waihola below high-tide level, and is submerged for a good many hours daily. It is very inconspicuous, and when not in flower very easily overlooked. The flowers, though so minute, attract the observer's notice by glittering in the sunshine like small beads of dew. It has only two stamens, a character which readily distinguishes it from the common species, *G. elatinoides*, Benth. Its nearest relative seems to be *G. spathulatum*, Arnot, from Rockhampton (Queensland).

5. *Deschampsia chapmani*, sp. nov.

Culms about 10in. high, decumbent and branched at the base, slender, leafy to the base of the panicle. Leaves flaccid, flat, narrow; ligule long, subulate, scarious, the basal part much broader than the blade of the leaf; sheaths deeply striate.

Panicle about 4in. long, laxly branched, the branches three or fewer, subdivided into scabrid capillary branchlets bearing numerous rather distant shortly-pedicelled spikelets.

Spikelets about $\frac{1}{8}$in. long, two-flowered (rarely three-flowered), green, shining; outer glumes unequal, membranous, narrow-lanceolate, acuminate, the lower one-nerved and half as long as the spikelet, the upper three-nerved and two-thirds the length of the spikelet; flowering glume membranous, broadly oblong, truncate and eroded into four or more teeth, usually one-nerved (additional nerves when present very faint), with a short slender blunt dorsal arm: palea bifid, with two faint ciliated sub-median nerves: rachilla glabrous, produced to half the length of the upper flower.

Hab. Auckland Islands. This interesting and, from a systematic point of view, important species was collected by Mr. F. R. Chapman, after whom I have much pleasure in naming it.

6. *Deschampsia tenella*, sp. nov.

Culms 8in. to more than a foot in length, tufted, much-branched at the base, very slender. Leaves flaccid, setaceous, striate, bright-green, 8in. long or less; sheaths grooved and produced into a long subulate scarious ligule broader at the base than the blade of the leaf.

Panicle 6in. long or less, rather effuse; the branches in pairs, long, scabrid, capillary, subdivided twice or thrice, and bearing few long-pedicelled minute spikelets.

Spikelets very small, $\frac{1}{12}$in. long or less, shining, two-flowered; outer glumes very unequal, membranous; the lower linear; the upper linear-lanceolate, acute, faintly one-nerved, and less than half the length of the spikelet; flowering glume oblong, membranous and hyaline, truncate at the apex with three short acute lobes, the middle lobe mucronate or shortly awned, the awn decurrent as a ridge for half the length of the glume; palea bifid, with two sub-median ciliate nerves; rachis and base of flowering glume clothed with fine silky hairs; rachilla half the length of the upper flower, sparingly pilose.

Hab. Catlin's River district, in moist rather open spots in woods, up to 400ft. The plant from the Ruahine and Tararua Mountains, hitherto referred to *Catabrosa antarctica*, Hook. fil., appears to be a form of this species, as I hear from Mr. N. E. Brown, A.L.S., of the Kew Herbarium.

7. *Deschampsia novæ-zelandiæ*, sp. nov.

Culms tufted, branched at the base, slender, ascending, leafy below, 4in. to 12in. high.

Leaves about one-third the length of the culm, almost setaceous, striate and channelled above; sheaths broad, membranous, grooved, terminating in a long scarious subulate sheath much broader than the blade of the leaf.

Panicle about 2in. long, with rather few flowers; the branches in pairs or threes, short, giving off one or two pairs of branchlets bearing few shortly pedicelled spikelets.

Spikelets $\frac{1}{8}$in. long, slender; outer glumes unequal (the lower one-half, the upper two-thirds the length of the spikelet), broadly lanceolate, sub-acute, membranous, one-nerved (the upper sometimes three-nerved); flowering glume shortly oblong, membranous and hyaline, truncate, eroded at the apex into 3 to 5 shallow acute or gently-rounded lobes, the middle lobe occasionally shortly mucronate, nerves 3 to 5 very faint, the middle one most distinct; palea shortly bifid, with two faint sub-median ciliated nerves; rachilla glabrous, produced to nearly half the length of the upper flower; grain broadly oblong, rounded, not flattened or constricted.

Hab. Hector Mountains, 4,000ft. to 6,000ft.; Mount Arnould (Upper Hawea), 5,000ft.; Mount Cardrona, 5,000ft.; in very moist situations, chiefly by the sides of small water-courses fringed by bog.

8. *Deschampsia pusilla*, sp. nov.

Culms very short, densely tufted, branched at the base, twice as long as the leaves.

Leaves about 1in. long; sheaths broad, grooved, membranous, produced into a long lanceolate acuminate scarious ligule; blade narrow-linear, sub-terete, channelled above, striate.

Panicle contracted and spiciform; branches solitary, short, glabrous, each bearing three, or fewer, sub-sessile shining spikelets.

Spikelets $\frac{1}{8}$in. long, 2- (rarely 3-) flowered. Outer glumes sub-equal, as long as the spikelet, linear-lanceolate, acuminate, hyaline, one-nerved; flowering glume silky at the base, shortly oblong, truncate, cut at the apex into 3 to 5 teeth, hyaline, obscurely one-nerved (the nerve being really the adnate decurrent awn), often with a short stout median mucro or awn, usually terminal but occasionally sub-dorsal in position. Palea hyaline, deeply bifid, with two very faint ciliate sub-median nerves. Rachilla slender, glabrous, half the length of the upper flower.

Hab. Hector Mountains, 6,000ft.

9. Note on *Triodia antarctica*, Benth. and Hook. f.

This grass, originally described and figured by Sir Joseph Hooker, in vol. i. of the "Flora Antarctica," under the name of *Catabrosa antarctica*, has been removed from that genus and placed doubtfully under *Triodia*. As to the propriety of the change, I shall have something to say below; but I may here point out that it is evidently a close ally of the four species of *Deschampsia* described in the present paper. As I have never seen any specimen of the grass, which grows on Campbell Island and appears to be very rare, I refrain from renaming it; but, if my view of the *Deschampsias* described above is accepted, the Campbell Island grass will form another species of that genus. The plant figured in Buchanan's "Indigenous Grasses of New Zealand" as *Catabrosa antarctica*, Hook. f., is almost certainly a form of *Deschampsia tenella*, mihi.

10. Note on the systematic position of the four *Deschampsias* described in this paper.

Among botanists there has been great uncertainty as to the systematic position of the grasses described as *Deschampsias* in the present paper. When the Campbell Island grass was first described, Sir Joseph Hooker placed it in the genus *Catabrosa,* Beauv., at the same time indicating several important points of difference. In the "Genera Plantarum," Bentham and Hooker removed it without hesitation from the genus *Catabrosa*, but did not well know where to place it, suggesting doubtfully that it might take rank in R. Brown's genus *Triodia*. Some of our best local botanists readily acquiesced in this view, but I have never been able to satisfy myself of its correctness. Repeated study of specimens of *Deschampsia tenella* and *Deschampsia novæ-zelandiæ* (described above) made me more and more unwilling to recognize their affinity to *Triodia*, and my difficulties led me to consult the botanical authorities at the Kew Herbarium in hopes that light might be thrown on this puzzling group of grasses. Mr. N. E. Brown, A.L.S., was good enough to go into the question very carefully, and he communicated to me his opinion that the grasses in question were neither *Catabrosas* nor *Triodias*, but *Deschampsias*. From the first I was inclined to accept the view put forward by Mr. Brown, and the discovery of *D. chapmani* and *D. pusilla*, early in the present year, finally set all my doubts at rest. *Deschampsia chapmani* is clearly not a *Triodia*, for it differs from that genus in having a dorsal awn, more numerous teeth at the apex of the flowering glume, and a wholly different type of ligule, as well as in many minor particulars. On the other hand, it is clearly a close ally of the series of grasses here described as *Deschampsias*, and, indeed, occupies an exactly intermediate position between the typical species of the genus and the aberrant awnless, or nearly awnless, forms referred to it in the present paper. The close alliance of the whole series makes it extremely probable that they all belong to one and the same genus, and the structure of *D. chapmani* proves that that genus is not *Triodia;* and I feel quite satisfied that their alliance is with *Deschampsia*, unless, indeed, a new genus should be created for their reception.

Mr. N. E. Brown has sent me a small piece of an awnless grass from the Andes which the late Mr. Bentham regarded as a *Deschampsia*, and he informs me that in one section of the genus the species are without awns. Beyond the piece above referred to I have seen none of these species, and no account appears to be taken of them in the generic character as given in the "Genera Plantarum," though the brief notices of some of the genera merged by Bentham and Hooker in *Deschampsia* clearly imply that awnless species are included. This is a point of great importance, for in *D. tenella*, *D. novæ-zelandiæ*, and usually in *D. pusilla*, the absence of a distinct dorsal awn is the only cardinal character in which these species depart from the normal type of *Deschampsia*. In some, it is true, the outer glumes are markedly unequal, but in others they are not more unequal than is usual in the genus. In all other respects they are all true *Deschampsias* and have little in common with *Triodia*; and the *Triodia* (?) *antarctica* of Bentham and Hooker agrees with the endemic New Zealand forms in every generically important feature. The chief characters in which they differ from *Triodia* are the uniformly membranous texture of the glumes and their few and faint nerves, the small number of flowers in each spikelet (nearly always 2); the uniformly stipitate upper flowers; the more numerous teeth or lobes of the flowering glume; the sub-median nerves of the hyaline palea; the absence of any imperfect terminal flower; the rounded-oblong (not plano-convex) grain; and the peculiar, broad, long, subulate, scarious ligule. In addition to these points of difference common to all the species here described, *D. chapmani* has a distinct dorsal awn, a character wholly foreign to *Triodia*. A similar dorsal awn occurs frequently in the flowers of an allied form of which I have specimens from Mr. T. Kirk, F.L.S., under the MS. name of *Triodia purpurea*, and it occurs occasionally in the flowers of *D. pusilla*, while in *D. tenella* it is hardly doubtful that the nerve-like ridge on the back of the flowering glume is an awn-like structure adnate to the glume. The remarkably uniform character of the ligule is a point of some importance, the more so as it is quite unlike that of *Triodia*, which is usually, if not invariably, represented by a band of hairs. The New Zealand species of *Triodia*, and also the British and Australian ones, all agree in this. Indeed, the two native species of *Triodia* present few points of close alliance with the series of *Deschampsias* noticed in this paper, while their differences are obvious and striking. The result of this discussion seems to be that the character of the genus *Deschampsia*, as given in the "Genera Plantarum," needs to be amended, so as to include the new species now brought to light from New Zealand and its outlying islands.

11. *Lobelia linnæoides*, sp. nov.

This is *Pratia* (?) *linnæoides*, Hook. f., described on page 172 of Hooker's "Handbook of the New Zealand Flora." When it was described the fruit was unknown, and, as the habit and foliage present a close resemblance to the indigenous species of *Pratia*, it was provisionally ranked in that genus.

The fruit, however, is not fleshy and indehiscent, but a dry bilocular capsule, opening by two rather large rounded pores between the persistent calyx-teeth. The seeds are numerous and very minute. The present species is widely spread over the interior of Otago, at elevations ranging from 2,500ft. to 4,000ft. I can give the following localities for it: Mount Kyeburn, Old Man Range, Hector Mountains, Mount Pisa, Mount Cardrona, Mount Arnould, Mount Tyndall (Matukituki basin), Ben Lomond, and Mount Bonpland.

12. Note on occurrence of *Carex lagopina*, Wahl., in New Zealand.

In vol. xiii., p. 332, of the "Transactions of the N.Z. Institute," I described what I regarded as a new species of *Carex* under the name of *C. parkeri*. The specimens then at my disposal were immature, but I have recently gathered an excellent series of mature forms, which show that my species is identical with the European *C. lagopina*, Wahl. The name bestowed on it by me therefore becomes a synonym of the latter species. Mr. T. F. Cheeseman, F.L.S., in his "Revision of the New Zealand *Carices*" (Trans. N.Z. Inst., vol. xvi., p. 426), was the first to notice its resemblance to Wahlenberg's plant. The present species adds one more to the growing number of indigenous plants that are common to New Zealand and Northern and Central Europe. It grows plentifully on the Hector Mountains at a height of 6,000ft., and has been gathered by Mr. A. C. Purdie at an elevation of 3,000ft. near the head of Lake Wakatipu. I have not met with it at a lower elevation than 5,000ft., near Mount Aspiring.

13. Note on *Acæna buchanani*, Hook. f.

In the "Handbook of the New Zealand Flora," this species is described as having a single stamen, but I have specimens otherwise indistinguishable from it in which the stamens are uniformly two. The error, if error it be, is no doubt due to the imperfect materials which Sir Joseph Hooker had to examine.

14. Note on *Olearia hectori*, Hook. f.

Some two years ago I received flowering specimens of this species of *Olearia* from Catlin's River, collected by Mr. J. T. Bryant, and I have more recently gathered specimens from a plant grown in the garden of Mr. John Buchanan, F.L.S., at North-east Valley, and brought by him from Lake Wanaka many years ago. As the flowers are as yet undescribed, I append a notice of them.

Flowers solitary or in fascicles of two or three, borne on short aborted lateral shoots, and springing from below the leaves; pedicel slender, ½in. long or less, sparingly cottony, dilated at the base of the receptacle; involucral scales in two series, linear-oblong; the outer series broader and villous, the inner narrower and glandular.

Heads ¼in. long, ⅐in. wide; florets numerous; those of the ray with a short narrow ligule and a deeply divided style; of the disc, with a rather long sparingly silky corolla-tube, contracted above the insertion of the stamens, and with shorter and broader divisions of the styles; pappus of few simple crumpled or wavy hairs; achene densely silky.

This species is common by the open banks of streams and in swampy situations at Catlin's River, where it is known as the "swamp gum." It also grows in the upper valleys of the Clutha River, at the Matukituki, &c., and along the Kawarau River as far as the Cromwell Flat. I have not seen it anywhere in the Clutha basin below the mouth of the Kawarau Gorge. As a species it is perfectly distinct from the most nearly allied forms, *Olearia odorata*, mihi, and *Olearia virgata*, Hook. f. It is much closer to *O. odorata* than to *O. virgata*. It flowers at least four months before the former, and a month or more before the latter. At Dunedin and Catlin's River the time of flowering is October. In general appearance it greatly resembles *O. fragrantissima*, mihi, but the leaves are larger and not lozenge-shaped, the twigs are not flexuous, and the inflorescence is quite different.

Art. XLIII.—*On a New Species of* Celmisia.

By F. R. Chapman.

[*Read before the Otago Institute, 10th June, 1890.*]

Celmisia campbellensis.

A low-growing glabrous species. Not tufted.

Leaves rosulate, 3in.–6in. long, ½in.–1in. wide, lanceolate, obtuse or acute, serrate, coriaceous. Above, glabrous; below, thinly clad with loose hairy tomentum. Remarkably deeply ribbed. Sheathing.

Scapes numerous, 12in. high. Slightly tomentose. Bracts numerous, 1in.–2in. long, large, sheathing, glabrous or slightly tomentose, serrate.

Head very similar in size and colour and the form of involucral scales to *C. vernicosa*.

Corolla-tube pilose; pappus ⅙in. long; achene hispid.

Hab. Campbell Island.

This species is founded on the remarkable foliage, which is quite different from that of any other species, and notably so from that of *C. vernicosa*, with which it is closely allied. The broad, glabrous, strongly-ribbed, acutely-toothed leaves make it a totally different plant in appearance, and, though the head does not differ materially from that of *C. vernicosa*, the general appearance of the scape is different. In place of the narrow shining bracts, the tip of each of which reaches the base of the next, the broad serrate bracts of this species, set on a much stouter scape dusted with tomentum hairs, considerably overlap those above them. In one of my specimens the scape is branched, and carries two heads.

This species was discovered by my brother, Mr. Martin Chapman, of Wellington, when we were out together on a small piece of level country, near a large rock marked on the chart, in the vicinity of Venus Cove, Perseverance Harbour, Campbell Island, and I have named it from the locality. We found about a dozen plants in the space of an acre here, and none beyond. I have found it difficult to keep in cultivation.

Art. XLIV.—*Further Notes on the Three Kings Islands.*

By T. F. Cheeseman, F.L.S., F.Z.S., Curator of the Auckland Museum.

[*Read before the Auckland Institute, 3rd November, 1890.*]

Plates XXXVII., XXXVIII.

In the spring of 1887, when returning from the Kermadec Islands in the Colonial Government steamer "Stella," I was granted an opportunity of landing on the main island of the Three Kings group, the natural productions of which were previously quite unknown. My visit was limited to three or four hours; but sufficient information was obtained to make it apparent that the group was worth a more careful examination. The notes made on this occasion were embodied in a paper read before this Institute, and printed in vol. xx. of the Transactions.*

It was not long before another opportunity of visiting the group arose. In the spring of 1889 great quantities of wreckage were washed ashore between the North Cape and Cape Maria van Diemen, and elsewhere on the northern coasts of the province. This wreckage was identified as belonging to a missing

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* Trans. N.Z. Inst., vol. xx., p. 141.

ship called the "County of Carnarvon," and, as it was supposed that she might have run upon the Three Kings, and that some of the crew might have reached the islands, the Government determined to despatch the "Hinemoa" to search the group. On applying to the Marine Department, I was very courteously granted permission to accompany the steamer. I now propose to give a description of the physical features of the group, accompanied with some general remarks on the vegetation, and a list of the species observed. In doing this, I shall avoid as far as is possible repeating matter published in my former paper.

The Three Kings Islands were discovered by the celebrated Dutch navigator Tasman on the 5th January, 1643. According to the "New Zealand Pilot," they are situated about thirty-eight miles west-north-west of Cape Maria van Diemen, and occupy a space of about eight miles in an east-north-east and west-north-west direction. Cape Morton Jones, the northern extreme, is in latitude 34° 6′ 20″ S., longitude 172° 9′ 45″ W. The group consists of one large island, which is distinguished by the name of the Great King, a smaller island to the north-east known as the East King, another to the west called the West King, and on the western or outer side of this, a group which has been named the Princes Islands, and which consists of a row of eight or nine rocks terminated by a small island.

Leaving our anchorage off Cape Maria van Diemen about 2 o'clock in the morning, we were abreast of the Princes Islands at daylight. As the weather was beautifully fine, Captain Fairchild determined to commence his examination of the group with the smaller islands, our previous visit having shown us that they can only be landed upon when the sea is exceptionally calm. The steamer's head was therefore pointed for the extreme western island, which is called the West King on the Admiralty charts, although of late years this name has been more generally applied to the island immediately to the west of the Great King. We rounded it at a distance of about half a mile, and so had good opportunities of examining it from different points of view. It is probably rather more than a quarter of a mile in length, by perhaps nearly as much in breadth, and reaches a height of about 400ft. It is surrounded by steep and precipitous cliffs, which are apparently quite inaccessible. In one or two places a landing might have been effected on some rocks at the foot of the cliffs, but the surf was so heavy that the risk would have been considerable, and, as it was evidently impossible to scale the cliffs, it would have been useless waste of time to lower a boat. The vegetation was evidently scanty. Here and there some dark-green patches showed on the cliffs, probably composed of trailing masses of ice-plant (*Mesembryanthemum australe*) and *Coprosma baueriana;* and with the glass some stunted flax and toetoe grass (*Arundo conspicua*) could be seen growing on the top, as also a few shrubby plants which it was impossible to identify; but, on the whole, the island presented a barren appearance, and was little more than a bare rock.

From the eastern point of this island eight or nine tall conical rocks extend in an almost straight line in the direction of the Great King. They vary in height from 70ft. or 80ft. to 150ft. or more, and are separated by deep and narrow passages, through which a small steamer could probably be taken in case of need. Their linear arrangement is very singular, and their whole appearance highly romantic and picturesque. One of them is perforated; another overhangs considerably; and almost every one has some striking peculiarity of shape. Some of the larger ones are occupied as breeding-places by gannets and other sea-birds, which find on them a home secure at any rate from man's invasion. On one or two some green patches of vegetation show, doubtless *Coprosma baueriana* and *Mesembryanthemum.* The smaller ones are bare, black, and forbidding, and are probably washed over by the spray in heavy gales.

Leaving these behind, and proceeding in the direction of the Great King, another island was reached, rough and rugged enough, but yet presenting a much more promising appearance than those just described. It is usually called the West King, although, as mentioned above, it is not the one to which that name is applied on the Admiralty charts.

The West King is about three-quarters of a mile in greatest length by not quite half a mile in greatest breadth. In shape it is roughly triangular, the apex pointing a little to the south of east. The west side, or base of the triangle, is bounded by bare and inaccessible cliffs from 200ft. to 300ft. in height, against the foot of which the sea continually breaks. The south shore is also high and precipitous, and offers no practicable landing-place. On the north the island slopes more gradually to the sea, and in several places the cliffs are comparatively low. But, although this side of the island was carefully scanned from the deck of the "Hinemoa," no place could be seen where the cliffs could be scaled, even supposing it possible to land at their foot. After steaming round the island, the only locality which seemed to promise a tolerably safe landing, so far as we could judge, was at the extreme eastern point. From this point, too, a rocky ridge rises with a steep but practicable slope, so that once on shore there would evidently be no great difficulty in reaching the top of the island.

Landing on small and exposed rocks at a distance from the mainland is always an undertaking requiring some care, and not devoid of danger. In this case there was no shelter or jutting point to break the force of the long ocean-swell continually rolling in, even in the finest weather; and great care had to be taken in approaching the rocks, for if driven broadside on the boat would be instantly swamped and stove in. After some search a rock with a perpendicular face towards the sea, and with deep water alongside, was selected as the landing-place; and by taking advantage of favourable opportunities, our party were able, one by one, to jump on to this from the bow of the boat. No time was lost in making a start for the summit of the island. Rounding some huge rocks which lined the beach at our landing-place, we gained the foot of a long ridge, which leads to the highest point by a rough but not very steep ascent. The lower part was open and bare of vegetation, and was occupied by vast numbers of gannets and mackerel gulls as a breeding-place; thousands of birds sitting on the rocks as closely as they could be packed. The gulls had their quarters on the portion nearest the beach, and on our near approach rose in the air, circling and swooping about just above our heads, screaming and uttering the most discordant cries. The noise from such a multitude of throats was deafening, while the stench from the guano-covered rocks was almost insupportable. Almost every little depression contained a nest, and in some places they were packed so close that it was impossible to advance without stepping on the eggs. Our sailors were not long in discovering that the eggs were fresh, and it was amusing to see them breaking them against the rocks, and tossing off the contents with the greatest relish. On our return to the boat they collected quite a large hamper of these delicacies for the use of their messmates on board the steamer. The gannet-rookery was of much larger extent, and from the multitude of the birds, and their white plumage, presented from a little distance a striking and attractive sight. It was interesting to see the intentness with which the birds watched our advance up the hill. Hardly any attempted to leave their nests until we were close to them, but they sat moving their heads from side to side, and uttering hoarse screams. When we were almost treading on them many attempted to take flight, but it was remarkable to see what difficulty they had in doing this. Apparently they are unable to rise straight from the ground, but are obliged to run downhill for a distance, flapping their wings, until they have acquired sufficient momentum to lift themselves from the ground. In their haste to escape they rolled over one another, breaking and scattering their own and their neighbours' eggs, and creating a scene of the utmost confusion. Quite a large number refused to leave their homes, and struck out valiantly with their sharp bills at the legs of the intruders; and we all of us found that a peck from the bill of a gannet, vigorously delivered, was by no means to be despised. They do not construct a nest, but deposit a single egg anywhere in a slight hollow. The eggs were just beginning to hatch, and we saw plenty of young baby gannets—ugly fat slate-coloured lumps, without a particle of down or feathers. Later on they acquire a most beautiful covering of snow-white down, but we were too early in the season to find them in this stage.

There is but little vegetation on that portion of the ridge occupied by the birds. The edges of the cliffs on either side are festooned with ice-plant (*Mesembryanthemum*), samphire (*Salicornia*), *Rhagodia*, *Senecio lautus*, and other well-known coast plants. Here and there patches of Captain Cook's scurvy-grass (*Lepidium oleraceum*) were growing vigorously on the highly-manured ground. This plant must have been much more common at the time of Cook's visit than now. In some of the localities where he collected it for the use of his crew it is well-nigh extinct.

Leaving our friends the gulls and gannets behind, and climbing higher up towards the central peak of the island, the first vegetation encountered was composed of patches of toetoe grass, flax, tea-tree, short-stemmed cabbage-trees (*Cordyline*) and *Hymenanthera latifolia*. We passed on rapidly through this, being anxious to reach the light bush which covered the rest of the slope before us, and which was mainly composed of a handsome large-leaved tree which stood out very conspicuously in the distance. We had first noticed it from the deck of the steamer, and had then taken it for the rare puka tree (*Meryta sinclairii*), hitherto supposed to be confined to the Morotiri or Taranga Isles (Hen and Chickens), off Whangarei, and now we found that our surmise was correct. Further examination proved that nearly the whole of the northern side of the island, where not too steep, was covered with it. Growing massed together in this way, its large and bold foliage produced a very striking effect. In sheltered places it was often mixed with luxuriant specimens of the cabbage-tree (*Cordyline australis*), and the combination gave quite a tropical aspect to the scenery, which was enhanced by the undergrowth being chiefly composed of the large-leaved form of the kawakawa (*Piper excelsum*) so common in the Kermadec Islands, and of unusually luxuriant specimens of *Pteris comans*. The average height of the puka was from 10ft. or 15ft. to 20ft., but specimens almost 30ft. in height were noticed. At the time of our visit the female trees were ornamented with large bunches of purplish-black berries.

The puka must be regarded as one of the most remarkable of the New Zealand trees, and it is certainly one of the rarest. It was first discovered by the veteran botanist Mr. Colenso, who was shown by the Maoris a single tree growing at Paparaumu, Whangaruru Harbour, which they informed him had been brought from the Poor Knights Islands. It was surrounded by a high fence, and was strictly *tapu*, Mr. Colenso not being permitted access to it, or allowed to remove specimens. Major W. G. Mair was the next to visit the locality, and he succeeded in obtaining specimens of the foliage, some of which were given to Dr. Sinclair. Later on Mr. Robert Mair obtained ripe fruit, which was also forwarded to Dr. Sinclair. This material, imperfect as it was, was forwarded to Kew, and formed the basis of the descriptions given in Sir Joseph Hooker's "Flora Novæ-Zelandiæ," and in the later published "Handbook." After the lapse of a few years the solitary tree at Whangaruru was cut down by the natives; but about the same time a Mr. George Henson discovered it growing wild on the Morotiri or Chickens Islands. In 1869 Professor Hutton and Mr. Kirk made a special visit to that locality, with the result of finding some eight or nine plants. A few years later I visited the islands, and saw thirteen old plants and a few seedlings. Mr. Reischek, who landed several times on the Chickens while pursuing his ornithological researches, also saw the tree, and has informed me that about twenty or thirty are all that exist on the group. He observed, however, a solitary specimen on the north side of the Hen Island. Until its discovery on the Three Kings Island these localities remained the only ones known to Europeans. Its existence on the Poor Knights is highly doubtful, and rests entirely on Maori authority. I have been informed that several of the specimens growing on the Chickens have been recently destroyed by fires lighted by fishermen or yachting parties, and no doubt it will soon become extinct in that locality. All lovers of New Zealand plants must therefore rejoice that it has at last been found in abundance, and in a locality where it is not likely to be soon blotted out of existence.

The puka was introduced into cultivation by the late Mr. Justice Gillies and Mr. G. B. Owen about twenty years ago. Since then it has found its way into several gardens in the vicinity of Auckland, but has not by any means been planted as much as it deserves. Few trees have bolder or handsomer foliage, and it might be used with considerable effect in landscape gardening. It is easy of cultivation, perfectly hardy in the North Island, will bear exposure to the strongest winds, and in good soil makes very rapid growth. One planted in my own garden eight years ago is now nearly 18ft. in height, with a spreading crown of branches 16ft. in diameter, and with a trunk 24in. in circumference at the base. Many of the leaves (including the petiole) are quite 2ft. 6in. in length.

The other shrubby plants noticed were the ngaio (*Myoporum lætum*), the two kinds of tea-tree (*Leptospermum ericoides* and *L. scoparium*), the wharangi (*Melicope ternata*), and my two new species, *Coprosma macrocarpa* and *Paratrophis smithii*. The last mentioned was particularly abundant, especially towards the summit of the island, forming a bush a few feet in height, with flexuous and closely-interlaced branches, and presenting a very different appearance from the tall, slender, sparingly-branched form seen in the gullies of the Great King, and described in my previous paper. The climbing-plants were the common kaihu (*Parsonsia albiflora*), *Muhlenbeckia adpressa*, and *Sicyos angulatus*. The undergrowth was mainly composed of ferns, *Pteris comans* and *Asplenium lucidum* being the species most abundant. *Davallia tasmani* was plentiful, attaining a greater size than on the main island of the group. A few sedges and grasses were also occasionally seen. The extreme summit of the island is rocky and almost bare of vegetation.

The bell-bird (*Anthornis*) was the only land-bird really plentiful, but it was present in great numbers. Fantails, grey-warblers, and white-eyes were all seen, but were comparatively scarce. Two or three moreporks were started from the deep shade of the puka-trees; and in a large patch of toetoe grass our sailors found a hawk's nest containing some fledglings, nearly full grown, which they took on board the steamer. Several petrels breed on the island, digging out burrows among the roots of the puka. From one of them I dislodged a specimen of the small shearwater (*Puffinus assimilis*). The locality seems a likely one for the tuatara lizard, but unfortunately we neglected to take a spade ashore with us, and were therefore unable to examine the burrows.

After spending the greater part of the morning on shore, we were recalled by the whistle of the "Hinemoa." The afternoon and the whole of the next day were given to the exploration of the Great King, which is separated from the West King by a deep-water channel, free of all danger, of two or three miles in width.

The Great King is much the largest of the group. It is about a mile and three quarters in greatest length, measuring in an east-and-west direction, and its greatest breadth is over three-quarters of a mile. The outline given in the Admiralty charts is most erroneous, and it is difficult to suppose that it can have been based on a real survey. It is there shown of the shape of an equilateral triangle; but its real outline is very different, and much more irregular. A broad and deep bay runs in on the north-west side, almost meeting a smaller one from the south-east, and leaving only a narrow neck between. The island is thus almost cut into two portions, an eastern and a western, of which the western is much the largest. The coast-line is bold and rocky, and is formed by steep and precipitous cliffs, varying in height from 300ft. to 700ft. The cliffs often rise directly from the water, the waves breaking against them. In some places huge caves have been worn out of the rock, and the deep hollow sound the surf makes when driven into these can be heard at a considerable distance from the shore.

There are at least three landing-places on the island, but no one of them can be said to be good. The one which we used is at the head of the northern bay, and is well sheltered from easterly winds. The south-east bay, just opposite to this, can be made use of in westerly winds; so also can a little bay situated a short distance more to the westward. The set of the wind and waves into these bays has to be carefully studied when a landing is attempted, for a very slight increase to the surf always breaking on the beaches makes the undertaking risky and difficult, if not impossible. Wherever the explorer lands, the cliffs, which are nowhere less than 250ft. in height, have to be scaled before the top of the island can be reached; and a rough and laborious climb it is.

Starting from the top of the ridge separating the two bays, a path can be found to the highest peak by keeping close to the edge of the northern cliffs. The vegetation is principally short and stunted tea-tree, mixed with the common fern, flax, short-stemmed cabbage-trees, and a few sedges and grasses. The new species of *Coprosma* described in my previous paper (*C. macrocarpa*) is plentiful, and when covered with the large orange-yellow berries, which are almost the size of small plums, presents quite a showy appearance. An unusually large-leaved variety of the hangehange (*Geniostoma ligustrifolium*) is also common. Wherever the tea-tree attains a little higher growth than usual, and consequently affords more shade, the new *Davallia* discovered in my previous visit abounds. It is in fact one of the characteristic plants of the island; and, as I saw it in great quantity on the Western King, it is probably distributed through the entire group. Its stiff leathery fronds and stout chaffy rhizome are not unlike those of the Polynesian *D. solida*, and have no resemblance whatever to the other New Zealand species, *D. novæ-zealandiæ*. Since writing my previous paper I have been able to compare it with good specimens of the Australian *D. pyxidata*, to which at one time I thought it might be referred; and I have now no doubt of its perfect distinctness. In this view I am supported by Mr. J. G. Baker, of the Kew Herbarium. He informs me that it is more nearly allied to *Davallia canariensis*, so common in the Canary Islands and Madeira, but is yet quite distinct. As the plant requires a name, I have given it that of Tasman, who was not only the first discoverer of the group, but also of New Zealand, and whose name has not yet been associated with any of its natural productions. It may thus be characterized:—

Davallia tasmani, n. sp.

Rhizome stout and long, densely clothed with tawny subulate scales. Stipes rigid, smooth, 3in.–9in. long. Frond 4in.–12in. long, 3in.–9in. broad, deltoid, tri- or quadri-pinnatifid, very coriaceous, quite glabrous. Primary pinnæ ovate-deltoid, acuminate; secondary rather narrower; pinnules lanceolate, cut down nearly to the base into 3–6 pairs of segments. Sori numerous, cup-shaped, sunk in the top of the teeth, usually with a projecting horn on the outer side.

The highest point on the island is about 995ft. above sea-level. On the north it drops with a sheer precipice into the sea; and our sailors amused themselves by rolling stones over the edge, and watching them fall into the water. We looked directly on to the deck of the "Hinemoa," which, though anchored quite half a mile from the shore, seemed to be almost at our feet. The eastern side of the bay, with its black and frowning cliffs, was directly opposite to us. On our left was the extreme western point of the island—perhaps 100ft. lower than where we were standing. The day was beautifully fine, and the sea below us was hardly moved by a ripple; but the long ocean-swell, with its regular undulations, was plainly visible on its deep-blue surface. The only sounds were the breaking of the swell against the cliffs and the cries of the sea-birds on an isolated rock just beneath us, on which our boatmen had landed in the hope of obtaining eggs.

A large basin-shaped valley commences at the foot of the peak, and occupies most of the centre of this portion of the island. A pretty little stream flows through it in a southerly direction, and is joined by several tributary rills on either side. The valley is mostly covered with tall-growing tea-tree from 12ft. to 25ft. in height, mixed with some shrubs and small trees. Most of the interesting plants seen on the island occur here. It was here that the first specimens of the remarkable *Paratrophis smithii* were observed, a description of which appeared in my previous paper. A new *Pittosporum* was also collected, which I have named in honour of Captain Fairchild, the well-known commander of the "Hinemoa." *Panax lessonii*, *Melicope ternata*, *Coprosma macrocarpa*, and *Hedycarya dentata* were all plentiful. Along the edges of the stream were several fern-trees, but only one species (*Cyathea*


MAP OF THE
THREE KINGS
OR
MAHAWA TAWHI ISLANDS.
This map is based on the Admiralty Chart; Great I. is from sketches by Mr. S. Percy Smith, (Surveyor General) in 1887. The additional soundings marked thus (18) are by Captn. Fairchild (Marine Department).
Scale of Statute Miles.
PRINCES Is, 4 MILES WEST
North East I.
North West B.
Hapuka Pt.
Crater Hd.
Landing place
GREAT ISLAND
Caves
Cave
South East B.
Farmer Rks (uncovered)
Tasman Bay. (Landing place)
Princes Is
West I. 350ft
600ft
890ft
4 knots (flood)
PRINCES Is
GREAT ISLAND.
NORTH EAST I.
THREE KINGS Is W. ½ N. 6 MILES.
172° 2' Longitude 3' East from 4' Greenwich 5' 6' 7' 8' 9' 10' 11'
Drawn by G. W. Sturtevant 1891

NORTH COAST, GREAT ISLAND.

(from a sketch by Mr. S. Percy Smith)

medullaris) was noticed. Of smaller ferns, the most remarkable was *Lomaria acuminata*, which is plentiful on the Kermadec Islands, but extremely rare in New Zealand proper. In open sunny places were large masses of *Colensoa physaloides*, its bold foliage and pretty blue flowers making it very conspicuous.

Anxious to find out what became of the stream, we decided to follow it down; but there was little change in the vegetation along its whole course. After awhile the sides of the valley contracted, the stream running over a rocky bed, with a steep grassy hill on one side, and a very similar one covered with tea-tree on the other. Still following the stream, and turning the corner of a knoll covered with pohutukawa-trees—the finest seen on the island—we suddenly reached the edge of the cliffs, the stream discharging itself over them in a cascade which must be nearly, if not quite, 200ft. in height. Climbing up the hill to the left, and looking over the cliffs, we saw that the stream fell into the head of a little bay, probably one of the most picturesque localities on the island. Afterwards we took the steamer into it, and thus obtained a better view than could be had by a peep over the cliffs. The western end is formed by a high perpendicular bluff, to the seaward of which three huge rocks, fretted and worn by the waves into fantastic points and pinnacles, stand out in a line. Some distance inside the bluff the cliffs slope away more gradually, and in one place there is a comparatively easy ascent from the shore to the top, starting from a shelving rock which would form an excellent landing-place with the wind off the shore. It was obvious that we had found the place where Tasman attempted to water his vessel, but which we had failed to notice during our previous visit, probably from keeping too far from the shore while steaming round the island. It may not be uninteresting to quote the paragraph relating to it in Tasman's journal, taking the translation given in Burney's "South Sea Discoveries," vol. 3. After mentioning his discovery of the islands, and describing their appearance, he says: "About noon we sent Francis Jacobsz in our shallop, and the supercargo, Mr. Gillimans, in the "Zehaan's" boat, to the island to try if fresh water could be got. In the evening they returned and reported that they had been at a safe small bay, where fresh water came in abundance from a high mountain, but that there was a great surf on the shore, which would make watering there troublesome and dangerous. . . . Our people saw no trees, nor did they observe any cultivated land, except that near the fresh water there were some square plots of ground green and very pleasant, but of what kind the greens were they could not distinguish. Two canoes were drawn up on the shore."

The narrative then goes on to say that on the following morning two boats with water-casks were sent to the shore, and that on nearing it many armed natives were seen, whose demeanour was by no means pacific. The surf was heavy, and landing would have been dangerous; so that after a consultation among the officers the attempt was abandoned, and the boats returned to the ships, which immediately took their departure. Tasman's words, "where fresh water came in abundance from a high mountain," can only apply to this bay, for there is no other place on the island where a permanent stream discharges into the sea. The gradual ascent up the cliffs which we noticed would be the one made use of by the Maoris from their landing-place, and the shelving rock on the beach is one of the few places where a canoe could have been safely drawn up.

The eastern portion of the Great King is much less interesting, and needs little description. Its highest point is also on the north-west, and from thence it slopes evenly and gradually to the south-east. It is mainly covered with short tea-tree, flax, common fern, and a few sedges. A shallow gully takes a southerly direction to the edge of the cliffs, and may have water in it during the winter months, but it was quite dry at the time of our visit.

In many parts of the island the cliffs have a good deal of vegetation growing on them; but their inaccessibility precludes an examination, except near the landing-places and one or two other localities. The curious *Veronica* collected on the Western King was seen in small quantity. *Pittosporum fairchildi* was not uncommon, growing in a much more compact form than in the gullies. A few karaka-trees (*Corynocarpus*) were scattered in sheltered nooks. Pohutukawas are seen all round the island, but in small numbers, and are dwarfed and stunted compared with their usual size on the mainland. A remarkable variety of the titoki (*Alectryon excelsum*), with leaves three or four times the size of the type, was gathered. It is so different in appearance that it might be distinguished as variety *grandis*. Here and there may be seen small clumps of the parapara (*Pisonia brunoniana*), with its viscid fruit, which frequently catches small birds which are so unfortunate as to come in contact with it. Several other noteworthy plants occur on the cliffs; but as they are all mentioned in the appended catalogue, it is hardly necessary to particularize them here.

The land-bird most frequently seen on the Great King is the bell-bird (*Anthornis*), which is present in great numbers. It was most pleasing to listen once more to its song—"like a chime of silver bells"—so familiar to all old colonists, but now, alas! to be heard no more on the mainland of the North

Island. In my previous paper I have given a list of the other kinds seen, and I have no additional species to record now. By far the most interesting is the native quail (*Coturnix*); for, so far as is known at present, it is absolutely extinct elsewhere in New Zealand. It is by no means common in its last refuge; for, although I walked round the island and crossed it from side to side in two or three places, I did not see more than thirteen or fourteen, and it is possible that several of these may have been started twice over. They usually got up in pairs, generally close to the explorer, and after a flight of 200 or 300 yards would settle again. On one occasion a single bird rose almost from between my feet. Looking down, I noticed a beautifully-made cup-shaped nest, containing six perfectly fresh eggs. These I of course secured, and they are now in the Auckland Museum.

While I was engaged in the examination of the Great King, Captain Fairchild paid a visit in the "Hinemoa" to the East King, to ascertain whether a landing could be effected. It proved to be exceedingly rocky and precipitous on all sides; and, although with care it would have been possible to land at the foot of the cliffs, it appeared to be quite impossible to reach the top of the island. Acting, therefore, on his advice, I made no attempt to land. It is about the same size as the Western King, but is rounder in outline, and a little higher. The whole of the top is covered with light bush, mainly composed of the puka, which appears to be even more plentiful than on the Western King. Cabbage-trees (*Cordyline*) and pohutukawa were also seen; but the steamer could not be taken sufficiently close inshore to identify any other species.

Few localities would make a better fishing-station than the Three Kings, and it is to be regretted that they are so distant from the chief centres of population. During our three days' stay the crew of the "Hinemoa" caught large numbers of fish. One hapuka, taken from a boat anchored not more than a quarter of a mile from the shore, weighed 112lb., and another turned the scale at 96lb. Kingfish and yellow-tail are also remarkably plentiful, while schnapper, kahawai, and gurnard all abound.

I have appended a catalogue of the flowering-plants and ferns noticed in the group, the total number being 143. Five are new species, and are not known to occur elsewhere, although there is a strong probability that they may exist in the North Cape district, which has been very imperfectly examined for plants. Three others are not known on the mainland, although they occur on other outlying islands. The remaining 135 species are of more or less common occurrence in the northern part of the colony.

Although the Three Kings Islands are nearly thirty-eight miles distant from the mainland of New Zealand, the sea between is comparatively shallow, the average depth, according to the Admiralty charts, being from 40 to 50 fathoms; but immediately on the outside of the group, the depth rapidly increases, and soundings of nearly 200 fathoms have been obtained within six or seven miles, while in a due north direction the 500-fathom line is not more than twenty miles distant. It is obvious that the islands stand on the very edge of a submarine plateau, which stretches from forty to fifty miles northward of New Zealand, and then suddenly sinks into much deeper water. It is natural to assume that they have been at one time connected with the mainland, and, in support of this, it may be observed that their geological structure corresponds very closely with that of the greater portion of the North Cape peninsula, the rocks composing both being slates of probably Palæozoic age. The late Dr. Hochstetter expressed the opinion that "the peculiar features of the northern peninsula of the North Island are only to be accounted for by adopting the theory of a gradual sinking of the land," and other geologists maintain similar views. It must also be remembered that the hypothesis which, so far, has given the best explanation of the origin and peculiarities of the fauna and flora of New Zealand has for its chief factor a former extension of New Zealand to the north-west.

It is an interesting question as to whether subsidence is still taking place in this part of New Zealand; for it would require little more to convert the North Cape peninsula into a group of scattered islands. North of Ahipara, the whole of the west coast to within a few miles of Cape Maria van Diemen is composed of low sand-hills, often not more than 50ft. above the level of the sea. On the eastern side the coast is also chiefly composed of sand, with the exception of the hills at Cape Karakara, to the north of Doubtless Bay, and the narrow strip near Ohora Harbour on which Mount Camel stands. The North Cape peninsula proper is moderately high, the hills near the North Cape and near Cape Maria van Diemen being nearly 1,000ft. above sea-level; but even there a stretch of sandy and swampy land joins Tom Bowline's Bay with the east coast, lying so low that a fall of 50ft. would submerge it, and convert the North Cape into an island. In a similar way, one or two of the arms of Parengarenga Harbour approach very closely to the west coast. A subsidence of 150ft. would unite Doubtless Bay with Rangaounu Harbour and the opposite coast, would join both Ohora and Parengarenga Harbours with the west coast, would cut off the North Cape from the rest of the peninsula, and would convert that portion of the province north of Mongonui into a chain of widely-separated islands. The Three Kings Islands, however, would still be high above water, and, from their tall cliffs and bold contour, would not be much less in size than now.

I have to express my obligations to the Surveyor-General, Mr. Percy Smith, for the accompanying map of the group (Pl. XXXVII.) and a sketch of one of the landing-places on the Great King (Pl. XXXVIII.). I have also to thank Captain Fairchild, of the "Hinemoa," for the kind assistance he has given to me during both my visits.

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atalogue of the Phænogamic Plants and Ferns observed on the Three Kings Islands.

1. Clematis indivisa, *Willd.*
2. „ fœtida, *Raoul.*
3. Ranunculus plebeius, *Br.*
4. Cardamine hirsuta, *L.*
5. Lepidium oleraceum, *Forst.*
6. Melicytus ramiflorus, *Forst.*
7. Hymenanthera latifolia, *Endl.*
8. Pittosporum fairchildi, *Cheeseman, n. sp.*
9. Stellaria parviflora, *Banks and Sol.*
10. Spergularia rubra, *Pers.*
11. Entelea arborescens, *Br.*
12. Aristotelia racemosa, *Forst.*
13. Linum monogynum, *Forst.*
14. Geranium dissectum, *L., var.* carolinianum.
15. Pelargonium australe, *Willd.*
16. Oxalis corniculata, *L.*
17. Melicope ternata, *Forst.*
18. Alectryon excelsum, *D C.*
19. Corynocarpus lævigata, *Forst.*
20. Coriaria ruscifolia, *L.*
21. Rubus australis, *Forst.*
22. Acæna sanguisorbæ, *Vahl.*
23. Tillæa verticillata, *D C.*
24. Drosera auriculata, *Backh.*
25. Haloragis alata, *Jacq.*
26. „ tetragyna, *Labill., var. β.*
27. „ depressa, *Hook. f.*
28. Leptospermum scoparium, *Forst.*
29. „ ericoides, *A. Rich.*
30. Metrosideros robusta, *A. Cunn.*
31. „ tomentosa, *A. Cunn.*
32. „ scandens, *Banks and Sol.*
33. Epilobium nummularifolium, *A. Cunn.*
34. „ junceum, *Forst.*
35. Sicyos angulatus, *L.*

36. Mesembryanthemum australe, *Sol.*
37. Tetragonia expansa, *Murr.*
38. „ trigyna, *Banks and Sol.*
39. Hydrocotyle asiatica, *L.*
40. „ heteromera, *D C.*
41. „ novæ-zealandiæ, *D C.*
42. Apium australe, *Thouars.*
43. Angelica rosæfolia, *Hook.*
44. Daucus brachiatus, *Sieber.*
45. Panax lessonii, *D C.*
46. Meryta sinclairii, *Hook. f.*
47. Corokia cotoneaster, *Raoul.*
48. Coprosma macrocarpa, *Cheeseman, n. sp.*
49. „ grandifolia, *Hook. f.*
50. „ baueriana, *Endl.*
51. „ robusta, *Raoul.*
52. Lagenophora forsteri, *D C.*
53. Bidens pilosa, *L.*
54. Gnaphalium luteo-album, *L.*
55. „ involucratum, *Forst.*
56. „ collinum, *Lab.*
57. Erechtites arguta, *D C.*
58. „ quadridentata, *D C.*
59. Senecio lautus, *Forst.*
60. Sonchus oleraceus, *L.*
61. Wahlenbergia gracilis, *A. Rich.*
62. Colensoa physaloides, *Hook. f.*
63. Lobelia anceps, *Forst.*
64. Gaultheria antipoda, *Forst.*
65. Leucopogon fasciculatus, *A. Rich.*
66. „ frazeri, *A. Cunn.*
67. Parsonsia albiflora, *Raoul.*
68. Geniostoma ligustrifolium, *A. Cunn.*
69. Myosotis spathulata, *Forst.*
70. Convolvulus sepium, *L.*
71. „ tuguriorum, *Forst.*
72. Dichondra repens, *Forst.*
73. Solanum aviculare, *Forst.*
74. „ nigrum, *L.*
75. Veronica, *sp.*
76. Myoporum lætum, *Forst.*
77. Pisonia umbellifera, *Seem.*
78. Rhagodia nutans, *Br.*
79. Salicornia indica, *Willd.*
80. Scleranthus biflorus, *Hook. f.*
81. Muhlenbeckia adpressa, *Lab.*
82. „ complexa, *Meisn.*
83. Hedycarya dentata, *Forst.*

84. Pimelea virgata, *Vahl.*
85. „ prostrata, *Vahl.*
86. Paratrophis smithii, *Cheeseman, n. sp.*
87. Parietaria debilis, *Forst.*
88. Peperomia urvilleana, *A. Rich.*
89. Piper excelsum, *Forst.*
90. Tetranthera calicaris, *Hook. f.*
91. Acianthus sinclairii, *Hook. f.*
92. Microtis porrifolia, *Spr.*
93. Thelymitra longifolia, *Forst.*
94. Cordyline australis, *Hook. f.*
95. Dianella intermedia, *Endl.*
96. Arthropodium cirrhatum, *Br.*
97. Phormium tenax, *Forst.*
98. „ colensoi, *Hook. f.*
99. Juncus communis, *E. Mey.*
100. „ bufonius, *L.*
101. Luzula campestris, *D C.*
102. Cyperus ustulatus, *A. Rich.*
103. Schœnus axillaris, *Hook. f.*
104. Isolepis nodosa, *Br.*
105. „ riparia, *Br.*
106. Gahnia arenaria, *Hook. f.*
107. Cladium teretifolium, *Hook. f.*
108. Uncinia australis, *Pers.*
109. Carex paniculata, *L., var.* virgata.
110. „ ternaria, *Forst.*
111. „ testacea, *Sol.*
112. „ breviculmis, *Br.*
113. „ neesiana, *Endl.* (?)
114. Paspalum scrobiculatum, *L.*
115. Panicum imbecille, *Trin.*
116. Echinopogon ovatus, *Pal.*
117. Dichelachne crinita, *Hook. f.*
118. Agrostis æmula, *Br.*
119. „ billardieri, *Br.*
120. Arundo conspicua, *Forst.*
121. Danthonia semiannularis, *Br.*
122. Poa anceps, *Br.*
123. Cyathea medullaris, *Swz.*
124. Hymenophyllum polyanthos, *Swz.*
125. Davallia tasmani, *Cheeseman, n. sp.*
126. Adiantum affine, *Willd.*
127. „ hispidulum, *Swz.*
128. Hypolepis tenuifolia, *Bernh.*
129. Pteris tremula, *Br.*
130. „ aquilina, *L.*
131. „ comans, *Forst.*

132. Pellæa rotundifolia, *Forst.*
133. Lomaria procera, *Spreng.*
134. „ acuminata, *Baker.*
135. Doodia media, *Br.*
136. Asplenium obtusatum, *Forst.*
137. „ falcatum, *Lam.*
138. „ flaccidum, *Forst.*
139. Aspidium richardi, *Hook.*
140. Polypodium tenellum, *Forst.*
141. „ serpens, *Forst.*
142. „ billardieri, *Br.*
143. Lycopodium volubile, *Forst.*

Art. XLV.—*On a Remarkable Variety of* Asplenium umbrosum, *J. Sm.*

By T. Kirk, F.L.S.

[*Read before the Nelson Philosophical Society, 11th November 1890.*]

About twelve years ago I received from the Rev. F. H. Spencer a specimen of an *Asplenium* collected in the Nelson District, which presented several points of difference from any other New Zealand fern; but, unfortunately, it was in an imperfect condition, and no positive conclusions could be drawn as to its identity: it was therefore laid on one side until better material could be procured, and was forgotten until I had the pleasure of receiving specimens of the same plant from Mr. McKerrow Campbell, when it was clearly seen to be an *Asplenium* belonging to the sub-genus *Athyrium*, and at first sight appeared to be distinct from any New Zealand species. A closer examination showed, however, that it was a remarkable variety of *Asplenium umbrosum*, J. Sm., a species occurring on calcareous soils in many parts of the colony, although on a cursory examination it appears to have but little in common with the type apart from its membranous texture. A well-developed specimen of the typical form exhibits spreading drooping fronds, from 3ft. to 5ft. in length, and sometimes 4ft. across at their greatest breadth, thrice-pinnate, with the ultimate pinnules distant, and from $\frac{1}{3}$in. to $\frac{3}{4}$in. long, deeply lobed or toothed. In a more frequent form the fronds are ovate-lanceolate in outline, from 1ft. 6in. to 2ft. long and from 6in. to 9in. broad, twice-pinnate, with close-set deeply-lobed pinnules; the rhachis in both forms being somewhat robust. The chief points of difference in the present plant are the attenuated rhachis, the smaller size, the weak habit, the extremely delicate texture, and the more simple cutting; while the stipe and rhachis are more or less clothed with narrow-linear scales, which are sometimes piliferous. The fronds vary in form from oblong to deltoid, the apical portion in all cases being rather long and narrow. They are from 1ft. to 1ft. 5in. long and from 4in. to 6in. broad, the stipe being about one-half the length of the entire frond; and are twice-pinnate at the base, the upper portion being usually pinnatifid; the pinnules are rounded at the tips, and minutely or coarsely serrate. The sori are short, broad, and slightly curved.

Before the sori arrive at maturity the pinnules are flat and open, the entire frond generally resembling that of the North American *Asplenium thelypteroides*, Michaux, except that its outline is oblong rather than lanceolate; but as the sori approach maturity the pinnules become contracted at the margin, and slightly convex above, when the frond assumes the appearance of a small form of *Asplenium filix-fœmina*, Bernh., in this respect surpassing another indigenous fern, *Hypolepis distans*, Hook., which has hitherto been supposed to approach it most closely in general appearance. The extremely membranous texture is very remarkable; it is nearly as delicate as *Cystopteris fragilis*, Bernh.

Mr. McKerrow Campbell informed me that the fresh plant when bruised exhales an odour like that of tobacco. Certain states of *Doodia media* are said to emit a similar perfume, although I have not been able to perceive it. A state of *Pteris scaberula*, A. Rich., gives off a delicious odour as of lemons; while *Polypodium scandens*, Forster, was formerly used by the Maoris, when mixed with fat, to anoint their hair and bodies, on account of its fragrance.

I append a technical description of the plant under notice, and have to acknowledge my indebtedness to Mr. McKerrow Campbell for his kindness in forwarding specimens.

Asplenium umbrosum, J. Smith, var. *tenuifolium*.

Rhizome creeping, more slender than in the type. Fronds erect or sub-erect, 12in. to 16in. high, oblong oblong-acuminate or deltoid, twice-pinnate at the base, pinnatifid above; pinnules flat or convex, minutely or coarsely serrate. Rhachis extremely slender, filiform above, more or less clothed with scattered membranous scales.

Hab. South Island, Takaka Valley, Nelson. *J. McKerrow Campbell.*

Art. XLVI.—*On the Botany of the Snares.*

By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 13th February, 1891.*]

The group of rocky islands known as the Snares consists of two large and several small islets, situated on the 48th parallel of south latitude and about sixty-five miles from the South Cape of Stewart Island. As they lie outside the usual track of vessels, they are but rarely visited, so that hitherto nothing has been known of their natural history.

The two large islands of the group are separated by a narrow channel, the larger of the two being not more than a mile and a half across. As it is the only member of the group on which I was able to land, the following notes cannot be considered exhaustive.

The island is the abode of numberless crested penguins (*Eudyptes chrysocomus*), with several species of petrels and other oceanic birds: the penguins and petrels especially exercise an injurious influence on the vegetation: the former by crushing the smaller herbaceous plants under their broad feet during the breeding-season, and by killing the trees on which their "rookeries" are established; the latter by burrowing among the roots of the trees in all directions. Several interesting land-birds were observed, the most remarkable being the Auckland Island snipe (*Gallinago aucklandica*), and the grass-bird (*Sphenoeacus fulvus*) which has become rare on the mainland, but is decidedly frequent amongst trees on this little island; to which must be added a small robin, originally discovered on Chatham Island, and described by Sir Walter Buller as *Miro traversii*. The occurrence of birds with such weak power of flight on these small islands is very suggestive.

Formerly these islands were visited by sealers, who have nearly succeeded in extirpating the fur-seal, only a pair being known to inhabit them at the present time. I was fortunate in seeing one of these, which allowed itself to be stroked on the neck with a long rod by Captain Fairchild, and seemed to enjoy the process rather than otherwise. The visits of sealers account for the presence of a few introduced plants.

The island is of irregular shape, and about a mile and a half in its greatest diameter. In many places the cliffs are steep and lofty, but a good boat-harbour exists on the north-east side, and the landing is easy. The rocks are granitic, and the greatest altitude does not exceed 480ft. The greater portion of the island is covered with light and occasionally open bush, never exceeding 30ft. in height: in a few places a dense scrubby growth of *Veronica elliptica* from 4ft. to 8ft. high requires some exertion to force a 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 edge of the cliff, and a few small patches are found in the central parts of the island. In places where bush has been felled by sealers the ground is covered with a dense growth of *Veronica elliptica*, intermixed with tussock.

There is but little fresh water on the island: two small rills issuing from swampy ground unite before reaching the cliff, but the water is undrinkable, owing to its being polluted by the penguins; and the two or three swamp-plants maintain their existence under difficulties, being constantly 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 appear almost ready to attack man himself.

Approaching the island on a fine January morning, the attention is at once arrested by the peculiar grey or whitish tint of the foliage, flecked here and there with patches of green. 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 bush: when growing in level situations it is erect, with rather open spreading branches, but when situate on a sloping surface exposed to the wind it is often inclined, or with a prostrate trunk, the roots being partly torn out of the soil; the upper branches, rooting at the tips, give rise to new trunks, which in their turn are brought to the ground and repeat the process. The short trunks in some specimens are fully 3ft. in diameter, but the majority are from 1ft. to 2ft. The extreme height of the tree rarely exceeds 28ft.

In the original description of this plant in the "Flora Antarctica"* it was united with *O. colensoi*; but in the "Flora Novæ-Zelandiæ"† it is treated as a distinct species, although from insufficient material the description is necessarily imperfect. Botanically the two species are closely allied, *O. lyallii* differing from *O. colensoi* chiefly in the more open habit, more robust branches, broadly-ovate or orbicular-ovate leaves which are abruptly acuminate, and especially in the involucral leaves being arranged in from five to eight series. The whole plant is more densely tomentose, fully-formed leaves being white above and below; the tomentum on the upper surface is floccose, and falls away during the first winter. The mature

* "Flora Antarctica," ii., p. 543.
† "Flora Novæ-Zelandiæ," i., p. 116.

leaves on old plants are excessively thick and coriaceous, doubly crenate with a very short almost sheathing petiole, but on young plants growing in the shade they were almost membranous in texture, and very large, some examples measuring over 7in. in length by 5in. in breadth. The flower-heads are arranged in crowded terminal racemes, 4in. to 7in. long, the rhachis, bracts, peduncles, and outer involucral leaves being alike clothed with dense snow-white tomentum. The remarkable difference in habit and foliage causes the plant to present an appearance which contrasts strongly with *O. colensoi*, although the technical distinctions are almost trivial. *O. lyallii* will be a valuable addition to the New Zealand plants available for the purposes of the cultivator. It appears to be restricted to the Snares and the Auckland Islands, but is rare and local in the latter habitat.

The patches of green foliage amongst the white masses of *Olearia* were caused by another grand plant, *Senecio muelleri*, T. Kirk, a noble species, originally described* from specimens collected on Herekopere Island, January, 1883; but the specimens in the original habitat are not nearly so large as those found on the Snares, which attain the extreme height of 26ft. with a short trunk fully 2ft. 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, while its extreme rarity invests it with special interest.

Veronica elliptica, to which reference has already been made, completes the short list of three species comprising the ligneous plants of the island. The plant found on the Snares is, however, of a more robust form than the plant found at Stewart Island and the Bluff; the flowers also are larger, with pure-white corollas, which are never pencilled or streaked.

The open land is covered with tussocks of the remarkable grass *Poa foliacea*, the lowland form of which produces a vast amount of nutritious herbage. Large tussocks of *Carex trifida*, the largest of the New Zealand species, occur amongst the *Poa*, and one or two small plants of no great importance find shelter at their base.

One of the most interesting plants is *Colobanthus muscoides*, which was supposed to be restricted to the Auckland and Campbell Islands, where it is abundant on sea-cliffs; it appears to be confined to a single locality on the Snares, where it occurs in a small swamp. Its northern range is thus extended fully a hundred and fifty miles. It forms rather large dense masses, the inner portion consisting of the

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* Trans. N.Z. Inst., vol. xv., p. 359.

partially-decomposed leaves and stems 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 stems and containing apparently perfect seeds imbedded some three or four inches below the surface of the mass; the old surface having become clothed with a growth of young plants too quickly to allow of the germination of the buried seeds.

Another interesting plant was an undescribed *Ligusticum*, to which I have given the name of *L. acutifolium.* It was observed in one place only, at an altitude of about three hundred and fifty feet above sea-level; its stems below the leaves were nearly as thick as a man's wrist, and the entire plant was about 4ft. high. Its nearest allies are *L. intermedium*, Hook. f., and *L. lyallii*, Hook. f., but it is destitute of the viscid milky juice which is so characteristic of those species in the recent state. The leaves are membranous, thrice-pinnate, with large acute segments, and the fruits approach those of *L. lyallii.* Unfortunately, the specimens seen were past flowering.

The most striking herbaceous plant on the island is undoubtedly the punui (*Aralia lyallii*, var. *robusta*), which is sometimes 3ft. high or more, with noble orbicular reniform leaves over 2ft. in diameter. It differs from the typical form in wanting the remarkable stolons of that plant, in the petioles being very stout, flat on the upper surface and concave beneath, giving a plano-convex section, and in their being nearly solid 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 dull pale-yellow hue, never lurid; but there is no structural difference, although it must be admitted that at first sight the plant appears to depart widely from the type.

Lepidium oleraceum was found in one or two places in the cliffs associated with *Myosotis capitata*, var. *albida*, a form frequent on Stewart Island. *Lomaria dura* was plentiful everywhere close to the sea.

A few naturalized European plants have been introduced by the sealers, and the following common New Zealand plants, which appear to be recent immigrants on the Snares, have doubtless been introduced by the same agency:—

Sonchus oleraceus, *L.*
Juncus bufonius, *L.*
Hierochloe redolens, *R. Br.*
Deyeuxia forsteri, *Kunth.*

Mosses are exceptionally rare. *Hypnum serpens* was the only species identified; another species was observed on the trunks of *Olearia*. A few Lichens were seen, but Hepaticæ and Fungi were not observed, and no opportunity of collecting marine Algæ was afforded.

The following catalogue of the flowering plants and ferns collected shows a meagre flora even for so small an area. A closer examination of the cliffs than I was able to give might add a few species to the list, and a few others might possibly be collected on the smaller islands, but it is unlikely that any material additions will be made :—

CRUCIFERÆ.
Lepidium oleraceum, *Forst.*
Cardamine depressa, *Hook. f.*

CARYOPHYLLEÆ.
Colobanthus muscoides, *Hook. f.*

CRASSULACEÆ.
Tillæa moschata, *D C.*

HALORAGEÆ.
Callitriche verna, *L.*

UMBELLIFERÆ.
Ligusticum acutifolium, *n. s.*

ARALIACEÆ.
Aralia lyallii, *T. Kirk, var.* robusta.

COMPOSITÆ.
Olearia lyallii, *Hook. f.*
Senecio muelleri, *T. Kirk.*
Sonchus oleraceus, *L.*

BORAGINEÆ.
Myosotis capitata, *Hook. f, var.* albida.

SCROPHULARINEÆ.
Veronica elliptica, *Forster.*

JUNCEÆ.
Juncus bufonius, *L.*

CYPERACEÆ.
Scirpus antarcticus, *L.*
" cernuus, *Vahl.*
Carex trifida, *Car.*

GRAMINEÆ.
Hierochloe redolens, *R. Br.*
Deyeuxia forsteri, *Kunth.*
Poa foliosa, *Hook. f., var.* a.
Festuca scoparia, *Hook. f.*

Filices.

Lomaria dura, *Moore.*
Asplenium obtusatum, *Forster.*
Aspidium aculeatum, *Swartz, var.* vestitum.

NATURALIZED.

Gramineæ.

Dactylis glomerata, *L.*
Holcus lanatus, *L.*
Poa annua, *L.*
Lolium perenne, *L.*

Apart from the striking plants specially mentioned in the body of this paper, the chief conclusions to be drawn from the list are of a negative character, but some of them are of considerable importance. For instance, it shows that arborescent ferns do not extend beyond the southern extremity of Stewart Island, thus determining their extreme limit in the South Hemisphere to be in 47° 20′ south latitude. The same remark applies to Coniferæ; also to *Drimys, Melicytus, Pittosporum, Aristotelia, Rubus, Carpodetus, Weinmannia, Leptospermum, Myrtus, Fuchsia, Tetragonia, Pseudopanax, Schefflera, Gaultheria, Cyathodes, Leucopogon, Rhipogonum,* and other genera characteristic of the New Zealand flora.

Art. XLVII.—*On* Pleurophyllum, *Hook. f.*

By T. Kirk, F.L.S.

[Read before the Wellington Philosophical Society, 13th February, 1891.]

Plates XXXIX. and XL.

This fine genus is endemic in the Antarctic islands, and comprises three species, two of which were discovered during the visit of the Antarctic Expedition under Sir James Ross in 1840, and were described by Sir Joseph Hooker, the botanist to the expedition, in the first volume of his grand work on the flora of the Antarctic islands, published in 1845. The occurrence of such striking and beautiful plants on those small islands could not have been anticipated, and their discovery excited considerable interest in the botanical world; but it was scarcely to be expected that half a century would elapse before further information respecting them would be available.

Fine plates were given by Hooker of the two species described by him; but by some mishap a leaf of *P. speciosum* appears to have been drawn by the artist as the leaf of *P. criniferum*, and has caused some confusion. In the botanical portion of D'Urville's "Voyage au Pôle Sud" M. Hombron gave a fine plate of *P. criniferum* under the name of *Albinea oresigenesa*, which was published in 1845; but, owing to his death before the letterpress was issued, the plant was described by M. Decaisne as *Pleurophyllum hombroni*.

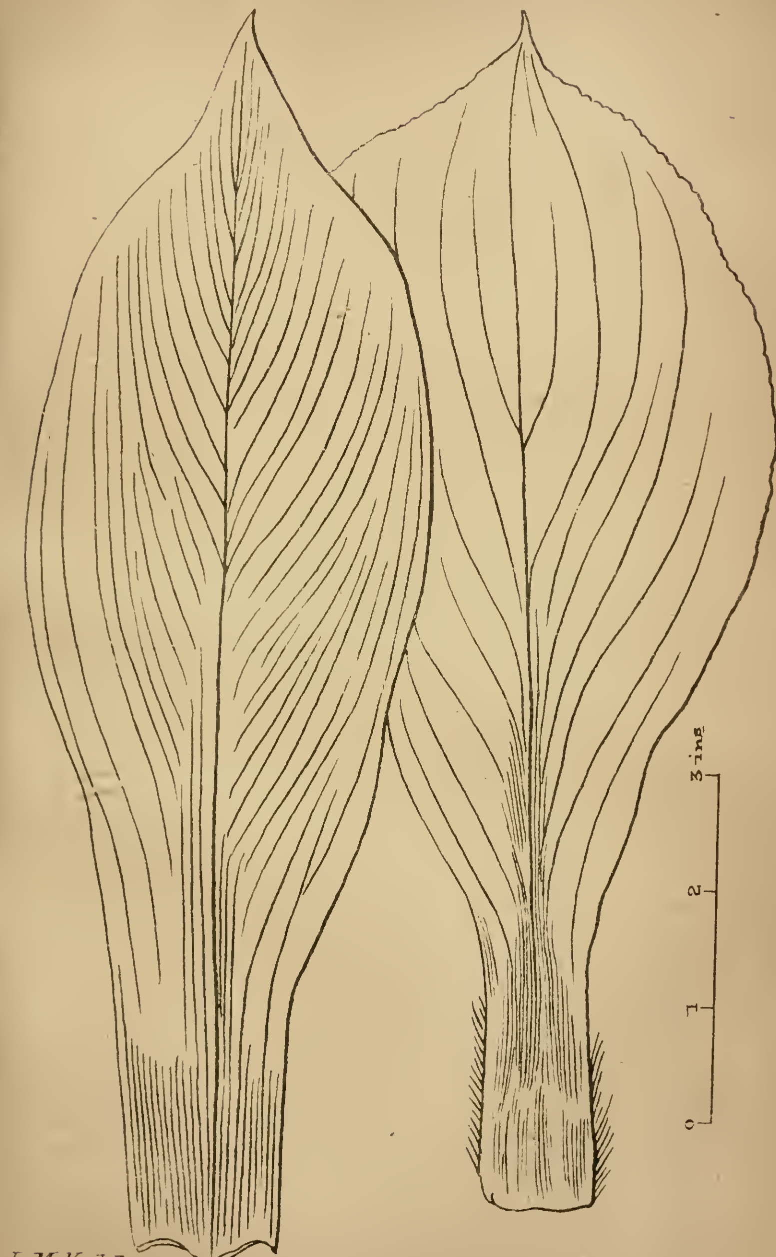
In the "Transactions of the New Zealand Institute"* Mr. J. Buchanan, F.L.S., has described a third species under the name of *P. hookeri*. The description is accompanied by a plate which was unfortunately drawn from a specimen of *P. criniferum*, and does not represent the plant described in the text. When botanizing in the Auckland Islands I collected a plant which evidently differed from both the species described by Hooker, as well as from Buchanan's drawing of *P. hookeri*. I therefore came to the conclusion that it was new, and distributed specimens under the provisional name of *P. gilliesianum*; but a careful study of Mr. Buchanan's description of *P. hookeri* shows that it is certainly the plant which he intended to describe under that name. For this reason I retain the name given by him, notwithstanding the discrepancy shown in his drawing.

It is therefore desirable on various grounds that the recently-acquired knowledge of this interesting genus should be placed at the disposal of botanists. I have embodied it accordingly in the revised descriptions which follow.

It may, however, be worth while to point out that *Pleurophyllum*, like *Olearia* and *Celmisia*, differs from *Aster* chiefly in habit, and that much can be said in support of their union, as proposed by Sir Ferdinand von Mueller with regard to *Olearia* and *Celmisia*. Should this step be adopted *Chiliotrichium* and other genera must be included, and the large genus *Aster* would become unwieldy, as long since shown by Bentham. *Pleurophyllum* is therefore maintained in its present position chiefly on grounds of expediency.

All the species are characterized by large fleshy roots, radical leaves, and erect scapigerous racemose inflorescence. The leaves are marked by parallel nerves running from the base of the petiolar portion of the leaf, and which may either be straight or may follow the outline of the leaf. The involucral leaves are in two or three series, the disc-florets are perfect, with a 4–5-toothed limb, and the outer florets are female, usually with ligulate corollas. The receptacles are flat and alveolate, and the pappus-hairs are arranged in 2 or 3 series,

* Vol. xvi., p. 395, pl. xxxvii.



PLEUROPHYLLUM HOOKERIANUM.

L.M.K. del.

PLEUROPHYLLUM HOOKERIANUM.

unequal. The scapes and peduncles are clothed with white tomentum. Sir Joseph Hooker arranged the species in two divisions :—

A. *Radiatum.*—Ray-florets with elongated corollas, 3-toothed at the apex. Principal nerves of the leaf straight, stout. *Pleurophyllum verum.*

B. *Discoideum.* Ray-florets with abbreviated corollas, bifid, trifid, or tripartite. Principal nerves following the outline of the leaf, slender. *Pachythrix.*

A. Radiatum.

1. *Pleurophyllum speciosum*, Hook. f., Fl. Antarct., i., 31, tt. 22 and 23.

Leaves all radical, 6in.–18in. long, 5in.–10in. broad, appressed to the ground, forming a huge rosette, broadly ovate, or obovate, or unequally rhomboid, rounded at the apex or shortly acuminate, thick when fresh, strongly ribbed, ribs straight and extending the entire length of the leaf, loosely tomentose below, villous or setose above, the bristles being intermixed with moniliform hairs. Racemes erect, with numerous linear leafy bracts. Heads 1½in.–2½in. in diameter; disc-florets purple; rays purple or whitish. Achenes strigose.

Hab. Auckland and Campbell Islands. Sea-level to 800ft.

A magnificent plant, of which there are two trivial forms: *a*, with leaves closely appressed to the ground, and with but few beaded hairs or none, ray-florets whitish or purplish-white; and *b*, with sub-erect narrower leaves, abundantly clothed with moniliform hairs; ray-florets of a deep violet-purple. The first is the prevailing plant on the Auckland Islands, the second on Campbell Island. In some specimens a few distant prickle-like points or teeth may be found on the margin of the leaves by close search.

The remarkably stout parallel ribs, from 15 to 30 in number, give the leaf a plicate appearance, as if it had been folded longitudinally, which is well seen on making a transverse section across the middle, and is not found in any other species. The inflorescence may be spiciform with very short peduncles, or lax and open with elongated peduncles which are sometimes 6in. in length; the bracts are more or less villous or tomentose below, with a few scattered hairs above, sometimes indeed with a few jointed hairs. Heads from 8 or 10 to 20 or more; involucral leaves linear-acuminate, clothed with scanty hairs or almost tomentose. Ray-florets female, arranged in two or three series, tubular below. Achene strigose; pappus-hairs in three series, not thickened upwards.

B. Discoideum.

2. *P. criniferum*, Hook. f., Fl. Antarct., i., 32, tt. 24 and 25.

Radical leaves, 1ft.–4ft. long, 4in.–12in. broad, with long sheathing-petioles, sub-erect, spreading (except the leaf), oblong-lanceolate, ovate-lanceolate, or almost ovate, usually acute, membranous but firm, white with thin tomentum beneath, upper surface slightly scabrid or setose, margins with a few distant projecting teeth. Stems 2ft.–6ft. high, stout, strongly grooved, cauline leaves sessile, white above and beneath. Heads discoid, 1in.–1½in. diameter. Involucral leaves ovate-acuminate, or oblong, sparingly ciliate. Ray-florets short, bifid or trifid or tripartite. Achene strigose; pappus-hairs slightly thickened upwards. *Pleurophyllum hombroni*, Decaisne, Bot., Voy. au Pôle Sud, p. 36. *Albinea origenesa*, Homb., Icon., t. 4, Dicot. Phan. *P. hookeri*, J. Buch., Trans. N.Z. Inst., pl. xxxvii.

Hab. Antipodes Island, *T. Kirk.* Auckland and Campbell Islands, *Hook. f.* Macquarie Island (?), *Professor Scott.* Sea-level to 1,100ft.

The petiolate leaves at once distinguish this species, which is easily recognized even at a considerable distance. The leaves vary in outline to even a greater extent than stated in the descriptions, some specimens being almost linear-lanceolate, others obovate-lanceolate, and others again almost orbicular-ovate; the sheathing-petioles sometimes equal the lamina, at others they are not one-third of its length, but they are never absent, and are invariably tomentose below: the cauline leaves should be considered as large bracts; they are never petioled, and are usually tomentose on both surfaces; they give the entire plant a handsome conical form, which is very distinctive. The curious projecting marginal teeth are sometimes reduced to mere points, but are rarely absent; the principal nerves, 7 to 15, are extremely slender, and follow the outline of the leaf; they may easily be traced from the base of the petiole. Flower-heads from 15 to 30 or more, the terminal being the largest; peduncles varying in length from 1in. to 6in., erect. The rays are few and very short, so that the discoid form of the anthodium is not impaired. The pappus-hairs are in three series, and slightly thickened above, as observed by M. Decaisne.

The examination of numerous specimens in the living state demonstrated the impossibility of maintaining *P. hombroni* as a species distinct from *P. criniferum*. The supposed absence of the petiole in *P. criniferum* is clearly due to the error in the original plate; the other characters to which M. Decaisne attaches importance are the longer peduncles, the widely separated stigmas, and the slightly clavate hairs of the pappus. The divergent condition of the stigmas is the only point that could prove of the slightest value for specific purposes, and that is doubtless due to the more advanced period of the flowering-season at which the specimens collected by MM. Hombron and Jacquinot were collected. My specimens collected in January have most of the styles in a divergent condition, and but few approximate; but the English Antarctic Expedition finally left these islands on the 17th December, which was a very early period for these southern plants, and enhances the feeling of admiration with which the large amount of work accomplished by the distinguished botanists who accompanied the expedition is necessarily regarded.

Professor Scott includes *P. criniferum* in his catalogue* of the plants of Macquarie Island; but his specimen must be referred to the next species. It is extremely probable that both species occur there.

3. *P. hookerianum*, J. Buchanan, in Trans. N.Z. Inst., vol. xvi. (1883), p. 395, in part, excl. pl. xxxvii. *P. gilliesianum*, T. Kirk, MS.

Radical leaves 6in.–10in. long, 3in.–4in. broad, white on both surfaces with silky, lax, or close tomentum, flat, appressed to the ground, forming a rosette; obovate or oblong-obovate, abruptly acuminate, narrowed into a broad sheathing membranous base; principal ribs 9–13, with numerous intermediate parallel nerves, marginal teeth reduced to small points. Scapes 1–3, 15in.–24in. high, naked below, except 3 or 4 lanceolate bracts at the base. Heads hemispherical or almost globose, $\frac{3}{4}$in. diameter. Involucral leaves linear, acute or acuminate, the outer with a few scattered hairs. Ray florets few or 0, ligulate corollas short, bifid or bilobate. Achene silky, pappus hairs in three series, not thickened upwards.

Hab. Mountains above Carnley Harbour, Auckland Islands, *T. Kirk;* Campbell Island, *J. Buchanan, T. Kirk;* Macquarie Island, *Professor Scott!* 600ft.–1,200ft.

Easily distinguished by its silky acuminate leaves, rayless, hemispherical, or globose heads, and its small size. The middle nerves are sometimes so close as to form a kind of false midrib in the middle third of the leaf, but widen out in the narrow basal portion. The scape is rigid, and carries from 15 to 24 heads on spreading peduncles, varying from $\frac{1}{4}$in. to 1in. in length, with a linear almost filiform deciduous bractlet at the base of each; in some specimens the upper portion of the scape is so deeply grooved that it becomes angular. In most respects the ray-florets resemble those of *P. criniferum*,

* Trans. N.Z. Inst., vol. xiv., p. 382.

except that they are smaller, and are rather bilobate, or even emarginate, than deeply bifid; they are also of a deep lurid red or reddish-purple.

As pointed out by Mr. Buchanan, there can be no doubt that this is the supposed dwarf mountain form of *P. criniferum* mentioned in "Flora Antarctica," p. 33, "with all the leaves lanceolate and more densely silky, more nearly approaching *Argyroxiphium* than the ordinary state." The early period of the flowering-season at which the expedition visited the islands doubtless accounts for the characters of this species not having been recognized, as it is very late in developing its flowers, which could scarcely be fully expanded before Christmas.

DESCRIPTION OF PLATES XXXIX. AND XL.

PLATE XXXIX.

Pleurophyllum hookerianum. Leaves, three-fourths of the natural size.

PLATE XL.

P. hookerianum. Scape, two-thirds the natural size. 1 and 2. Ray-florets. 3. Disc-floret (enlarged).

ART. XLVIII.—*On the Botany of Antipodes Island.*

By T. KIRK, F.L.S.

Read before the Wellington Philosophical Society, 13th February, 1891.]

ANTIPODES Island is situate in 49° 41′ south latitude, and 178° 43′ of east longitude. It was discovered by Captain Pendleton, in the year 1800, but up to the present nothing whatever has been known of its fauna and flora. The island has the shape of a ham, its greatest length being two miles and a half from east to west: the eastern extremity corresponds to the shank of the ham, and appears to have been formed by a narrow lava-stream; its greatest breadth is above a mile and a half from north to south. It is simply the crater of an extinct volcano, and would be roughly circular in shape were it not for the lava-stream which has been already mentioned. The cliffs are very steep and rugged, rendering the island inaccessible except at the north-east corner, where a landing can be effected only in the finest weather; a small stream descends to the sea on this side, and another on the north-west. The crateriform portion of the island is encircled by low rounded hills on three sides, broken, however, by the stream which flows over the cliffs on the north-west side: a small well-defined cup-crater is still visible amongst the hills on the south side, but from want of time I was unable to examine it. Mount Galloway, on the western side of the island, is a bold round-topped hill, and forms the highest point, attaining an altitude of 1,320ft. as determined by Captain Fairchild.

It is not quite certain whether the entire island is volcanic. Some distance from the landing-place I noticed what appeared to be a mass of finely-bedded reddish sandstone, but could not get near enough to determine its character: it may have been phonolite, which sometimes assumes a similar appearance, and which occurs in the interior of the island. Most of the rocks observed were basaltic.

Large portions of the interior are more or less swampy, and the bulk of the vegetation consists of coarse sedges and grasses, amongst which many small herbs are concealed. There is an almost total absence of ligneous vegetation, the only woody plants observed being three species of *Coprosma*, two of which are of prostrate habit or nearly so; and the largest, which is confined to the vicinity of Mount Galloway, rarely exceeds the stature of a low bush. Altogether when seen on a dull day the island presents a most desolate and unattractive appearance.

In many places the dullness is relieved by the albatros (*Diomedea exulans*), whose nests were dotted over large portions of the island. Some young dark-coloured birds, with down still remaining on their necks and wings, were observed sitting upon or constructing nests, but only one of the nests seen by me contained an egg. In all instances the truncated mound of earth forming the nest of these young birds was roughly made, loose, and somewhat small, presenting an unfinished appearance, which formed a remarkable contrast to the nests of the adult birds by which they were surrounded. Sea-hawks were numerous, and constantly on the look-out for unguarded eggs. The small yellow-headed parroquet (*Platycercus novæ-zelandiæ*) was not unfrequent at the base of Mount Galloway; and the Auckland Island snipe was observed in most parts of the island, but of somewhat smaller size and deeper colour than the typical form; this form may be identical with the doubtful *Gallinago pusilla*.

To return to the vegetation: the mass of sedges and grasses was relieved in many places by the large leaves and flower panicles of *Stilbocarpa polaris* and by a handsome *Senecio* new to science. Although herbaceous, it is of robust growth, and forms large spreading bushes with fistulose stems the thickness of a man's finger, and terminal corymbs of yellow rayless flower-heads. It is related to *S. candicans*, DC., of the Falkland Islands, but the leaves are sessile and much divided; it appears likely to be of easy cultivation. A curious and pretty gentian, also new to science, was plentiful; it formed rather close masses of erect stems, procumbent at their base, and sometimes over 1ft. in diameter. The stems and leaves were either of a pale-yellow colour or reddish-purple, with solitary axillary flowers, those on the plants with yellow stems being white, and those on the others purple, vertically streaked with red, the result in each case being that the flowers, notwithstanding their abundance, are not observed until the plant is somewhat closely examined. It is allied to *G. concinna*, of the Auckland Islands. *Colobanthus muscoides* was observed on the cliffs, and in this locality exhibits a considerable extension of its range eastward. A remarkable form of *Stellaria decipiens*, with the leaves much smaller and the capsules much larger than those of the typical form on the Auckland Islands, was found growing over deserted nests of the albatros. *Ligusticum antipodum* was abundant, although everywhere past flowering. *Pleurophyllum criniferum* was found in many places, and was fully as luxuriant as on the Auckland and Campbell Islands. The three last-named plants exhibit in this locality a considerable extension of their northern and eastern range. A dwarf-nettle, *Urtica australis*, with large leaves of considerable stinging-power, was plentiful, chiefly on the eastern side of the island. It is stated, on the authority of Bidwill, to occur in the southern extremity of the North Island, but has not been collected of late years in any part of the North or South Islands, and appears to be confined to small islands in Foveaux Strait, the Chatham Islands, Antipodes Island, the Auckland and Campbell Islands. Another plant of considerable interest is *Deschampsia hookeri*, originally described from Campbell Island under the name of *Catabrosa antarctica*, Hook. f. The typical form of *Carex paniculata* occurs in immense tussocks on the north side of the island, and could not be distinguished from the ordinary British form. The ordinary New Zealand form, better known as *C. appressa*, R. Br., was plentiful. The principal grasses were *Poa foliosa*, *Festuca scoparia*, and *Agrostis antarctica*. A slender form of *Poa anceps* with elongated panicles was observed in several places, and in this locality attains its extreme southern limit. *Cotula plumosa* occurs sparingly on the cliffs, and *Juncus scheuzerioides* was abundant in a *Sphagnum* swamp, marking the source of springs on the slope of Mount Galloway.

About a dozen species of ferns and lycopods were collected, but, with the exception of *Hypolepis millefolium* and *Lomaria dura*, all are of wide distribution in the colony.

The 55 species of Phanerogams and Ferns enumerated in the following list comprise representatives of 19 natural orders, or an average of 2·8 species for each order, allowing for the naturalized forms. This is a low average even for a New Zealand district, especially when it is remembered the *Compositæ*, *Cyperaceæ*, *Gramineæ*, and *Filices* comprise more than one-half the total number of species.

Grouped according to their distribution in New Zealand only, the plants of Antipodes Island may be arranged as under:—

	Species.
1. Extending to the North and South Islands ...	34
2. Extending to the South Island	6
3. Extending to Antarctic islands and Stewart Island	2
4. Extending to Antarctic islands only ...	9
5. Endemic	2
Naturalized	2
	55

It must, of course, be understood that the enumeration here given cannot be considered fully exhaustive, although it is not probable that any large additions will be made.

Class. CARYOPHYLLEÆ.

4. Stellaria decipiens, *Hook. f.*, *var.* parvifolia.
    " media, *Linn.* Naturalized.
1. Colobanthus billardieri, *Fenzl.*
4. " muscoides, *Hook. f.*

PORTULACEÆ.

1. Montia fontana, *L.*

ROSACEÆ.

1. Acæna sanguisorbæ, *Vahl.*

CRASSULACEÆ.

1. Tillæa moschata, *DC.*

HALORAGEÆ.

1. Callitriche verna, *L.*

ONAGRARIEÆ.

2. Epilobium linnæoides, *Hook. f.*
1. " confertifolium, *Hook. f.*
1. " alsinoides, *A. Cunn.*

UMBELLIFERÆ.

1. Apium australe, *Thouars.*
4. Ligusticum antipodum, *Hook. f.*

Class. ARALIACEÆ.

4. Stilbocarpa polaris, *Decaisne.*

RUBIACEÆ.

4. Coprosma ciliata, *Hook. f.*
1. „ cuneata, *Hook. f.*
1. „ repens, *Hook. f.*

COMPOSITÆ.

4. Pleurophyllum criniferum, *Hook. f.*
1. Lagenophora forsteri, *DC.*
4. Cotula plumosa, *Hook. f.*
1. Gnaphalium bellidioides, *Forster.*
5. Senecio antipodus, *n. s.*
1. Sonchus oleraceus, *L.*

CAMPANULACEÆ.

2. Pratia angulata, *Hook. f.*, *var.* arenaria

GENTIANEÆ.

5. Gentiana antipoda, *n. s.*

URTICEÆ.

1. Urtica australis, *Hook. f.*

ORCHIDEÆ.

1. Corysanthes (?).
1. Chiloglottis bifolia.
1. „ cornuta, *Hook. f.*
1. Prasophyllum colensoi, *Hook. f.*

JUNCEÆ.

2. Juncus scheuzerioides, *Gaud.*
4. Luzula crinita, *Hook. f.*

CYPERACEÆ.

1. Scirpus cernuus, *Vahl.*
1. Uncinia rupestris, *Raoul.*
2. Carex paniculata, *L.*, *var.* appressa
1. „ ternaria, *Forster.*
2. „ trifida, *Car.*

GRAMINEÆ.

4. Agrostis antarctica, *Hook. f.*
1. Deschampsia hookeri.
3. Poa foliosa, *Hook. f.*, a.
1. „ anceps, *Forster, var.*
„ annua, *L.* Naturalized.
3. Festuca scoparia, *Hook. f.*

Class. FILICES.

1. Hymenophyllum multifidum, *Swartz.*
1. Hypolepis millefolium, *Hook.*
1. Pteris incisa, *Thunb.*
1. Lomaria capensis, *Willd.*
1. „ alpina, *Spreng.*
2. „ dura, *Moore.*
1. Asplenium obtusatum, *Forst.*
1. „ bulbiferum, *Forst.*
1. Aspidium aculeatum, *Sw., var.* vestitum.
1. Polypodium australe, *Mett.*

LYCOPODIACEÆ.

1. Lycopodium fastigiatum, *R. Br.*
1. „ varium, *R. Br.*

ART. XLIX.—*Description of New Species of* Centrolepis, *Labill.*

By T. KIRK, F.L.S.

[*Read before the Wellington Philosophical Society, 13th February, 1891.*]

Centrolepis minima.

A minute species forming small patches. Glabrous in all its parts. Stems $\frac{1}{4}$in.–$\frac{1}{3}$in. high. Leaves few, subulate, membranous, not sheathing, acute, channelled above. Peduncle terminal, bracts not exceeding the leaves, opposite. Flowers, 1 in each bract; carpels 2–4, rarely 6, styles 2–6, slightly cohering at their base.

Hab. South Island: Shores of Lake Brunner, *T. Kirk.*

This species forms small rather loose patches, which are rather inconspicuous, only the tips of the leaves and bracts rising above the sandy mud. I find no trace of scales, possibly owing to the advanced season at which my specimens were gathered.

C. viridis.

Forming cushion-like masses, sometimes 2ft. in diameter and an inch or more in height. Leaves $\frac{1}{4}$in.–$\frac{1}{2}$in. long, sheathing and imbricating at the base, filiform, obtuse, or with minute acicular points, often setaceous, channelled above; sheaths more or less clothed with scattered hairs. Peduncles terminal, usually exceeding the leaves, bracts distant, almost equal, the basal one with a short obtuse mucro; flowers, 1 or rarely 2 in each bract, each flower consisting of a narrow hyaline scale as long as the bract, 1 stamen with elongated filament, and 1 carpel with protruding style. Carpels 1-ovuled. Capsule dehiscing loculicidally. *Centrolepis monogyna*, T. Kirk, Journal of Linn. Soc., xix. 286, not of Bentham.

Hab. South Island. In mountain-bogs, 3,000ft.–4,000ft. Nelson: Mount Arthur Plateau; Owen Mountains, Wairau Gorge, *T. F. Cheeseman*. Canterbury: Arthur's Pass, &c., *T. Kirk*. Otago: Mountains above Lake Harris, Longwood Range, *T. Kirk*. Stewart Island, *T. Kirk*. Descends to the sea-level in Stewart Island.

Varying greatly in luxuriance and in the length of the peduncles. The lower bract is articulated with the peduncle, and the upper with a short pedicel which is also articulated with the peduncle; upper bract with broad membranous margins. Capsule dehiscing longitudinally.

I formerly referred this to *C. monogyna*, Bentham, but the lowest flower is invariably perfect and the seed narrower than in that minute species. The occasional occurrence of two carpels in the same flower proves the accuracy of Bentham's judgment in removing *C. monogyna* from *Aphelia*, in which it had been placed by Hieronymus on account of its having a solitary carpel.

It should have been stated that in some specimens the hairs on the sheaths are somewhat dense, the stems appearing villous at the first glance.

Var. *β*, *ligulata*.

More slender than the typical form. Leaves ½in.–¾in. long, spreading, filiform, obtuse or sub-acute, with larger sheaths, which are marginate, the upper portion of the margin forming a kind of ligule.

Hab. Stewart Island, near Fraser Peaks.

C. strigosa, Rein and Schulter, Syst. Veg., i., 43. Hieron., Central, 101. Benth., Fl. Aust., vii., 207. F. Mueller, Key to Vict., pl. i., 449.

Hab. South Island: The Bluff Hill, *T. Kirk*.

A tufted annual, ½in.–2in. high. Leaves all radical, linear or almost filiform, shorter than the naked scapes, with few rigid hairs. Floral bracts close together, broadly-ovate, strongly ribbed, hispid except the short glabrous spreading points. Flowers 3–5 in each flower with 3 hyaline scales, laciniate at the tips, the largest nearly equalling the outer bract, the others shorter. Carpels 3–8 in each ovary. Styles free.

The outer bract of each scape contains the largest number of flowers, and the basal flower in each bract contains the largest number of carpels.

Gaimardia pallida, Hook. f., Fl. Antarct., i., 86. *Alepyrum pallidum*, Hook. f., Fl. N.Z., i., 268, t. 62c, from the Ruahine Mountains, Ruapehu, and Campbell Island.

Appears to me to belong to *Centrolepis* rather than to *Gaimardia*, in which it was doubtfully placed by its learned author. It has the habit of *C. monogyna*, Benth., and the carpels are superposed, although usually one of them becomes absorbed; the bracts are much more like those of *Centrolepis* than *Gaimardia*. Its position is somewhat intermediate, and there is much to be said in favour of maintaining R. Brown's genus *Alepyrum* for its reception as proposed by Hieronymus.

Art. L.—*On the Macrocephalous* Olearias *of New Zealand, with Description of a New Species.*

By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 13th February, 1891.*]

Olearia is restricted to New Zealand and Australia, the species of each country being endemic, and exhibiting a remarkable amount of variation in habit, from dwarf shrubs to trees 40ft. high, with solitary, racemose, or paniculate inflorescence, some of the forms being of great beauty. The species with large solitary or racemose flower-heads are, however, the most attractive to the cultivator, and possess the greatest amount of interest for the botanist. As the published descriptions of some of the forms included in this section are imperfect owing to paucity of material, it is desirable to revise them when needed, and to state their chief characteristics and their distribution more fully than has hitherto been attempted.

In this section the leaves may be narrow-lanceolate, oblong or ovate, or orbicular-ovate, and are the largest to be found in the genus; their margins may be entire, or sharply serrate or crenate, or doubly serrate or crenate; in several species the teeth are obtuse, rounded, and callous, but in all cases the texture is exceedingly coriaceous; the under-surface, or rarely both surfaces of the leaf, are clothed with appressed white tomentum; and the leaf is either distinctly petioled or narrowed at the base into a flat-winged petiole.

The flower-heads are invariably terminal, although subsequent to flowering their position is often obscured by the elongation of the shoot; they may be solitary or racemose but are never paniculate, and the peduncles may be naked or clothed with linear or imbricating or foliaceous bracts. The peduncles, rhachis, pedicels, under-surfaces of bracts, and usually the outer involucral leaves, are more or less clothed with appressed snow-white tomentum. Again, the involucral leaves may be arranged in one or two or many series; the outer series of florets may be either ligulate or campanulate, so that the heads are rayless or destitute of rays, while the disc-florets may be yellow or of a deep violet-purple colour; lastly, the achenes may be glabrous or silky, and the pappus-hairs equally arranged in a single series, or unequal and arranged in two series.

A. *Flower-heads terminal.*

1. **Olearia semidentata**, Decaisne, in Hook. f., Fl. N.Z., i., 115.

A small sparingly-branched shrub 1ft.–2ft. high; branches slender, sparingly clothed with loose tomentum. Leaves close-set, spreading or ascending, 1½in.–2½in. long, ¼in.–⅓in. broad, linear-lanceolate, acute, narrowed at the base, distantly serrate, white beneath, with thin appressed tomentum, coriaceous. Heads crowded on slender peduncles, equalling or exceeding the leaves, and clothed with distant linear bracts; involucral leaves in 3 series, acute. Achenes faintly striate, glabrous or faintly puberulous.

Hab. Chatham Islands: *Dieffenbach, Captain Gilbert Mair, W. L. Williams, H. H. Travers*, and others.

A charming plant, easily distinguished from all other species by the crowded linear, acute serrate leaves, which are sometimes less than ¼in. broad. The ray-florets are purple, those of the disc deep violet.

2. **O. chathamica**, n.s.

Of similar habit to the preceding, but more robust. Leaves excessively coriaceous, 1in.–2in. long, ⅓in.–⅔in. broad, ovate, or oblong-lanceolate, narrowed into a short broad petiole, acute, serrate, teeth with obtuse callous tips; white, with appressed tomentum beneath; midrib and lateral nerves prominent beneath. Flower-heads few, on slender peduncles with distant linear bracts, white beneath; involucral leaves in 2 series, the outer white, with loose tomentum; ray-florets with white ligulate corollas, disc-florets violet-purple. Achenes striated pubescent. *O. operina*, Hook. f., Handbk. N.Z. Fl., p. 731. *O. angustifolia*, var., J. Buchanan, Trans. N.Z. Inst. vii. (1874), pl. xv.

Hab. Chatham Islands. *H. H. Travers!*

Best distinguished from *O. semidentata* by the broader, coriaceous leaves, with obtuse teeth; from *O. operina* and *O. angustifolia* by the slender peduncles and distant linear bracts. A charming plant. In the "Vegetation of the Chatham Islands," under "*O. semidentata*," p. 22, Baron von

Mueller, referring to this plant, remarks, "The leaves are not unlike those of *O. colensoi*."

3. **O. operina**, Hook. f., Fl. N.Z., i., 115.

A sparingly-branched shrub, 6ft.–12ft. high. Branches stout, loosely tomentose. Leaves very coriaceous, spreading, 2in.–4in. long, white with appressed tomentum beneath, narrowly obovate-lanceolate, acuminate, narrowed into a winged petiole, teeth close, obtuse, callous; veins obscure beneath. Peduncles 1in.–3in. long, crowded, stout, clothed with short imbricating cottony bracts. Heads large, involucral leaves in 2–3 series, tomentose. Achenes silky. *Arnica operina*, Forster.

Var. *β*. Branches short, stout; leaves short, excessively coriaceous, with more deeply-toothed margins. Peduncles stouter.

Hab. South Island: Martin's Bay to Preservation Inlet. Sea-level to 100ft. *β*, Preservation Inlet.

It is remarkable that no drawing of this fine plant has been published. The heads are often very numerous, varying from four to eighteen, but more frequently from six to ten; the rays are white, the disc-florets yellow.

At Puysegur Point an area of several acres was cleared when the lighthouse was erected, and is now covered with dwarf specimens of this species, sparingly intermixed with *O. colensoi* and *O. traillii*, the whole presenting a singular appearance owing to the compact strict habit, which is very different from the somewhat straggling habit of ordinary specimens.

4. **O. angustifolia**, Hook. f., Fl. N.Z., i., 115.

A shrub or small tree, 6ft.–20ft. high, with robust tomentose branches. Leaves 3in.–5in. long, narrow-lanceolate acuminate, narrowed below, sessile, excessively rigid and coriaceous, crenate or doubly crenate or serrate, the points being hard and rounded, white with appressed tomentum beneath, midrib and principal nerves prominent beneath. Heads 1½in.–2in. in diameter on stout peduncles, shorter than the leaves; bracts foliaceous, imbricating, white beneath. Involucral leaves in 2 series, the outer densely tomentose. Ray-florets ligulate, each with a linear scale at its base. Achene silky, grooved. Pappus short, unequal. *T. Kirk*, Forest Flora of N.Z., t. 138.

Hab. Exposed places by the sea, south of Paterson's Inlet, Stewart Island. Sea-level to 100ft.

The most beautiful species of the genus, and one of the rarest. Flower-heads from 3 to 10; ray-florets white, disc-florets violet-purple. Leaves fragrant. Distinguished from all other pedunculate species by the narrow rigid foliage and foliaceous bracts.

B. *Flowers in Terminal Racemes.*

5. **O. traillii**, T. Kirk, Trans. N.Z. Inst., xvi. (1883), p. 372; Forest Flora of N.Z., t. 142.

A shrub or small tree, 15ft. high or more, with robust tomentose branchlets. Leaves crowded near the tips of the branchlets, 4in.–6in. long, 1in.–1¼in. broad, lanceolate or narrow obovate-lanceolate, acute or acuminate, narrowed into a broad winged petiole, very coriaceous, white beneath, margins doubly crenate with narrow rounded callous points. Heads in erect terminal 3–8-flowered racemes, with foliaceous deciduous bracts; rhachis, peduncles, and under-surface of bracts white with appressed tomentum; peduncles 2in.–8in. long; involucral leaves in 3 series, scarious, acute, the outer sparingly tomentose at the tips; ray-florets ligulate, disc-florets tubular campanulate. Achenes grooved, silky.

Hab. Sea-level, Stewart Island, rare and local.

One of the most striking plants in the N.Z. flora, easily distinguished from the other racemose species by its narrow leaves and rayed heads. Rays milk-white, disc-florets violet-purple.

6. **O. colensoi**, Hook. f., Fl. N.Z., 115, t. 29.

Hab. North and South Islands to Stewart Island. Not observed below 3,000ft. in the North Island, but descends to sea-level on Stewart Island. Ascends to 5,000ft.

In the North and South Islands this fine species is confined to the mountains, and is usually a bush or shrub with leaves varying from broadly-oblong to narrow-obovate, but on Stewart Island it descends to the sea-level, and occasionally developes into a tree 40ft. high, with a trunk 2ft. in diameter. The under-surface of the leaves, and the peduncles, are clothed with white appressed hairs, the flower-heads are destitute of rays, and the florets are of a lurid brown colour, approaching black. The leaves are usually crenate or doubly crenate, but occasionally specimens are found in which the margins are doubly serrate, both primary and secondary teeth being extremely acute.

7. **O. lyallii**, Hook. f., Fl. N.Z., i., 116. *Eurybia antarctica*, Hook. f., Fl. Antarct., ii., 543.

A shrub or small tree, sometimes nearly 30ft. high, with trunk 2ft. in diameter; branches open, robust, tomentose. Leaves broadly-ovate or orbicular-ovate, abruptly acuminate, excessively rigid and coriaceous, doubly serrate or crenate, white with floccose tomentum above, and with appressed tomentum beneath; petiole short, stout, sheathing at the base. Heads in terminal racemes 4in.–7in. long; rhachis, bracts, peduncles, and outer involucral leaves white with appressed tomentum, involucral leaves in from 5 to 8 series. Florets similar to those of *O. colensoi*, but darker, outer series female, rayless. Achene silky, pappus-hairs in two series, thickened upwards.

Hab. The Snares and the Auckland Islands.

Although this grand plant differs widely from *O. colensoi* in appearance, it is very closely allied to that species, the chief points of difference being the more open habit, stouter branches, orbicular-ovate leaves, stouter petioles, and especially the many-seriate involucre; but specimens may occasionally be found which approach *O. colensoi* in habit and foliage. The greyish hue of this plant during the summer and autumn months is most striking, and is due to the upper leaf-surfaces being clothed with tomentum which is of much thinner consistency than that on the lower surfaces. The leaves of *O. colensoi* are sparingly tomentose on the upper surface of the young leaves, but the tomentum disappears before the leaves are fully developed. In *O. lyallii* it is more plentiful, and appears to be permanent for the first year. The leaves of *O. lyallii* are more rigid and coriaceous than those of its near ally, and they are often attacked by a handsome orange-coloured fungus, *Uredo oleariæ*, Cooke, n.s.

C. *Peduncle naked, terminal.*

8. **O. insignis,** Hook. f., Fl. N.Z. ii., 331. Bot. Mag. t.

Hab. South Island: Marlborough, from Awatere southwards to the Conway River. Ascends from sea-level to 4,000ft.

A robust species, of remarkable habit and great beauty, usually forming a low spreading shrub 1ft.–3ft. high, and rarely attaining the extreme height of 8ft. The leaves are crowded at the tips of the branches, and vary greatly in outline from oblong to ovate or narrow-obovate; they are from 3in. to 7in. in length, including the petiole, and from 1in. to 4in. broad, shining above, excessively rigid and coriaceous, but quite entire. They are densely clothed with white tomentum beneath, which becomes tawny or reddish in dried specimens, and sometimes projects beyond the margin, forming a narrow white border; the young leaf is usually clothed above with a thin layer of tomentum, which usually disappears entirely, but in some cases a narrow line is left, presenting the appearance of a marginal nerve, which, however, can be easily scraped away. Peduncles 1–5, tomentose, 6in.–12in. long, as thick as a goosequill, usually naked, but not unfrequently one or several sessile or pedunculate clasping leafy bracts are developed, sometimes of irregular shape, at others resembling ordinary leaves, except in size. Head 1in.–2½in. diameter, with numerous series of closely-imbricating involucral leaves, which are excessively tomentose, tips acuminate, flat or recurved; in some specimens the basal series is greatly enlarged, forming a kind of spurious involucre. The ray-florets are very numerous, filiform and tubular below, with rather long flat rays; disc-florets yellow. Achene very long and excessively silky; pappus 1-seriate, hairs thickened upwards, white changing to reddish-brown when dry.

The abnormal development of bracts may partly be caused by external conditions. Three plants which I had under cultivation in pots some years ago produced naked peduncles for two years, but on their roots becoming cramped bracts were freely developed on most of the peduncles. Even in the wild state naked and bracteate peduncles may be found on the same branch, and it is certain that bracts are more freely developed in some seasons than in others.

Olearia marginata, Colenso, Trans. N.Z. Inst., xv. (1884), p. 321, appears to be a form of *O. insignis*, with bracteate peduncles, and the tomentum produced beyond the margin of the leaves, but I have not seen authenticated specimens of Mr. Colenso's plant. It was found near Renwicktown, Marlborough.

Olearia grandiflora, Hook. f., Ic. Pl., t. 862, from South Australia, and *O. pannosa*, Hook. f. (*Eurybia pannosa*, F. Mueller, Pl. Vict., t. 32), from South Australia and Victoria, are nearly allied to *O. insignis*, Hook. f.

All the species of this section are easily cultivated, and require very little special treatment. They bear cutting-in freely, and are easily propagated by layers and cuttings. They will flourish in any ordinary garden-soil, but attain their greatest luxuriance in a mixture of peat and loam.

Art. LI.—*Notes on Certain Species of* Carex *in New Zealand.*

By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 13th February, 1891.*]

Carex glauca, Scop., Fl. Carn., ii., p. 223; Rchb., Ic. Fl. Germ., cent. vii., 269. *C. recurva*, Huds., Fl. Ang., 413. E.B. 1506.

This species was detected by Miss Kirk between Evans and Lyall Bays, Port Nicholson, where it grows in large quantity, and extends over several acres. About six years ago the habitat was fenced in, so that the vegetation has not been so closely cropped by wandering cattle as formerly, when the growth of herbage was rendered almost impossible. Now, however, the paddocks being but moderately stocked, several native plants which were formerly rare in this locality are to be found in abundance. Amongst them *Schœnus nitens*, Hook. f., may be specially mentioned, as it is almost as plentiful as the *Carex* with which it is associated, although for many years previous to the enclosure it was so extremely rare that not more than one or two stray specimens could be detected during the season. The grass is "self-sown," the seeds having been deposited by cattle, so that it is extremely difficult to account for the introduction of the *Carex*; but it can scarcely be supposed that a plant generally distributed through Europe, North Africa, and Siberia would be restricted to a single habitat in New Zealand if really indigenous in the Southern Hemisphere.

The following description will enable New Zealand botanists to recognize this species should it be found in other localities.

C. glauca, Scop.

A grassy, soboliferous species. Culms 6in.–18in. high, rather slender. Leaves erect or recurved, $\frac{1}{4}$in.–$\frac{3}{8}$in. broad, flat, glaucous, shorter than the culms. Spikelets 4–6, upper 3 male, female erect or nodding, $\frac{1}{2}$in.–$1\frac{1}{4}$in. long, with male flowers at the top, cylindrical, slender or stout, pedicels usually short. Glumes ovate, acute, with green midrib; perigynia obovoid or elliptic, slightly rough, exceeding the glumes. Stigmas, 3.

Carex muricata, Linn.

A plant doubtfully identified with this species owing to the immaturity of the specimens is recorded by Mr. Cheeseman from Mount Owen, in the Nelson District, where it grows at an altitude of 4,000ft. Mr. J. Rutland, to whom I am greatly indebted for much information respecting the plants of the Marlborough District, has recently sent specimens of the large form of this species known as *C. contigua*, Hoppe, from a grass-paddock near Havelock; but it is to be feared that, although it has even a wider distribution in the Northern Hemisphere than the preceding species, it can scarcely be considered indigenous to New Zealand.

Carex leporina, Linn.

This species has been recorded by Mr. Cheeseman from several localities in the Nelson District, and was discovered by the writer at Ohariu, about fifteen miles from Wellington.

Recently I have received specimens collected in the Pelorus by Mr. Rutland. But, notwithstanding the fact of its wide, general distribution in northern Europe, Siberia, western Asia, Greenland, the Rocky Mountains, &c., and its occurrence on both sides of Cook Strait, it must be considered an introduced species in New Zealand. It is believed to occur in the Falkland Islands.

It is plentiful in the British Islands, and its fruits are very likely to be introduced with badly-cleaned grass-seed.

Carex chlorantha, R. Br., and *C. divisa*, Huds.

As the first-named species was stated by the writer to occur in New Zealand,* it seems desirable that the reasons for erasing it from our lists should be fully stated, to prevent mistake respecting it in the future.

In 1871 I collected a *Carex* on the shores of the Waitemata which I was unable to refer to any species known to me. It occurred on a small flat at the base of the cliff, and covered a space of between thirty and forty square yards, forming a sward so extremely dense that it was scarcely possible to obtain rooted specimens with an ordinary pocket-knife. The leaves were as dense as a piece of pasturage, and the culms, from 4in. to 6in. high, but slightly overtopped the leaves, and gave the plant the appearance of *C. arenaria*, L., to which it is, indeed, closely related. During the next year specimens were sent to Kew, and there identified as a variety of *C. inversa*, R. Br., an identification which I was unable to accept. I then forwarded specimens to my friend Baron von Mueller, who identified it with *C. chlorantha*, R. Br., and recorded it as a New Zealand species in his "Fragmenta."† At that time works on Australian botany were not available for reference in Auckland, and there was no reason to doubt the accuracy of the identification; specimens were therefore distributed under that name, and some were deposited in the Museum of the Auckland Institute, where they remained at the time of my removal to Wellington in 1874. A few years later I received a note from Mr. N. E. Brown, of the Kew Herbarium, stating that the plant "was not *Carex inversa*, and, if not a form of *C. colensoi*, would prove to be a form of *C. divisa*." This, of course, was interesting; but on making a re-examination of my specimens I was convinced that the plant could not be referred to *C. colensoi*, and its general appearance differed so widely from that of any form of *C. divisa* known to me that, in the absence of authenticated specimens of *C. chlorantha* for comparison, I still continued to refer it to that species. Mr.

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* Trans. N.Z. Inst. (1877), vol. x., p. 42, Appendix.
† Fragmenta Phyt. Aust., viii., 256 (November, 1874).

Cheeseman, in his "Revision of the New Zealand *Carices*," published in 1883,* stated that *C. chlorantha* had become extinct in the vicinity of Auckland, which was not correct so far as the plant in question was concerned. On visiting Auckland in October, 1886, I made special search for the *Carex*, and, after some little difficulty, succeeded in finding it growing in the greatest luxuriance, but restricted to a comparatively small space on the lower part of the cliff. The coast-line had been greatly altered during the ten or twelve years that had elapsed since the plant was last seen by me, and the flat on which it grew in such abundance had been completely swept away, so that the base of the cliff was washed by the waves; but the plant still existed in considerable quantity. It had, however, changed its habit: instead of forming a compact turf with culms less than a foot in height, it formed loose open tufts with long slender nodding culms, some of which were over 2ft. 6in. high; the leaves were longer and narrower, the heads smaller. There was no difficulty in identifying it with *C. divisa*, Huds., and it was interesting to find the plant occupying a littoral situation similar to those which it chiefly affects in the eastern and southern counties of England. I subjoin a description to assist local workers in the event of its being found in other localities in the colony.

Carex divisa, Huds., Fl. Ang., 348, ed. i. E.B., 1096.

A slender tufted species, with stout, slightly-creeping rootstock. Culms 1½ft.–2½ft. high. Leaves equalling or shorter than the culms, narrow, flexuous, involute. Spikelets numerous, bracteolate, forming a more or less compact head about 1in. long; male flowers at the top; glumes ovate, acuminate, perigynia plano-convex, almost orbicular, veined, with a minute bifid serrulate beak.

The bracts are filiform or setaceous, but the lowest never overtops the spike, as is commonly the case with English specimens.

Distributed through Europe, North and South Africa, West Siberia, North-west India, Chili, &c.

There is greater probability of this species proving indigenous in the colony than either of the preceding, but further evidence is required. If introduced it must have been in the early days of settlement, to allow time for it to overcome the native vegetation so completely as to form a compact sward, and in that case it would be difficult to explain why it had not become more widely diffused in the Waitemata and elsewhere, as its utricles are produced in great abundance.

* Trans. N.Z. Inst., vol. xvi., p. 442.

IV.—MISCELLANEOUS.

Art. LII.—*The Story of John Rutherford.*

By Archdeacon W. L. Williams.

[*Read before the Auckland Institute, 6th October, 1890.*]

Having occasion recently to look up the story of John Rutherford, I thought that additional interest might be imparted to it if it could be illustrated by the native traditions of the circumstances attending his capture, and of any events connected with his enforced residence of nearly ten years among a savage people. As many interesting details of Captain Cook's visit to these parts are still current among the natives, it was to be expected that the capture of the "Agnes," which occurred forty-seven years afterwards, would be the subject of a tradition quite as circumstantial and as interesting as that relating to the great navigator, especially as this event would acquire additional importance from the fact that they became possessed thereby of a considerable number of much-coveted firearms. The object of this paper is to place on record the results of inquiries made among the natives, and the conclusions to which they lead.

Rutherford states that he left New Zealand in 1826, and, after a sojourn of nearly a year at Tahiti, and of some further time at Port Jackson and Rio de Janeiro, arrived in England early in 1828. Being himself unable to write, he got a friend to commit the story of his adventures to writing, at his dictation, in the course of the voyage from Rio to England. The substance of this story was published in 1830 by Charles Knight, in "The New-Zealanders," a volume of the Library of Useful Knowledge, which is said to have been revised and in part written by Lord Brougham. As this book is long since out of print, and now seldom to be met with, I will extract from it such a brief sketch of Rutherford's personal adventures as may suffice for my present purpose.

After several voyages in different parts of the world, Rutherford shipped on board the "Magnet," a three-masted schooner trading among the islands of the Pacific Ocean. This vessel having put in at Hawaii, in the Sandwich Islands, Rutherford fell sick and was left on that island. Having recovered, however, in about a fortnight, he was taken on board the "Agnes," an American brig of six guns and fourteen men, which was then engaged in trading for pearl- and tortoise-shell among the islands of the Pacific. On her return from Hawaii the "Agnes" approached the east coast of New Zealand, intending to put in for refreshments at the Bay of Islands. A gale of wind, however, drove her some distance to the south of the East Cape, and on the 6th March, 1816, she was opposite a large bay which is called Takomardo (or Tokamardo, as spelt on page 274). Being in great need of water, the captain somewhat reluctantly determined to stand in for this bay, and ultimately came to anchor off the termination of a reef of rocks, immediately under some elevated land which formed one of the sides of the bay. Canoes soon came off from all parts of the bay, paddled chiefly by women, who gave much trouble by their pilfering propensities. In the morning a chief named Aimy came on board in a large war-canoe carrying above a hundred men, and trading proceeded with such vigour that by the close of the day about two hundred pigs had been purchased, with a large quantity of fern-root to feed them on. The captain had also arranged with Aimy that he should take the ship's boat on shore for a supply of water. This having been hoisted on board, the boat was sent again for a further supply, but did not return till the following morning, when the captain paid Aimy for his trouble, giving him two muskets, with a quantity of powder and shot. There were now about three hundred of the natives on the deck, and the captain, being apprehensive for the safety of the ship, ordered the sails to be loosed and preparations to be made for putting to sea as soon as the crew should have had their dinner. Just as this order was being carried out, there being none of the crew on deck excepting the captain and the cook, the natives commenced an attack upon the ship. The captain was killed at once with a tomahawk, and the cook, who ran to his assistance, was despatched in the same manner. The chief mate was next struck down as he came running up the companion-ladder. Four of the crew jumped overboard, but, being picked up by some canoes that were coming from the shore, were bound hand and foot. The rest were soon secured, and all were taken on shore. The ship was then plundered and the cable cut, so that she was soon stranded on the beach, where she was set on fire. Six more of the crew were killed on the following day, and their bodies, together with those of the captain, cook, and chief mate, were cooked and eaten.

On the third day Rutherford and his five surviving companions were taken about ten miles inland, to a village which was the residence of a chief named Rangadi, and on the following day each of them was stripped of his clothes, and, being laid on his back, was held down by five or six men, and tattooed. At this village Rutherford and four of the others remained for about six months, one of them, named John Watson, having been taken away by a chief named Nainy soon after their arrival there. After this they set out, in company with Aimy and another chief, to pursue their journey further into the interior, one of their number, however, whose name is not given, being left with Rangadi. On their arrival at another village, the chief of which was called Plama, another, whose name was John Smith, was left with him. When they had travelled about twelve miles further they stopped at a third village, and here they remained two days. The chief of this village, Ewanna, treated them very kindly, and one of the white men, named Jefferson, was left with him. From thence Rutherford and his remaining companion resumed their journey with Aimy and another chief until they came to Aimy's own village, which thenceforth became their home.

The first event of importance which occurred at this place was the death of Rutherford's companion, more than a year, perhaps, after their arrival, though the time is not distinctly marked. It occurred on this wise. Aimy and his family went to a feast at another village a few miles distant, and while they were away the chief's mother, who had been ailing for some time, died. On Aimy's return there was much discussion as to the cause of the old woman's death. After hearing all the circumstances from the *tohunga* who had been in attendance on the invalid, an old chief gave it as his opinion that it was clear that the immediate cause of the old lady's death was that she had eaten potatoes which had been peeled with a white man's knife after the said knife had been used for cutting rushes wherewith to repair a house; on which account he thought that the white man to whom the knife belonged should be killed. Rutherford ventured to plead for his comrade's life, but it was all in vain. The chief who had pronounced the sentence proceeded to execute it by striking the poor man on the head with his *mere*, and so killing him.

Rutherford was now left alone among the natives, and, his clothes being all worn out, he had to adopt in his dress the fashions of the country. For the first sixteen months of his residence at Aimy's village he kept a reckoning of days by notches on a stick; but when he afterwards moved about with the chiefs he neglected this mode of tracing the progress of time. At length Aimy proposed, in the presence of the tribe, that he should be made a chief. To this proposal he consented; whereupon his hair was cut in the most approved fashion, his head and his face were adorned with red-ochre and oil, and his newly-acquired dignity was further marked by presents of some mats and a handsome stone *mere*. He was invited, moreover, to select a wife from among the marriageable young ladies of the tribe. His choice fell upon Aimy's daughter, Eshore; whereupon Aimy insisted on his taking her younger sister, Epecka, with her.

Some time after this he took a long journey with the chief Aimy, attended by a suitable retinue. In about a month they arrived at a place called Taranake, on the coast of Cook Strait, where they were received by Otago, a great chief, who had come from near the South Cape. Here he saw an Englishman named James Mowry, who was the sole survivor of a boat's crew which had been cut off by the natives, had lived eight years among them, and had married Otago's daughter. This man had been well tattooed and made a chief, and had become so thoroughly at home with his people that he had no desire to leave them. He had heard, Rutherford says, of the capture of the "Agnes," and gave him an account of the deaths of Smith and Watson. "On leaving Taranake," the story continues, "we took our way along the coast, and after a journey of six weeks arrived at the East Cape, where we met with a great chief named Bomurry, belonging to the Bay of Islands. He told us that he resided in the neighbourhood of Mr. Kendal, the missionary. He had about five hundred warriors with him, and several war-canoes. . . . They had plundered and murdered nearly every person that lived between the East Cape and the River Thames; and the whole country dreaded the name of Bomurry. . . . He and his followers having taken leave of us and set sail in their canoes, we also left the East Cape the day following, and proceeded on our journey homewards, travelling during the day and encamping at night in the woods. In this way we arrived in four days at our village."

In the course of time another important expedition was undertaken, the account of which shall be given mainly in Rutherford's own words: "One day a messenger arrived from a neighbouring village with the news that all the chiefs for miles round were about to set out in three days for a place called Kipara, near the source of the River Thames, and distant about two hundred miles from our village. The messenger brought also a request from the other chiefs to Aimy to join them, along with his warriors; and he replied that he would meet them at Kipara at the time appointed. We understood that we were to be opposed at Kipara by a number of chiefs from the Bay of Islands and the River Thames, according to an appointment that had been made with the chiefs in our neighbourhood." After describing the preparations for the journey, the narrative continues: "We were five weeks in reaching Kipara, where we found about eleven hundred more natives encamped by the side of a river. On the opposite side of the river—which was about half a mile wide and not more than 4ft. deep in any part—about four hundred of the enemy were encamped, waiting for reinforcements." With these people was a white man, "who," says Rutherford, "told me that his name was John Mawman, that he was a native of Port Jackson, and that he had run away from the 'Tees' sloop-of-war while she lay at this island. He had since joined the natives, and was now living with a chief named Rawmatty, whose daughter he had married, and whose residence was at a place called Sukyanna, on the west coast, within fifty miles of the Bay of Islands."

An account of the engagement then follows: "Early the next morning the enemy retreated to the distance of about two miles from the river, upon observing which our party immediately threw off their mats and got under arms. The two parties had altogether about two thousand muskets among them, chiefly purchased from the English and American South Sea ships which touch at the island. We now crossed the river, and, having arrived at the opposite side, I took my station on a rising ground about a quarter of a mile distant from where our party halted, so that I had a full view of the engagement. I was not myself required to fight, but I loaded my double-barrelled gun, and, thus armed, remained at my post, my wife and the two slave-girls having seated themselves at my feet. The commander-in-chief of each party now stepped forward a few yards, and, placing himself in front of his troops, commenced the war-song. When this was ended both parties danced a war-dance, singing at the same time as loud as they could, and brandishing their weapons in the air. Having finished their dance, each party formed into a line two deep, the women and boys stationing themselves about 10 yards to the rear. The two bodies then advanced to within 100 yards of each other, when they fired off their muskets. Few of them put the musket to the shoulder while firing it, but merely held it at the charge. They only fired once, and then, throwing their muskets behind them, where they were picked up by the women and boys, drew their *merys* and tomahawks out of their belts, when, the war-song being screamed by the whole of them together in a manner most dismal to be heard, the two parties rushed into close combat. They now took hold of the hair of each other's heads with their left hands, using the right to cut off the head. Meantime the women and boys followed close behind them, uttering the most shocking cries I ever heard. These last received the heads of the slain from those engaged in the battle as soon as they were cut off, after which the men went in among the enemy for the dead bodies; but many of them received bodies which did not belong to the heads they had cut off. The engagement had not lasted many minutes when the enemy began to retreat, and were pursued by our party through the woods. In a short time our party returned victorious, bringing along with them many prisoners. One of our chiefs had been shot by Shungie, and the body was brought back, and laid upon some mats before the huts. The name of this chief was Ewanna. He was one of those who were at the taking of our vessel. There were, besides Ewanna, five other chiefs killed on our side, whose names were Nainy, Ewarree, Tometooi, Ewarrehuru, and Erow. On the other side three chiefs were killed — namely, Charley, Shungie's eldest son, and two sons of Mootyi, a great chief of Sukyanna."

After this the party left Kipara in a number of canoes, and proceeded down the river to a place called Shaurakke (or Showrackee), from whence they returned to their respective homes. It was only a few days after their return that a vessel was announced off Tokamardo. It was arranged that Rutherford should go on board first to throw the captain off his guard, that the natives might the more easily seize the ship and murder the crew. As soon, however, as Rutherford had gone on board he warned the captain of his danger, persuaded him to put to sea again at once, and to take him with him. Thus, Rutherford says, he made his escape on the 9th January, 1826, after he had been ten years on the island all but two months.

The narrative an outline of which I have now given is illustrated by many details of the manners and customs of the people, which are told in such a way as to leave a favourable impression on the reader and to enlist his sympathy. The bay which is mentioned as the scene of the capture of the "Agnes" is placed some distance south of the East Cape. The short description given of it does not fix the locality decisively, nor yet does the statement that the vessel came to anchor "off the termination of a reef of rocks immediately under some elevated land which formed one of the sides of the bay." The writer of the book to which I am indebted for the narrative, comparing this description with that of Poverty Bay given by Captain Cook, concludes without hesitation that this is the place intended, and his conclusion is accepted by other writers. The name Tokamardo, however, suggests at once the bay, about thirty-five miles from the East Cape, which is called by the natives Tokomaru, and answers fairly to the description given in the narrative. The position, too, assigned to Aimy's village suits this locality, and there can be little doubt that Tokomaru, and not Poverty Bay, is the place intended. But it matters little which of the two we decide upon when we find that the natives have no tradition whatever of any such event as the capture of the "Agnes" and the murder of the greater portion of the crew having ever taken place anywhere in this part of New Zealand. The arrival of a ship for the purpose of trading, and the acquisition of firearms, to say nothing of the capture of the ship and the slaughter of the crew, were events which would be much talked about in those days, and would not readily be forgotten. Besides, what we know of the people both before and since this alleged occurrence makes it extremely improbable that anything of the kind should ever have happened. It is true that the people whom Cook encountered at Poverty Bay were hostile; but when they found, from his treatment of the three youths whom he captured, that he had no desire to injure them, they were disposed to be very friendly, one of the first to come peaceably on board the ship as they were leaving the bay being recognized as one of the very men who were so exceedingly troublesome two days before. At Anaura, too, and at Tolaga Bay, a few miles distant from Tokomaru, the people could not possibly have been more kindly disposed, though they were well aware of what had occurred only a few days before at Poverty Bay. And only three years after 1826, the date which Rutherford gives for his escape, we find that there was a brisk trade carried on all along this coast, the natives being everywhere engaged in the production of flax, which they bartered principally for firearms and ammunition. The articles required for this trade were supplied by Sydney merchants to their agents, who lived among the natives, and were always treated by them with the greatest possible consideration and kindness. The natives tell of three white men, whom they knew by the names of Riki, Punga, and Tapore, who lived for some time among them before the days of the flax trade; but these men came and went of their own accord, and the circumstances of their sojourn in the district do not in the least correspond with those in which Rutherford places himself.

It is to be noticed that Rutherford mentions no names of places in the neighbourhood of Tokamardo. He purports to give the names of several chiefs, but none of these can be identified with any of the names of chiefs now living, or of those of the generation which has recently passed away.

Another remarkable circumstance is that he does not make the slightest allusion to the ravages which were made in the district by the Ngapuhi Tribe, from the Bay of Islands, under the notorious chief Hongi. After Hongi's return from England in 1821, two expeditions were made by this tribe into these parts—the first, under Hongi himself, in 1823, and the second, under Pomare, two years later. The former was most disastrous to the people of Waiapu and the neighbouring parts, whose spears and *meres* were a very inadequate defence against the firearms of their assailants. Every pa that was attacked was taken with great slaughter, and the survivors, to the number of many hundreds, were carried off as slaves. There was great consternation throughout the district, and numbers of the people hid themselves away in their mountain fastnesses until their much-dreaded invaders had departed. The southernmost pa taken by the Ngapuhi was only about five miles distant from Tokomaru, and from this point they retraced their steps and returned home. Pomare likewise came as far south as Tokomaru, but he treated all the people to the south of the East Cape as friends, and formed a matrimonial alliance with them, taking as his wife Te Rangiipaia, daughter of Te Porioterangi. Rutherford mentions Pomare as being near the East Cape, on his way home, when he and his friends returned from their visit to Taranaki; but of Hongi's invasion he does not say a word. And yet, of all the events which disturbed the monotony of everyday life during those ten years, there could have been nothing to be compared with this. It is impossible that any one who was well acquainted with the circumstances of the district at the period in question should, in relating the principal occurrences of those years, pass over such a calamity as this without the slightest allusion.

The last event of importance in Rutherford's narrative is the expedition to Kaipara to take part in the war with Hongi; but the natives of the part of the country from which this expedition is said to have started have no knowledge whatever of anything of the kind. The account, too, which he gives of the battle makes it very doubtful (to say the least) whether he was present at it, as he represents himself to have been; for he gives the victory to the wrong side. The Kaipara people and their friends, who were opposed to Hongi, were successful in the early part of the engagement, but were afterwards beaten with great slaughter, and fled to Waikato, whither Hongi followed them to avenge the death of his son.*

A close examination of the whole narrative leads very decidedly to the conclusion that Rutherford's account of his personal adventures is a mere romance; that he knew nothing of the locality in which he professes to have resided nearly ten years, beyond the name of Tokomaru; and that, whether the years which he spent in New Zealand were many or few, they were spent in the north, somewhere in the neighbourhood of the Bay of Islands.

But what, it may be asked, could be the object of such a fabrication? To this question I can only suggest a possible

* For the particulars of this battle, and its results, see the "Life of Henry Williams," by Hugh Carleton, vol. i., p. 64, note.

answer. It may be that Rutherford was a deserter from one of those ships which, in the early days, so often visited the northern part of the island for the purpose of procuring kauri spars. Supposing this to have been the case, it would be an object of supreme importance with him that he should escape detection; and it would be a great help to him in securing this object if he could induce the natives among whom he found a home to confer upon him the honour of a tattooed face; and it would be with the same object in view that he concocted the plausible story of the capture of the "Agnes," and of his forcible detention in a distant part of the country, to account for his appearance on his emerging once more into the civilized world.

Art. LIII.—*On some Means for increasing the Scale of Photographic Lenses and the Use of Telescopic Powers in connection with an Ordinary Camera.*

By Alexander McKay, F.G.S.

[*Read before the Wellington Philosophical Society, 13th August, 1890.*]

Occasionally notices appear in works devoted to, or incidentally treating of, advances in photographic art, by which it is evident that telescopic photography in its application to ordinary landscape views is engaging the attention of those aiming at improvements in photographic apparatus.

There seems also to be a difference of opinion as to how far mere sharpness and distinctness is a virtue in a landscape photograph. No doubt in this respect the distant parts should be rendered in due subordination to the middle and foreground parts of the picture. This matter in most cases takes care of itself, and very frequently the complaint is well founded that the distant parts of the picture are indifferently rendered. In my opinion the defects here spoken of are only too common.

Again, in approaching the outskirts of a mountainous country, such as the Southern Alps of New Zealand, or the Seaward or Inland Kaikouras in the north-east part of the South Island, there are many excellent combinations which, on account of the distance, cannot by an ordinary instrument be rendered except on a very small scale, and then totally devoid of anything like detail. This difficulty or impossibility has often been a matter of great regret to myself, since, when the mountain-range is viewed from such a distance as admits of a picture being taken on a scale sufficient to show anything like the details, the picturesque combination first observed has vanished, and something totally different has taken its place. This must have been the experience of many amateur and professional photographers besides myself.

To meet and overcome such difficulties lenses of more than ordinary focal length might be used. Lenses of 25in. or of 30in. focal length would, no doubt, to some extent satisfy the requirements of the object in view; but, as such instruments require the use of cameras of a corresponding extension, the apparatus would prove cumbrous, unwieldy, and also unstable should the weather be at all windy.

Some of these difficulties it has been attempted to overcome by the use of an ordinary telescope attached to and placed in front of the lens; but at first sight it must be evident that this is a very doubtful improvement, involving as it does the support of the telescope and otherwise the unsteadiness of the sliding parts. Besides, the results are not what should be aimed at. The picture resulting, though sharp in detail, is of small size, and requires the after-process of enlargement, which may or may not be successfully accomplished.

Some years ago I set myself the task of producing telescopic pictures, and at first I used an ordinary achromatic telescope having positive focus; but, for the reasons already pointed out, I soon discovered that this could be of no use as applied to the purpose I had in view, and it became evident that what was wanted was a telescope of considerable power, but having a very short focal length. As meeting the requirements of the case, and serving the purpose I had in view, I made use of one tube of an opera-glass of small size. This, placed in front of the photographic objective, gave a much larger picture than that obtained by using the longer-focussed telescope with positive focus. I next mounted the lenses, the objective and eyepiece, in separate tubes, sliding one into the other, so that this part could thus be focussed, and afterwards fixed the whole to the case of a single achromatic photographic lens. With this, and by varying the power of the biconcave eyepiece-lens, I obtained pictures of different scales, varying in size from a quarter-area to that of a half-plate. At the same time I also found that, by a slight adjustment of the telescopic part, focus on the camera-screen could be obtained at any distance, from near contact with the back lens to the furthest extension the camera was capable of, and this with a corresponding increase of the scale and size of the picture as the length of the camera-screen was greater from the back lens of the instrument.

I could now produce pictures of almost any size, but they were lacking in vigour, and were not quite as sharp as I desired they should be. This last defect I subsequently found was due to a dissociation of the visual and actinic foci. But I had so far succeeded in my original object, and, besides, had made two discoveries which I rightly deemed to be of considerable importance: first, that the focus on the screen of the camera-box is, by use of the optical combination described, controlled by the telescopic part, and that a very slight difference in the distance between the objective and the eyepiece shifted the position of focus in the camera-box very considerably; second, that as the power of the eyepiece was varied the size of the picture was affected, though in the case of the higher powers there was necessitated a greater length of the telescopic part.

At this stage I made use of a $1\frac{1}{4}$in. objective lens, with an eyepiece of such power that, with the screen at a distance of 7in. from the back lens, a picture $6\frac{1}{2}$in. by $4\frac{3}{4}$in. was obtained. And shortly I found that it was not necessary to use the photographic objective at all, and that the telescopic part of the combination alone was sufficient to produce a moderately sharp picture; but in using the latter I was much troubled by the introduction of both chromatic and spherical aberration. In the face of these difficulties I obtained a number of pictures which under the circumstances might be considered as very fair results.

The instrument as it then was required a very small stop to produce anything like sharpness in the photograph. I have used a stop not more than $\frac{1}{50}$in. in diameter; and, with one of $\frac{1}{32}$in., used to obtain results on a Wratten and Wainwright's "instantaneous plate" by giving an exposure of from five to eight seconds.

The difficulty now was that over and above the twofold optical aberration of the instrument there was such poor illumination of the screen that it scarcely sufficed for the correct focussing of the instrument; and it might be, too, that there was some slight displacement of the visual and actinic rays. To obtain more light I had to make use of an objective lens of larger aperture; and, this being of considerably longer focus, the consequences were that the two foci were dissociated to such an extent that some compensation had to be devised whereby to neutralize this effect. I overcame the difficulty by constructing an eyepiece for use in the position of the camera-screen, but which could be pushed forward into the camera-box the distance required to obtain the correct focus; and, this once determined, a stop-flange was so placed that the same distance could be again found after this part of the instrument had been withdrawn to make way for the dark slide and prepared plate.

The use of a $2\frac{1}{2}$in. objective lens of long focus with the same eyepiece involved the necessity of a greater length of telescopic tube in front of the camera. I found, however, that the increased scale of the objective, due to the flat curvatures of the lens, enabled me to use an eyepiece of much lower power for obtaining a picture of the same size and scale as formerly; and that, to effect this, the whole optical combination need not exceed 8in. in length.

To overcome the chromatic and spherical aberrations above mentioned, I constructed a back combination consisting of a convexo-concave single lens, in near contact with the concave side of which a plano-convex achromatic lens was placed. This, though somewhat reducing the scale of the picture and the area of the circle of light, rendered the instrument nearly non-chromatic and perfectly rectilinear. I could now produce photographs the scale of which exceeded that of an ordinary half-plate lens, including an angle of 40°, five, ten, twenty, or even thirty diameters, simply by giving to the back lens a greater power of dispersion.

Used microscopically, I found that I could copy objects size for size at distances of 10ft. or 20ft., or more, thus admitting of the proper and effective lighting of the object to be photographed, and, in the case of spherical, cylindrical, or conic bodies, giving a representation more in accordance with the distance at which most objects are viewed; and I have no doubt that the larger forms of the instrument will within certain limits be very useful for microscopic work up to sixteen or eighteen diameters. Most of the photographic prints which I exhibit were taken with the 2½in. lens, having the eyepiece or back combination last described.

This instrument, although it did fairly good work, was on the whole too bulky and heavy for use in the field, and I had for field-work to devise a lighter and more handy form of the same, which, with some modifications, is before you.

In this, the optical part consists of a Ross's "rapid symmetrical lens," which, with the tube attached, is fitted to a travelling-screw, thus enabling the focussing of the instrument to be effected, if it is not desired to effect this by shifting the camera-screen. The outer photographic doublet being free from both chromatic and spherical aberration, it is not necessary to be so careful as respects the eyepiece, because aberration is not so likely to be present in that part of the instrument. Therefore the eyepiece fitted in the after-piece of the tube is a simple biconcave lens serving only the purpose of dispersing the rays at a greater angle than that at which they escape from the back combination of the rectilinear lens; otherwise it acts in the same way as the instruments I have described at greater length, with this variation only: that, if the distance between the outer combination and the eyepiece be increased or lessened, this displaces the focus on the camera-screen only by half that distance, and an adjustment of 1in. on the tube represents about 2in. of difference in the camera.

The eyepiece taking the place of the camera-screen is adjusted to the plane of the sensitive surface of the plate in the dark slide, and is easily brought to as great a degree of exactness as the dark slides themselves will register, and if needful it may also be made to compensate any displacement of the foci that may occur through using an imperfect telescopic eyepiece. In using the screen eyepiece the picture should be first arranged, and a proper balance of focus obtained; then, throwing back or aside the screen, the eyepiece may be applied to the production of focal sharpness, which may thus be made as perfect as lies within the capacity of the lenses concerned in its production.

Such, so far, have been my experiments and discoveries, and in bringing them and the instrument under the notice of the Society I do so with a view to their publication, so that others may have the opportunity of making improvements on what I have already effected, or of suggesting something entirely new in its place.

Art. LIV.—*The Determination of the Origin of the Earthquake of the 5th December, 1881, felt at Christchurch and other Places.*

By George Hogben, M.A.

[*Read before the Philosophical Institute of Canterbury, 2nd October, 1890.*]

Plate XLI.

I began to examine into the circumstances of this earthquake in connection with the general work of determining the origins of New Zealand earthquakes, and expected to find that the source of the disturbance was situated beneath the surface of the earth somewhere in the neighbourhood of Castle Hill, or (as Professor Hutton suggested to me in conversation) between Mount Torlesse and Mount Franklin. The evidence, however, gives a different result, and yet I believe is sufficient to show that the epicentrum is at or near the same spot as that of the 1st September, 1888.

The facts on which the present notes are based are related in the *Lyttelton Times* and *Press* of the following days. Very full accounts are given, but the number of data exact enough for our purpose is small.

The places at which the earthquake was felt are as follows:—

Place.	Time.	Apparent Direction.	Apparent Duration.	Effects. Remarks.
Christchurch	a.m. 7.37 *or* 7.38	N. to S. *or* N.E. to S.W.	10–35 secs.	Piece fell off cathedral tower. Chimneys, ceilings damaged, bells rung, panes broken, articles thrown off shelves, water in open vessels spilt; Avon stopped flowing for a moment, then flowed slightly more quickly. Not so much damage as 1868. Several clocks facing E. and W. stopped, but those facing N. and S. went on.
Lyttelton ..	7 h. 36 m. 43 s., N.Z.M.T.	N. and S...	..	"Sharp" (*or* "very severe"). S.s. "Wakatipu" heeled over on to wharf. No damage. Clock at time-ball tower stopped at time named. Town-clock bell struck several strokes at 7.38; several clocks stopped then.
Rangiora ..	7.33 ..	S.E. to N.W.	Nearly ½ min.	No damage done. All pendulum clocks, including town-clock, stopped at 7.33. One of the sharpest since 1871.
Kaiapoi Waikuku .. Saltwater Creek	7.35 ..	..	..	No damage of consequence. Some artesians stopped flowing for a time.
Cust ..	..	E. to W.		
Oxford ..	*About* 7.45	E. to W. ..	70–80 secs.	Unusually heavy. Chimneys moved ½in. to 2in. A few, badly constructed, overthrown. Bottles off shelves. Nearly all clocks stopped.
Prebbleton	7.35 ..	E. to W. ..	..	"Sharp." School-bell at Lincoln rang. No damage.

Place.	Time.	Apparent Direction.	Apparent Duration.	Effects. Remarks.
Leeston ..	a.m. 7.35 ..	N.E. to S.W.	..	"Smart." Accompanied with slight rumbling. Some clocks stopped.
Sheffield ..	7.34 ..	W. to E. ..	..	Rather sharp. Preceding and succeeding tremors.
Kowai Pass (Springfield)	*About* 7.35	N.E. to S.W.	Upwards of ½ min.	"Violent oscillation." Bottles off shelves. "More violent than twelve years ago."
Ashburton..	7.40 ..	..	..	The most severe since settlement of district.
Lyell ..	7.35 ..	E. to W. ..	5 secs.	
Wairau ..	*About* 7.30	N. to S. ..	20 secs.	
Westport ..	7.34 ..	..	..	Three distinct shocks; more than ordinary force.
Greymouth	7.33 *or* 7.30 (*about*)	W. to E., *then* N. to S.	20–30 secs.	"Heaviest ever experienced." Two sharp and distinct shocks. No damage.
Kumara ..	7.35 ..	From N.W., *then* S.W. to N.E.	..	Two shocks. Second shock was heaviest on the West Coast since 1868.
Hokitika ..	7.30 *or* 7.37	S. to N. ..	½ min. ..	Very strong and distinct shock.
Ahaura				
Wellington	7.30 ..	..	..	Slight.
Timaru	7.37 *or* 7.45			
Akaroa ..	7.30 ..	E. to W. ..	..	Very smart. No damage.
Dunedin ..	..	..	..	Seemed to be six shocks in immediate succession.
Hurunui ..	*About* 7.35	S.W. to N.E.	Nearly 2 min.	

Remarks on the Above.

Christchurch.—To the newspaper accounts I might add my own observation, taken at Christchurch and noted at the time. But as, unfortunately, I cannot at present find the note in question, I have refrained from making any use of the observation in my calculations. As far as my memory serves, however, the note states that the time (afterwards checked by a clock at Messrs. Coates and Co.'s) was 7.36 a.m.; the direction of the first shock, from between N.W. and N.; its duration, fifteen to twenty seconds: the second shock, at right angles to the first, began before the first had died away, and so gave to most people the impression of a twisting motion; it was of undefined duration, but more marked in most of its effects than the first shock. This agrees remarkably with the result presently arrived at.

Rangiora.—The pendulum of the town clock vibrated in a plane W. by S. to E. by N. Other clocks, at right angles to this direction, also stopped. Mr. T. W. Rowe has been good enough to ascertain this fact for me.

The two movements, the normal and transverse, are clearly distinguished at Greymouth, Christchurch, Rangiora—in the last two places the stopping of the clocks gives a direction at right angles (or nearly so) to the direction said to have been noted. Most of the given directions can be explained only either on the hypothesis of error in observation, or on the hypothesis that it was the transverse motion whose direction was noted. The transverse motion seems to have been more marked everywhere; and, even were it not so, it is natural that people should mark its direction more carefully than the movements taking place in the first moments of surprise. The time 7.37 or 7.38 at Christchurch is on any hypothesis of the origin inconsistent with the best time given, 7h. 36min. 43sec. a.m., New Zealand mean time, at Lyttelton. Most of the times are approximate, being to the nearest five minutes only.

Determination of the Origin.

1. *By Direction of the Shock.*—By drawing straight lines on a map through the given places in the directions named, and at right angles thereto in case these directions may be those of the transverse vibrations, we find three possible circles to cut or touch a fair number of the lines drawn, within which the epicentrum is to be looked for: (1.) A circle, centre A (see Pl. XLI.), radius ten miles and a half, an epicentrum within which would agree roughly with Lyell, Sheffield, Greymouth, Hokitika, Rangiora, Waiau, and Kaiapoi (almost). (2.) A circle, centre B, radius thirty miles, agreeing with Hokitika, Sheffield, Rangiora, Christchurch, Lyell, Waiau, Greymouth. Note that this circle has to be made very large to include a fair number of the directions, and is not quite consistent with the probable correct assumption that east to west is the direction of the normal wave at Greymouth. (3.) A circle, centre C, radius seventeen miles and a half, agreeing with Christchurch, Lyell, Sheffield, Hokitika, Waiau, Rangiora, Oxford, Greymouth, Hurunui, &c.

The circle, centre B, answers to the facts which give at first sight the impression of an origin near Castle Hill; but it is worthy of remark that I did not, with any combination of the time-observations employed, get an epicentrum situated within that circle.

2. *By Time-observations.*—Those used were—Rangiora, 7.33;* Greymouth, 7.33;* Westport, 7.34;* Sheffield, 7.34;* Lyttelton, 7.36¾;* Lyell, 7.35; Kumara, 7.35; Hokitika, 7.37; Christchurch, 7.37. The remaining times are either of doubtful value, or are inconsistent with any possible theory.

3. *Method of Straight Lines* (Milne, p. 200).—Four lines are available—those got, namely, from the times at the following pairs of places: (*a*) Rangiora–Greymouth, (*b*) Westport–Sheffield, (*c*) Lyell–Kumara, (*d*) Hokitika–Christchurch. The intersections of these lines give as possible positions of the epicentrum the six points marked with dots on the map. (*d* is one of the intersections of the last-named line, Hokitika–Christchurch.) All the points except (*d*) are within the circle C, and immediately to the north of Lake Sumner. The intersection of (*a*) and (*b*) gives D, within a mile of F (see below).

4. *Method of Circles* (Milne, p. 201).—I tried fourteen or fifteen combinations of the given data, and the positions obtained for the epicentrum are shown with small crosses on the map. Most of these lie in the north-east quadrant of the circle A. E is obtained from Lyttelton, Rangiora, Sheffield, Greymouth, and nearly agrees with Westport. It corresponds to a surface-velocity of six miles per minute, and a time at the centrum of 7.23¾ or 7.24 a.m. Its position is about 16 miles almost due north of the south-east end of Lake Sumner.

5. *Method of Co-ordinates* (Milne, p. 206).—The most satisfactory results are given by the first five of the times named in Method 2. The equations give an epicentrum F, 10 or 10½ miles north of the middle of Lake Sumner, 172° 16′ E. long., 42° 34′ S. lat.; velocity, 7·18 miles per minute. The equations show themselves not exact enough to determine either the time at the centrum (they give 7.27¼) or the depth of the latter. By trial it is found, however, that a time at the origin 7·26 a.m., and some depth less than ten miles (perhaps less than five miles), will agree best with the position and velocity found.†

Intensity.—Whether we take F, E, or D, the velocity appears to have been very small—only 500ft. or 600ft. per

* Most reliable.

† The occurrences reported to have been witnessed at Lake Sarah (N.Z. Journal of Science, vol. i., p. 176; Trans. N.Z. Inst., vol. xv., p. 533) can very well be explained as secondary effects of the earthquake. The statements of damage to the buildings, as far as they are opposed to our conclusion, can hardly weigh against the remaining evidence. Indeed, the damage done to the south-east corner of the Castle Hill Hotel suggests the transverse vibration of a wave proceeding from the north-east—that is, from the epicentrum found.

second—and the earthquake, therefore, a very slight one, as measured by the intensity of earthquakes in other parts of the world.

The technical assumption has been made that the epicentrum is a point; the argument seems to show that it is not of large extent; with our data we cannot determine its size or shape. F, E, D, are all within a few miles of the epicentrum, as determined by Professor Hutton (Trans. N.Z. Inst., vol. xxi.), of the earthquake of 1st September, 1888. It is noteworthy also that the geographical distribution of the shock, though not quite so great, is the same, as far as it goes, as the distribution of that earthquake. The fact that both the earthquakes that have injured the Christchurch Cathedral have proceeded from the same place may be worthy of practical consideration in any attempts that may be made to guard against possible damage in the future.

Art. LV.—*The Origin of the Earthquake of the 27th December, 1888, felt in Canterbury and Westland.*

By George Hogben, M.A.

[*Read before the Philosophical Institute of Canterbury, 6th November, 1890.*]

Plate XLII.

This earthquake was felt generally throughout Canterbury and Westland, and, though it was of a slight nature, the shock or shocks were so distinct, and the observations (in the absence of instruments) appear to have been so accurately taken, that the epicentrum can be determined with great exactness.

The principal data are as follows: Greymouth, 9.32 p.m.; Waikari, 9.29 p.m.; South Malvern, 9.28 p.m.; Sheffield, 9.28 p.m.; Christchurch, 9.27 p.m.; Ashburton, 9.27 p.m.; Dunsandel, 9.26 p.m.; Akaroa, 9.26 p.m. (or 9.25½ p.m.).

Inquiry made into the circumstances of these observations at the time seemed to show that those at Akaroa and South Malvern were the most exact. For the former I am indebted to Mr. W. Walton, then headmaster of the Akaroa High School, and the two times given represent the limits within which the beginning of the shock took place. That at South Malvern was taken by myself. In each of these cases the second as well as the minute was taken, and the times were verified as soon as possible afterwards by New Zealand mean time. They are almost certainly correct within a quarter of a minute. The times at Greymouth, Waikari, Sheffield, and Christchurch are also probably correct to half a minute—that is, to the nearest minute. Those at Ashburton and Dunsandel are more doubtful; but even the inclusion of these does not give results widely divergent from the others.

The directions noted are far less satisfactory, probably on account of the apparently twisting character of the movement, or, more strictly, the quick succession of the transverse movement upon the normal movement.

The methods employed in determining the epicentrum were the methods of straight lines, of circles, and of co-ordinates. The last, however, gives such definite results for the origin itself that it will be enough to state those alone, remarking only that the other methods do not disagree therewith, or show only such slight disagreements as can be explained without any straining of the evidence.

Taking Greymouth as the origin of co-ordinates, its meridian as the axis of x, and the axis of y eastwards, from the times at Greymouth, Waikari, South Malvern, Christchurch, Akaroa, we get the following equations (see Milne's "Earthquakes," p. 207):—

$$64x+150y+9u-3w=6{,}649.$$
$$138x+76y+16u-4w=6{,}205.$$
$$142x+148y+25u-5w=10{,}517.$$
$$184x+180y+36u-6w=16{,}564.$$

The solution of these gives us—

$x=$ 118 miles.
$y=$ 83 miles.
$u=$ 367, $\therefore v=19{\cdot}21$ miles per hour (velocity of propagation).
$w=5{,}605$, $\therefore t=7{\cdot}636$ minutes,

and time at the origin 9h. 24·364min. p.m.

$z=24{\cdot}2$ miles (depth of origin).

O on the accompanying map (Pl. XLII.) marks the position of the epicentrum: taking this and the depth of the actual centrum to be correct, we find the distances from the centrum, and the time at the origin as found by reckoning back from the times observed at the several places, to be as follows:—

Greymouth	144 miles	9h. 24·5min.
Waikari	86 "	9h. 24·5min.
South Malvern and Sheffield ...	69 "	9h. 24·4min.
Ashburton	60 "	9h. 23·9min.
Dunsandel	54 "	9h. 23·2min.
Christchurch	51 "	9h. 24·34min.
Akaroa	35 "	9h. 24·2min.

The agreement (the time at the origin, of course, should theoretically be the same from whatever place it is determined) is remarkable. No other assumed depth gives by trial any results so close. For Akaroa, in the last table, 9.26 is taken as the time of the beginning of the shock; it was, however, probably nearer to 9.25½ than to 9.26. Taking it as 9h. 25·7min., the origin of the shock felt there should be nearly 8 miles nearer to Akaroa. A is the nearest point to Akaroa that the other data will allow. In the same way the Ashburton time may be made to agree with the rest by supposing an extension of the disturbed area above the origin in the direction of B. I have therefore marked A O B as a possible boundary of the epicentric area. I have little doubt about the portion O A;* but the other portion, O B, is far within the limits of error, and is not more, therefore, than a speculation.

Professor Hutton, in a letter to the *Press*, gave the epicentrum as H. (See Pl. XLII.) He used, however, only part of the above data, and, finding that I was engaged on the question, did not pursue the matter further, but courteously gave way to me.

To sum up: The earthquake had its origin beneath the sea at a point (O) 45 miles south-by-east from Christchurch, nearly opposite Akaroa Heads and the mouth of the Rakaia; in longitude 172° 51′ E., latitude 44° 10′ S.; at a depth of about 24 miles. The shock took place at the origin at 9.24⅓ p.m., and was propagated with a velocity of 19⅕ miles per minute, or 1,690ft. per second.

The chief interest connected with the determination of this earthquake-origin is, that I think it will be found that most of the small earthquake-shocks felt from time to time in Christchurch and its neighbourhood proceed from the same region. For instance, there is very little doubt that a series of earthquakes on the 5th and 6th of June, 1869—much discussed in the newspapers at the time—had their origin at nearly, if not quite, the same spot.

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* Even the later time, 9.26 p.m. at Akaroa, requires us to suppose some extension of the epicentric area towards A. By assuming further that the portion of the earth's crust where the disturbance originated (or the focal cavity) was nearer the earth's surface in the direction of A than at O, we may make the agreement of the data from the six best places perfect. Without complete seismographic apparatus, however, such an assumption can be no more than a mere conjecture.

Art. LVI.—*Notes on the Earthquake of 7th March, 1890, felt at Napier, Gisborne, and other Places.*

By George Hogben, M.A.

[*Read before the Philosophical Institute of Canterbury, 7th August, 1890.*]

Plate XLIII.

By the courtesy of Dr. Lemon, I have, since December, 1889, been allowed to receive memoranda of earthquake-shocks as observed by officers of the Telegraph Department at various places in the colony. Up to the present time there has been only one earthquake (the one that forms the subject of these notes) for which the returns received have been sufficient in number to be used for the determination of the position of the earthquake-origin; but the means thus adopted will, I trust, secure what has generally not been secured in the past, a sufficient number of reliable data for determining the origin of any important earthquake in the future.

I need scarcely point out that the officers of the Telegraph Department, most of whom seem to take considerable interest in the subject, have unusual opportunities of aiding the determination of the chief centres of earthquake-disturbance by the only exact method that is possible at present in New Zealand —namely, by means of careful time-observations.

In regard to the particular earthquake referred to, I have rejected all other notices (newspaper and otherwise) as too inexact for the present purpose.

The returns from the several telegraph-offices are as follows:—

1. Place of Observation.	2. Observed Time of Beginning of Shock. (N.Z. Mean Time.)	3. Direction of Wave, as reported to have been observed.	4. Nature of Shock as reported.	5. Duration.
Napier ..	5.25 p.m.	N. to S. (apparently)	Sharp. *Clocks stopped.* Previous rumbling	15 seconds.
Gisborne ..	5.25 p.m.	N.E. to S.W.	Very sharp	30 seconds.
Feilding ..	5.29 p.m.	Not defined	Slight. Vibration continued evenly for	35 seconds (exactly).
Taupo (Tapuaeharuru)	5.29 p.m.	S.E. ..	Sharp. Peculiarly undulating motion	½ minute.
Wanganui..	5.30 p.m.	N.E. to S.W.	Severe (?)	33 seconds.
Wellington	5.30 p.m.	S. to N., then N. to S.	Slight	4 seconds.
Blenheim ..	5.30 p.m.	N. to S. ..	Slight. Previous rumblings for a few seconds	5 seconds.
Bull's ..	5.31 p.m.	N.E. to S.W.	Sharp.	
Tauranga ..	5.35 p.m.	S.E. to N.W.	Severe	5 seconds.

Remarks upon the Above.—These are all the places from which returns were received: none were sent from Kaikoura, Nelson, Foxton, Masterton, Ohinemutu. The times in all cases are stated to have been checked by New Zealand mean time. The remarks in column 4 are given nearly in the words of the observers (abridged). As usual, very different ideas of the severity of a shock exist in the minds of different persons. The only definite effect noted at any place was the stopping of several clocks at Napier. At Wanganui the shocks are called "severe," but the effects (for which a separate heading is provided in the forms supplied to the telegraph officers) were only very slight—the shaking of crockery and utensils, without any breakage.* The items in column 3, in the absence of special instruments, are of small or, at least, uncertain value: the newspaper reports in many cases give almost every point of the compass for the apparent direction of the wave, and an officer of the Telegraph Department can hardly be expected to form a much better idea on this point than an outsider.

From the general character of the memoranda forwarded from time to time I should be inclined to place most reliance on the returns from Wellington, Wanganui, Napier, and Gisborne, in the order named; and to these, on account of the internal evidence, I would add the present return from Taupo. The times at Bull's and Blenheim must either be rejected as inconsistent with any hypothesis of the origin—that at Bull's palpably so—or it must be supposed that in those cases local causes gave rise to considerable retardation and acceleration respectively of the rate of propagation.

The first impression on comparing the observations with the map (Pl. XLIII.) would probably be that the epicentrum must be looked for at some point between Ruapehu and Napier. This obviously would not agree with the return from Gisborne, or with the difference of one minute only between Wanganui and Wellington (which must both be taken as good observations).

Origin found by the Direction of the Wave.—If we remember that what an observer generally records is the apparent direction of the vibration, not that of propagation; that the normal and transverse movements of an earthquake are at right angles to one another; and that the longitudinal (or normal) motion generally reaches a place first, we should have, when both movements were felt, a fairly good guide of a rough kind to the direction from which the shocks proceeded (assuming the absence of reflection or deflection of the vibrations). When movement of one kind only is reported, as we cannot tell which of the two it is, we must draw two lines on our

* This fact, and the small velocity of propagation, show that the earthquake must be classed as "slight."

map through each place, one in the given direction, and the other at right angles to it. Doing this with our present data, and attempting to describe the smallest circles that shall touch or cut as many of these lines as possible, we find that two such circles can be described: (1) one, with its centre almost in the centre of the triangle Taupo, Napier, Gisborne (no point within or near this circle could be assumed to be the epicentrum, in face of the returns from Wellington, Wanganui, and Tauranga); (2) another circle can be described with a radius of about 38 miles, and a centre (marked A on the map) in the Pacific Ocean east of New Zealand, about 232 miles from Napier or Gisborne, and 300 miles from Wellington. It will be seen that this is consistent with what follows.

Method of Straight Lines.—This method may be used with three pairs of places at which the times are alike: Wellington–Wanganui (5.30 p.m.), Napier–Gisborne (5.25 p.m.), Taupo–Feilding (5.29 p.m.). The first two pairs of places (the lines joining which differ most in direction) would give an epicentrum (B) nearly on the 180th meridian, in latitude 40° 54′ S. This point is about 6 miles from the nearest part of the circle (centre A).

Method of Circles.—With a velocity of 15 or 15½ miles per minute an epicentrum (C) can be found from the data of the five places Gisborne, Napier, Taupo, Wanganui, Wellington. It is in longitude 179° 38′ W. (180° 22′ E.), latitude 40° 47′ S., about 200 miles from Napier, 290 miles from Wellington.

Method of Co-ordinates.—This method includes the two preceding, and, being a fuller application (analytically) of the same facts, must be at least as reliable as a means of ascertaining the epicentrum. It is, however, not reliable for ascertaining the velocity, time at the origin, and depth of the centrum, unless the times are very exact indeed. This is especially the case when the distances of the places of observation from the origin are too nearly equal, as they are in the present instance.

It is important, I think, to note the different value this method has for finding the co-ordinates of the epicentrum and for finding the other unknown quantities. The distinction I have made would take too much space to discuss fully; but I believe it to be mathematically sound. Professor Hutton has omitted to draw this distinction in his paper on "The Earthquake in the Amuri," Trans. N.Z. Inst., 1888, p. 283.*

* When more than five equations can be formed, the most probable solution is to be got by forming the normal equations, according to the Theory of Errors, from all the equations, rejecting those in which *mistakes*, as distinguished from *errors of observation*, are likely to occur. My remark, of course, is not to be taken as a criticism upon the value of Professor Hutton's paper, which appears to me to be a model for all future workers in the same field in New Zealand.

Taking the times from all the places except Bull's and Blenheim, with Tauranga as origin of co-ordinates, and the line Tauranga–Wanganui as the axis of x, then, forming the equations of observation as in Milne's "Earthquakes," p. 206, and forming the normal equations from them (see Merriman's "Method of Least Squares," chap. iii.), we have for our normal equations—

$$
\begin{aligned}
x), &\quad 559{,}406x+97{,}780y+62{,}892u-9{,}552w=58{,}622{,}552,\\
y), &\quad 97{,}780x+93{,}196y+45{,}732u-4{,}952w=11{,}688{,}384,\\
u), &\quad 62{,}892x+45{,}732y+23{,}842u-2{,}682w=\ 6{,}722{,}086,\\
w), &\quad 9{,}552x+\ 4{,}952w+\ 2{,}682u-\ 322w=\ 1{,}008{,}386;
\end{aligned}
$$

from which we get

$$x=109 \text{ miles (nearly)},\ y=305 \text{ miles (nearly)};$$

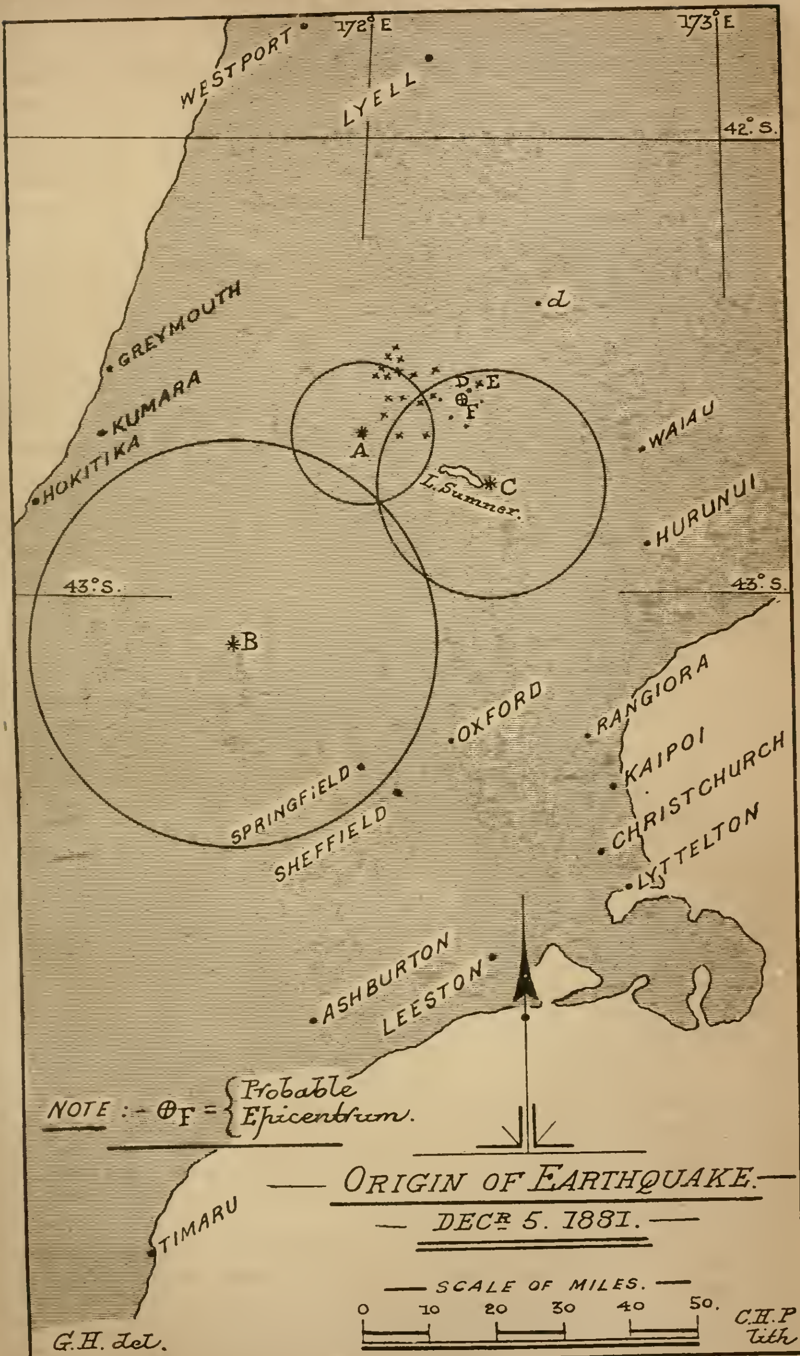
the deduced values of v, t, and z being, as I have pointed out, unreliable.

The epicentrum thus given (D) is situated in longitude 179° 9′ W. (180° 51′ E.), latitude 40° 38′ S.; it is distant from Wellington 320 miles, from Napier 221 miles, from Gisborne 205 miles. The above normal equations give us the most likely position for the epicentrum, if the observations be of equal weight. I believe we are justified, however, in taking the times of the five places named as of superior weight; but, being unable to assign any figures that shall accurately mark the difference in value, I take the four equations of observation for those places alone, and find an epicentrum (as near the true one as we can get) at E, 179° 49′ W. (or 180° 11′ E.), 40° 54′ S.; 280 miles from Wellington, 198 from Napier. This is very near B and C—10 or 12 miles from either—and is within the circle whose centre is A.

Time at the Origin.—From the same five places the following table gives the deduced time at the origin:—

Place.	Distance from E, in Miles.	Time at Origin if Velocity in Miles per Minute be			Time at Origin if Velocity = 15½ Miles per Minute, and Depth of Centrum 20 to 30 Miles.
		15	15½	16	
		P.M.	P.M.	P.M.	P.M.
Gisborne ..	197	5h. 11·9m.	5h. 12·3m.	5h. 12·7m.	5h. 12·2m.
Napier ..	198	5h. 11·8m.	5h. 12·2m.	5h. 12·6m.	5h. 12·1m.
Wellington	280	5h. 11·3m.	5h. 11·9m.	5h. 12·5m.	5h. 11·9m.
Taupo ..	265	5h. 11·3m.	5h. 11·9m.	5h. 12·4m.	5h. 11·8m.
Wanganui	280	5h. 11·3m.	5h. 11·9m.	5h. 12·5m.	5h. 11·9m.

The first three columns are calculated on the assumption that the distances from the origin = distances from E; the

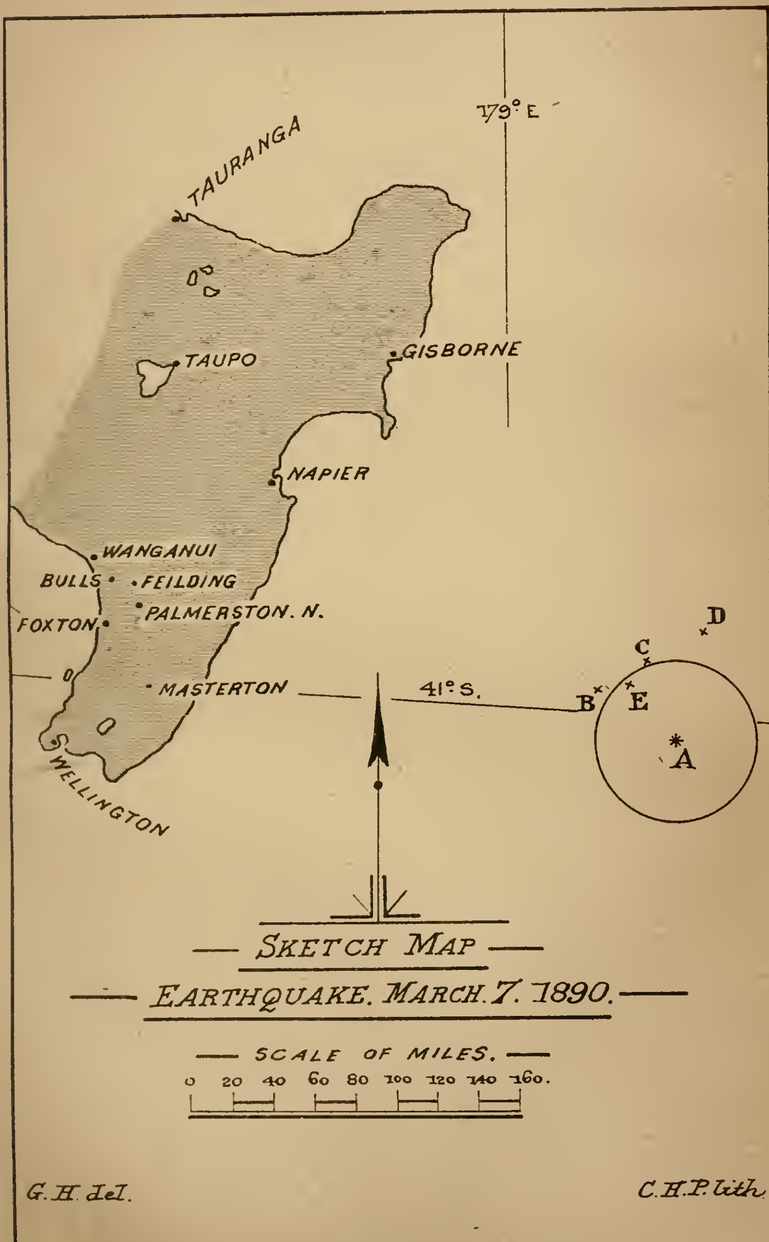

172° E
173° E
42° S.
43° S.
43° S.
WESTPORT
LYELL
d
GREYMOUTH
KUMARA
HOKITIKA
A
D
E
F
C
L. Sumner.
WAIAU
HURUNUI
B
OXFORD
RANGIORA
KAIPOI
CHRISTCHURCH
LYTTELTON
SPRINGFIELD
SHEFFIELD
ASHBURTON
LEESTON
TIMARU
NOTE :- ⊕F = { Probable Epicentrum.
ORIGIN OF EARTHQUAKE.
DECR 5. 1881.
SCALE OF MILES.
0 10 20 30 40 50.
G.H. del.
C.H.P lith

O. Position of Epicentrum.
A. O. B. Probable boundary northwards of disturbed area.

EARTHQUAKE DEC^R 27. 1888.

SCALE OF MILES.
0 10 20 30 40 50.

G. H. del. C. H. P. Lith


179° E
TAURANGA
TAUPO
GISBORNE
NAPIER
WANGANUI
BULLS
FEILDING
PALMERSTON. N.
FOXTON
MASTERTON
41° S.
WELLINGTON
D
C
B
E
A
SKETCH MAP
EARTHQUAKE. MARCH. 7. 1890.
SCALE OF MILES.
0 20 40 60 80 100 120 140 160.
G. H. del.
C. H. P. lith.

last column on the assumption that the centrum is at a depth of twenty to thirty miles.

The result of the method of circles shows that we cannot assume a velocity greater than about 15½ miles per minute; hence the time at the origin must have been 5.12 p.m. nearly.

Velocity of propagation = 1,364ft. per second, nearly.

Depth of Centrum.—No plausible estimate can be made as to the depth of the centrum, the distances being too great, or, at least, too great for the degree of accuracy of the time-observations. The origin was probably deep—say between twenty and thirty miles.

General Remarks.—I have not received or seen any notice of any extraordinary sea-wave being observed. I do not know that any previously-recorded earthquake can be referred to the same origin, unless it be that of the 30th October, 1879 (though this is doubtful).

The epicentrum has been assumed throughout to be a point, which, of course, it is not. It might very well be an area that would include B, C, E, and even D. But we have no means of determining the extent of the disturbed area.

ART. LVII.—*Bush Notes; or, Short Objective Jottings.*

By WILLIAM COLENSO, F.R.S., F.L.S., &c.

[*Read before the Hawke's Bay Philosophical Institute, 14th November, 1890.*]

'Tis in ourselves that we are thus and thus.
SHAKESPEARE.

1. *On a Clear Pool of Water in the Thick Forest.*

IT is a pretty and a pleasing sight to come suddenly on a deep pool of water in the dense still forest, especially on one formed in an excavation having steep sides, made by the side of the railway-line, with its pure smooth surface shining like a mirror, and clearly and faithfully reflecting the images of all branches and leaves and flowers of trees and shrubs, and of elegant drooping ferns overhanging its margins and growing around it. Early in the day, with the sun shining in the heavens, and its beams glinting down from the clear blue sky through the open spaces among the tall tree-tops, such a pool presents a ravishing spectacle, particularly when it possesses its natural delicate fringes of light-green floating fresh-water *Algæ* —*Conferva* and *Oscillatoria*—bespangled with glittering dew-drops. And even this is sometimes increased (though rarely) while one is quietly looking on pleasurably, and drinking in the scene, by the lighting-down of a dear little black-and-white forest bird* on one of the pendulous branches, so that its image is also reflected clearly in the watery mirror: perhaps it has come to quench its thirst, and will patiently wait until I retire? And then, suddenly, on the falling of a leaf, or a flower, or a tiny twig into the pool, all is blurred and vanished as if by magic; but ere long, the day being calm, the pleasing scene returns, and affords a delightful object for contemplation. This is also further heightened by considering the foulness of the bottom of the said water, caused by thick deposits of rotten leaves, mud, &c., which, on being only slightly stirred, mar the whole. As Shakespeare quaintly and truly remarks,—

> Roses have thorns, and silver fountains mud.

Just so it is with many of us. And, while thus contemplating and moralizing, his truthful and natural religious lines concerning the retired woodland life come rushing to the fore:—

> And this our life, exempt from public haunt,
> Finds tongues in trees, books in the running brooks,
> Sermons in stones, and good in everything.

Here I may mention that such a still pool of clear water was formerly used by the Maori chiefs as a kind of mirror, to show them the appearance of their own hair and heads when dressed with feathers, &c. And, of course, such a pool was sacred, and its water never used for any other purpose, unless it were to wash that *one* chief's head. Such pools have often served to remind me of the ancient poetical story of Narcissus.

I well remember in one of my early journeys at the north (in the "thirties") stopping at a Maori village where I had never been before. I noticed a delightful little pool of clear cold water in a rock-basin in the side of a rivulet in a sequestered spot in a thicket near by, and, being thirsty, I drank from it. This was seen by one of the Maoris of the place, who soon informed the others, and my transgression formed the subject of a long public debate as to what was to be done to me by way of retaliation, and what was I to pay as a fine or recompense. The water of that pool had never been drunk before by any human being, as it was the head chief's mirror-water. I got off, however, partly through my knowing a little of their language and their ways, and partly through my plea of being a foreigner and ignorant of the great sanctity of that dell: but there was much said about it—particularly my temerity, and its desecration, while some of them also waited to see the expected results (as in Acts, xxviii., 6).

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* *Miro australis*, wood-robin.

2. *On some Very Small Flowering Indigenous Spring Plants.*

I have often been struck with the neat and pleasing appearance of several of our very small flowering plants inhabiting the high, open, stony plains in the early spring. These, though mostly perennial, are low, and cannot be detected from a little distance, looking over and across those long and broad flats. To a visitor at that season, so looking at the plains, with their small, stunted, withered herbage, they appear *primâ facie* very dreary, and look still more cheerless than they really are when the blustering cold winds occasionally sweep over them in fitful blasts, soughing through the dry and dead stems of the last year's grasses. To discover their hidden floral beauties is no easy matter, particularly at this season of the year; to do this one must wander into them, and sit or lie down, and peer closely about, even to the pushing-aside the slightly higher and coarser plants (small herbs and grasses not yet in flower) which overtop and conceal and preserve them—the lowly vernal flowering ones. Some of those tiny flowering herbs form broad perennial patches or little beds, and sometimes slightly-raised dwarf cushions; but they are generally very low and flat, seldom rising above ½in. from the ground; but all grow thickly intermixed, frequently revealing themselves, even when not in flower, or their flowers closed, as happens on a dull cloudy day, by the various colours and tints of their leaves, which range from very dark- to pale-green, bronze, brown, light-red, and dark-purple. A few of the more striking may be more particularly noticed.

One of them, which is sure on first seeing to attract the attention, is a minute and neat creeping species of *Epilobium* (the smallest of the many species of that genus found in New Zealand), with its numerous curiously-marked, close-set, regular, orbicular, yellowish-brown leaves, less than 1 line in diameter, and its small, erect, white, star-like flowers. Another is a thick-growing species of *Oxalis*, with its very small, almost crisped, compact leaves, and pretty yellow flowers. A minute, erect, tufted *Asperula*, with its curious bicuspidate leaves, and terminal white starry flowers always horizontal and gazing to the sky; of this genus I think there are two species to be found here, one being the *A. perpusilla* of Hooker, which, he says, "is the smallest flowering plant in New Zealand." A little and peculiar half-rosulate species of *Ranunculus*, with its small spreading leaves forming a circle closely appressed to the ground, and its attractive, shining, yellow, star-like flowers, of 5–6 petals, rather large for the little plant; and when the flowers of a score or a dozen of them closely growing together are displayed to the sun they present a lovely galaxy of floral beauty in the desert wild sure to evoke a word of praise. In some sheltered hollows or small depressions in the soil a small variety of the graceful New Zealand Daisy ("that unassuming commonplace of Nature") will here and there be sparingly seen, fully expanding its day's-eye to the genial rays of the foster-parent sun. Here, too, may properly be placed a small and neat species of *Geranium*, which forms low, circular, semi-tufted plants 3in.–5in. diameter, their root-stocks very stout and branched, the branches very short, each with many small and neatly-cut leaves closely appressed to the soil; its few pale-coloured flowers, on very short scapes, modestly nestling in the centre. Another especial peculiarity of this plant (besides its very short flower-stalks) is the varying colours of its leaves—though all of one plant are of one colour—some being grass- others pale-green, others dark-brown, and others pale-fawn with reddish streaks. A minute *Myosotis*, scarcely exceeding 1in. in height, and bearing yellowish terminal flowers, is sometimes to be met with, but it is rare. This little wee member of the blue-flowered "forget-me-not" family, with its strangely aberrant-coloured flowers, I first detected on the dry shelly banks by the sea-shore, near Farndon, forty years ago. A small erect *Cardamine*, with minute pure-white flowers and dark-purple stalks, very likely identical with those of the Antarctic islets described by Hooker. A little spreading green and shining *Colobanthus*, with pale-green and white starry flowers. A highly graceful and curious little *Leptinella* (or *Cotula*), with neat and regular pinnate leaves, and tiny heads of yellow flowers, forming thick matted beds, its long stolons creeping underground. To obtain only a fair specimen of this pretty little plant one must cut out a pretty large turf. I have good reasons for believing there are two distinct species of *Leptinella* here on these plains, but they are very much alike at first sight. Another and a similar plant as to its manner of growth (but not as to its foliage and flower) is a small species of *Nertera*. This plant grows together so densely as rarely to allow of any other growing among its intermixed and rooting branches. Its small and simple, close and concave leaves are almost vertical. Its pale-yellow flowers are diœcious and highly curious, and are large for the humble plant; they grow singly, and are produced clear above its leaves, and are extremely delicate. Its flowers much resemble those of the larger shrubby *Coprosma* genus, to which this genus is very closely allied. And yet another very similar plant as to its densely compact and matted manner of growth, and also in the form of its closely-set leaves, which are small and very regular, is a species of creeping *Gnaphalium*, which often forms low, close-growing, and tolerably large patches; its slender flowering-stems, however, which are erect, and appear later in the season, are 2in.–3in. high.

The myriad flowers of all those little plants are all scentless, or nearly so; but not so these of the dwarf perennial *Leucopogon* that is found growing intermixed with them, but mostly in large, distinct, irregular patches, arising from its creeping underground roots. This is a dear little semi-shrubby plant, with needle-like tips to its small, neat, close, and regular leaves, which have also minutely-serrulate edges (a beautiful object under a magnifying-glass), each short erect stem, or branch, of 1in.–2in. bearing many sweet-smelling flowers that sometimes form a little whorl, diffusing a delightful odour extending to some distance, and serving to betray its source. Wordsworth truly says, "The flower of sweetest smell is shy and lowly." This dwarf shrub also bears a small dark-orange globular fruit (like a little fairy-like cherry), which is edible, and contains one wee stone. Another scented plant is the elegant-leaved umbelliferous *Oreomyrrhis*, which displays its dark-purple stems and pinnated leaves in a small radiating circle closely appressed to the ground, or more commonly to the fawn-coloured moss which closely invests it; these are always easily detected by their pleasing dark colour. The whole of this pretty plant is equally scented, and the odour, though strong, is not unpleasant. It is not, however, common, though perennial, and is mostly found scattered, yet sometimes several plants are found growing together.

All those plants (with many others) are generally accompanied by several small, thick-growing, tufted, and creeping mosses of various species, and forms, and colours, mostly barren, yet sometimes found in fruit; with here and there, occasionally, a small specimen of that curiously-formed plant and fern ally, *Ophioglossum*, with its single leaf and curious erect spike: all which greatly enhance the beauty of the humble and lowly floral scene.

> To me, the meanest flower that blows can give
> Thoughts that too often lie too deep for tears.
>
> *Wordsworth.*

There is still another and deeper consideration that finds its way into the intelligent botanist's mind when pondering over those little plants—viz., that the same or very similar species of some of these small and peculiar genera are only found in far-off isolated spots, distant also from each other—as the Andes from Mexico to Chili, Cape Horn and Fuegia, certain mountains in Australia and Tasmania, and those speck-like islets (Campbell's Island and Lord Auckland's Islands) in the Antarctic Ocean. The due and fair consideration of these facts serves to raise up thoughts almost boundless in the mind —thoughts, questions, seekings which cannot at present be reasonably solved.

3. *On Some of our Indigenous Forest Birds.*

I have been much grieved of late in my visits to the forests to find scarcely any birds: in this respect so very different from what the woods formerly were, when they were gay with their company, and resounded to their melody and screams. Some species of the old familiar wood-denizens seem to have become quite extinct, as they are now never met with. During this extended visit of mine to the woods I have noticed only a few birds of three distinct kinds in the forests—viz., the *tuuii*, or parson-bird;* the *kotare*, or kingfisher;† and the *piwakawaka*, or flycatcher‡—and very few indeed of these. On some days, and during some hours spent in traversing the woods, I have not observed nor heard a single indigenous bird. It is, however, very pleasing to hear the deep and rich loud notes of a parson-bird perched high on a topmost and exposed branch of a tall tree—his favourite position when singing—especially at sunset, when it is as a call to vespers. Very likely its song is now considered the more melodious from its rarity. I am of opinion that the cock-bird sings to its mate when she is sitting in her nest hatching her eggs. It is a very pleasing sight to see a pair of them together diligently occupied in extracting honey from the tree-flowers, especially when the sun is shining on their glossy, submetallic, dark plumage. I have in former years seen two and three pairs together so employed in one small tree. On such occasions, if unobserved by them, and one keeps quiet, they may be pleasingly watched for some time, as their whole attention seems to be given to their sweet and profitable labour.

The kingfisher, being a shy bird, and generally making its nest in steep cliffs by sides of streams, is rarely seen at this season away from its breeding-place. I have seen more of them in my garden and fields on the hill at Napier, in the winter season, than I have ever seen together in the woods. At Napier they catch crickets, mice, &c., and are very serviceable. Mr. S. G. Brandon, of Meanee, once sent me a kingfisher that he had found very recently dead in his paddock. It had a large mouse in its beak, a little more than half-swallowed. No doubt the living mouse had in its death-struggles bitten and clawed and held on to the bird's throat, so that both had miserably perished together. Here, in the bush, I noticed a pair of them having their nest in a hole near the top of a tall dead tree denuded of its bark, that was at least 40ft. high, and which stood at the edge of a wood by a small stream. A large bushy tuft of the long-leaved epiphyte

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* *Prosthemadera novæ-zealandiæ.*
† *Halcyon vagans.*
‡ *Rhipidura flabellifera.*

Astelia grew in the angle of a branch over the entrance. When their young were hatched it was quite a sight to see the parent birds continually flying down to the stream and returning with a small fish in their bills. On one or two occasions, when I timed them, each of the birds would go and return in about six minutes. I noticed they were not both absent together.

The interesting little flycatcher, with its monotonous sharp and short cry, which always seems to prefer making the acquaintance of man in the forest solitudes, I have seen but few of during this visit. By imitating its cry, or, rather, I think, the cry of its young, it will keep about one, gradually coming nearer and nearer, flitting from branch to branch, and incessantly displaying its tail-feathers. To me, when alone in the woods, this dear little bird is always welcome as a pleasing companion.

> To know
> That which before us lies in daily life
> Is the prime wisdom. *Milton.*

4. *On the Great Beauty of a Spider's Web.*

While standing in the doorway of a solitary outhouse here at Dannevirke, I noticed a large and perfect spider's web, which had been recently constructed by a species of spider commonly called "the geometrical spider," from the extreme regularity of the concentric circles of its work. Smaller yet similar webs of the same kind I had often observed about the fences of my grounds at Napier; this one, however, was a very fine specimen, extending from the top corner of the open doorway to the eaves, and quite perfect, the part filled up with concentric circles or cross-lines being about 11in. in diameter. Half the width of the web contained forty-five equidistant cross-lines, each being about 1 line apart. It was cunningly and well secured by both long and short guys, while around the central portion, for about 1½in., where the little architect was resting, was still unfinished. But the peculiar and attracting beauty of the structure arose from the manner of its appearance when the sun shone brightly and directly on it, every line displaying all the colours of the rainbow, glistening gloriously, which was also greatly increased by their slightly tremulous or minutely rippling motion. The sun's rays were prismatically divided and rendered, and their lovely microscopical refrangibility was very great—quite dazzling to the eyes. It was "a thing of beauty"—of natural beauty—to be seen, closely observed, admired, and never to be forgotten! I was so struck with it that I repeated my visits to the place to see it. I had before not unfrequently noticed a single line of spider's web briefly so acted upon by the rays of light, but never on such a large and complete scale, neither so splendid nor so lasting as to colours. Something similar, though fainter and transient, may also be observed at times on filmy soap-bubbles, when blowing them. Truly the sight was a gorgeous one.

5. *On a Bat.*

On some fine evenings in August I was much pleased in watching the tortuous flittings of a bat, not having noticed one for many years. Here, at Dannevirke, in the township, in open spaces among the houses, the little creature seemed to enjoy itself. Yet, while it was quick in its flight, it repeatedly doubled, making only short zig-zag turns, with much irregular rising and falling—perhaps in its pursuit of insects flying, as its food. Formerly bats were not rare; indeed, they have been found in little flocks (or more properly, perhaps, a cluster) in our short winter season, securely hibernating in hollow trees in the woods. No doubt their present scarcity around our rural townships is owing to the extensive felling and burning of the neighbouring forests, in which they too were destroyed.

On two occasions about forty years ago I kept a bat in a cage in my dwellinghouse. One of them lived three or four weeks. It was a pretty little animal, with its velvet coat (reminding me of that of an English mole), bright black bead-like eyes, and very sharp and white teeth. It often amused us of an evening in the twilight, when it was taken out of its cage and allowed to fly about the sitting-room, which it fully explored, always dexterously avoiding coming into contact with the cross-beams or any article of furniture; now and then resting by clinging to the walls with its wings expanded. As these little creatures take their food (small living insects on the wing) during their short irregular flights, and as there were none in the room, it was fed by hand with a few small flies, which it ate with avidity; but it was quite a task for it to master a small bluebottle fly, making, too, such a ludicrous fuss over it in its chewing and champing! It always managed them better when their wings were taken off.

6. *On the Great Docility and apparent Want of Fear of Man in Young Lambs.*

It is always a pleasing and interesting sight in the spring, in the lambing season, to see the young lambs "frisking about by the sides of their dams." Youth and age without cavil must equally take delight in witnessing this. When many ewes are together on the plains with their lambs, and all so very much alike, it seems as if it must be a difficult matter for each dam to know its own young ones, or for the young lambs to know their own proper mother; yet they generally, if not invariably, manage very well on such occasions. Sometimes, however, in my going among them at this season (in my crossing the large level plain lying between Dannevirke and the woods on the Mangatera River), taking care to disturb them as little as possible, I have fallen in with a lonely pair of little lambs, twins (as is not unfrequently the case), who have somehow missed their dam, and then they are sure to make up to me, keeping step in their walking, and time in their little juvenile bleating. They follow at my heels, and come close up if I stand still, and look up and bleat so very affectingly, as if they said, "Where is our mother?" or "We want mother." There was no mistake about it—no misunderstanding them. It has pained me more than once to have to drive them off from continuing to follow me like little dogs when I could not find their dam, fearing they might go further astray. Sometimes I have endeavoured to find their dam for them, and, I own, not always with success; but when I have done so, and got the little family together, their joy was great and very apparent. In placing them, however, with the wrong mother, though apparently without a lamb by her side, she would not adopt them nor allow them to come near her; and this, I think, they also well understood, as they would soon leave her and again come after me, bleating plaintively and looking so desolate! I have sometimes seen (but rarely) a ewe with three little lambs, triplets, at a birth. A very young lamb presents a rather curious appearance, for I have always noticed that the wool on its legs from the knees downwards was of a much lighter colour, perceivable also from a distance; its tail, too, being naturally long tends to alter its appearance, especially when frolicking. Another interesting feature is noticeable and striking in seeing the twin lambs lying down lovingly and close together sleeping in the sun, often in some grassy depression, or under a tuft of the common fern, their dam being some distance off grazing; and then, when disturbed in their nap by my approach, at first merely raising their little heads and looking around and stretching their legs, but afterwards rising and seeking their dam with noisy and quick bleats, and she, too, answering her children, their graduated cries no doubt being well understood between them.

Sheep have often been called silly stupid animals, and this from primitive times; hence we meet with such a descriptive line as this in the ancient comic Greek poet, Cratinus,—

> And, like a stupid sheep, go crying, "Ba!"

Yet I have on different occasions noticed pleasing instances of their sagacity. One of them I will give: In those open plains already mentioned (as well as in many other similar spots) stand a large number of cabbage-trees (*Cordyline australis*), the tii-tree of the Maori; but generally singly and scattered far apart. These often bear only a single head of long, narrow, harsh leaves at the top of their tall slender stems, somewhat resembling a huge coarse mop; but sometimes they are slightly branched, their branches also only bearing a similar tuft of leaves at their tips: hence the amount of shade given by them when the sun is shining is but small, and of course the shadow moves around the tree according to the position of the sun in the sky. The sheep in the summer season—especially just before they are shorn, when their wool is thick, long, and heavy on them, and the sun is very hot on those plains—seek the scanty shade of the cabbage-trees; and I have often noticed a ewe and her lamb cuddled together in the small shaded spot, and by-and-by, as the shadow from the tree is moved, they also move with it around the tree. I have observed three such movements made in a few hours.

7. *On the Dexterity and Industry displayed by Wood Rats or Mice in their extracting the Kernels of Small Nuts (Stones of Fruits) for Food.*

Wandering in the neighbouring forest, I have been amazed at seeing the great number of empty shells of the nuts or stones of the fruits (*drupæ*) of the black-pine tree, the *miro* of the Maoris (*Podocarpus ferruginea*), strewed about on the ground. All, too, had been completely cleaned from their fleshy exterior, which is by no means a pleasant or easy job (as I have found from experience), owing to its extreme stickiness, so closely adhering to one's fingers that soap will scarcely remove it. Those nut-shells had all been perforated at their hilum (their softer or thinner part where all alike was hard) in order to extract the small kernel, the little circular hole being about $\frac{1}{10}$in. diameter. To gnaw away the hard shell sufficiently to get at, or to get *out*, the very small kernel must have been a work of incessant labour to the little animal —especially as it only works by night—increased from the small size and semi-orbicular shape of the nut itself (somewhat resembling a small cherry-stone), which must also have been securely held between its fore-paws to enable it to do so.

In one part of this wood near the rivulet was a little raised, dry, clear-topped mossy spot, extending a few feet each way, such small hillocks being not unfrequent in the hilly and much-broken woods (and just such a spot as would serve nicely for a small picnic party, with the high and robust umbrageous trees around it); and here especially the shells were very thickly strewed—much more so than around about among the ferns and herbs and low shrubs in the damper parts of the wood, where, too, the earth was bare in many places; so that it seemed as if the army of industrious workers had brought their spoils to that drier and softer spot, there to labour and feast at their ease in the cold nights. No doubt, to have seen and quietly observed them at work would have proved an interesting sight, and given us a good lesson in their natural animal economy. Thinking over this subject caused imagination to conceive some slight analogy between (or, shall I say, the origin or cause of?) the humorous old Maori legend of the night-adventures of the chief Te Kanawa and the elves or fairies (*patupaiarehe*) in the forest, and this real animal objective scene, in which quaint story those numerous little merry folks played with Te Kanawa, and used him, much as the manikins of Lilliput did Gulliver. And so that old legend might have originated from a dream of Te Kanawa (who was sleeping on a dry mossy hillock in the forest) after quietly witnessing the dexterous feats of the wood-rats.

And here I may mention that fifty years ago, before the introduction of mice into this colony (or into the woody interior), I had often noticed with astonishment in my travelling through the forests the heaps of very hard, small, and stony nuts (*drupæ*) of the hinau-tree (*Elæocarpus dentatus*) gnawed and perforated at their bases in a similar way, which the old Maoris said was done by the Maori rat, which animal we know once swarmed in those woods, and was fructivorous.

The black-pine, or miro, is the scarcest of all the several species of pines in our New Zealand woods, and its scarcity may arise from its fruits being so eagerly sought for and devoured by those little animals.

8. *On the Rapidity with which the Largest New Zealand Trees are felled and converted into Timber for various Uses.*

Probably few, if any, of my audience have had the opportunity of witnessing the whole operation of felling a large timber-tree and cutting it up into planks and boards, as is now being daily done in the timber-forests of New Zealand. To those who have not seen this great, this truly wonderful performance I would say, "Do so as early as convenient. It will give you new thoughts, exalted ideas of man's ever-growing powers over Nature *when working in concert with her*." I will endeavour to give you in a few words an outline of what I have seen here at Dannevirke, though in this instance the best of words will prove wholly inadequate.

First, however, two things are necessary—that is, for *quick* work. The one is the erection, &c., of a steam saw-mill; the other, the formation of a tramway leading from the forest where the big trees grow to the mill. A tree (say, a fine, robust, and tall totara pine, the glory of its forest) is selected, felled, its big and stately trunk is cross-hand-sawn into two or three lengths, as may be required. These logs are then rolled on to a kind of sleigh or tram-cart by the help of screw-jacks, and conveyed by horses to the mill. There they are soon placed (by screw-jacks, as before) under the central powerful vertical giant saw, and quickly cut up into clean squared timber of various large sizes, as beams, thick planks, &c. Smaller circular saws are also used, revolving very rapidly, and all working together at the same time and by the same steam-power, to reduce the beams and planks in size and thickness, to form them into boards, and to dress, and plane, and mould them as wanted. These are plain and smoothly planed, their edges "tongued-and-grooved," bevelled, moulded, &c. And all these are finished so rapidly, though it may be in long lengths (14ft., 20ft., 25ft.), as to keep men constantly and briskly employed in taking them away from the benches, so that the operations may not be impeded. Other men are also kept diligently at work removing the strippings or outer casings of bark and sap-wood, and in clearing out the ever-accumulating sawdust from the pits below under the saws. A prominent and surprising feature is the immense size of those piles or hills of outer sawn strippings in long lengths that are thrown away as worthless; and also of the sawdust that surrounds the mill on every side, sometimes overtopping in height the mill itself, and serving to embarrass the workmen; besides which there is also great danger from fire, particularly in the hot and dry summer months.

A few days ago, while at the mill, I witnessed the placing of the lower trunk of a handsome robust totara-tree, about 15ft. long and 4ft. in diameter, solid, perfect, and symmetrical, under the big vertical saw. It was soon fixed in position, and I watched the progress. The first cut (as is usually the case) was made down its centre longitudinally, and the immense log was carried steadily onwards at the rate of 10in. per minute, as timed by my watch. Another remarkable feature is the smoothness and regularity of the surface of the sawn green timber, especially when the largeness, the coarseness, and the distance apart of the teeth of the saws are considered.

I believe it to be quite possible to fell a stately tree—the giant monarch of the forest—to haul it to the mill, and to cut it up into thin boards, "tongued-and-grooved," and ready for use, within two hours. But, of course, all timber requires more or less of seasoning before it is finally used by the carpenter and joiner. Here the sap is seen gushing out of the wood under the saws. At the same time, I do not think the timber-trees of the New Zealand forests, being evergreen, require that particular attention as to the proper season of the year for felling them that our English timber-trees do, these latter—as the oak, ash, elm, &c.—being deciduous; for in the former the sap is always rising, while in the latter it is not so in the winter season.

I have intimated that some present may not have seen this timber work, and I may, I think, pretty nearly equally say that many of you have not seen or known the old, slow, and painful mode of proceeding with such work at Home or in this country. I, alas! have not only seen it done, but have tried my hand at it in order to get some boards from trees, when none were to be had, by arduous manual labour—a slow and laborious process. It was dear-bought experience; the unpleasant remembrance of it I shall never lose. I have called it "such work;" but that is not correct, save that boards were obtained from trees by hand-sawing. One might with equal justice compare the speed of a lighter propelled by oars with that of another worked by steam; or the tedious old Maori mode of procuring fire by friction with the modern instantaneous one by a match.

9. *On Working-oxen.*

My lodging at Dannevirke is close to the railway-station, and my sitting-room window commands the main road leading to it. An especial object of interest to me is a dray with five or six yoke of oxen coming along with a load to the station or taking one from it, as these generally come from a long distance across the country, where in many places there are no made roads. And this incident serves forcibly to remind me of what once obtained (thirty or forty years ago) at Napier and the now settled districts of Hawke's Bay, with their present towns and boroughs, well-metalled roads, and bridges. Contemplating those oxen (generally twelve) in their ponderous dray, two things are highly prominent: (1.) The muddy state of the dray and its large high wheels, with the spaces between their spokes completely filled up level with the felloe with stiff hardened clay-mud securely fixed therein as if rammed, insomuch that it would be a difficult matter to dislodge any portion of it. This alone shows what kind of country they had come over or through, their tediously slow journey occupying in some cases several days. (2.) The calm and quiet demeanour and great docility of the oxen. There they patiently stand, alike in the hot sun, cold wind, or driving rain, one, two, or three hours, it may be, while the dray is being unloaded and reloaded with stores for the distant station. Sometimes, however, one of a yoked pair reclines on the ground, making it terribly disagreeable for its partner in the same unyielding and heavy yoke, now forcibly bowed down at such a painful angle. But "all hands" alike are regularly "chewing the cud," with half-closed, sleepy eyes, in a dreamy kind of way, which seems to alleviate their heavy lot, if not their toil, and often serves to remind me of the use of tobacco by civilized man, especially as formerly practised, and particularly by old sailors.

Moreover, in my writing this I am reminded of a Scandinavian settler here at Dannevirke who has adopted the novel mode of working two oxen in a light dray-like cart, completely harnessing them as if they were horses (the oxen yoked to their drays having no harness at all). Now, the having a bit in their mouths prevents the two poor animals from chewing the cud, and so these, being debarred from their natural habit, have no solace while standing still at loading or unloading, &c. I spoke more than once to the owner about it, pointing out the great natural difference between horses and cattle in the formation of their mouths, and their manner of eating, ruminating, &c.; but my doing so displeased him not a little. For my part, I cannot see that he gains anything by putting a bit into their mouths, as he does not use long reins—it can only serve for show. At the same time I should not omit to say that his two oxen look very well in condition, and are very docile. The harnessing of an ox or bullock within the shafts of a cart after the manner of a horse is not, however, wholly new in this colony, for I remember often seeing in the "forties" an ox so harnessed coming into Wellington with a settler and his family; but that had no cruel and irritating bit in its mouth.

But, of all the varied work and labour of oxen that I have ever seen, that of drawing out the large trunks of felled timber-trees through the thick, uncut, uncleared forest, without tracks, is to me the most astonishing. The incessant labour of both man (the driver) and beast is beyond all comparison—not to mention that of the faithful dog. At one time the pair of leaders, or the head or horn of an ox, at another the end of one of the yokes or the end of the log, gets jammed among the thick standing trees, and so "backing out" and clearing must take place before they can again move slowly on. Then, the multiplicity of words and of phrases used in all manner of tones (I don't mean swearing), and the discordant barking of the dog, now on this side of the oxen and now on that—which somehow the patient animals seem to understand—at all events they mostly obey—is surprising. On one occasion, on witnessing a work of this kind in the dense forest, I asked the driver (a steady, hardworking, honest man, who was known to me) which he considered "required the most patience, the man or the ox." He said he thought "both pretty nearly alike," and I agreed with him.

I may here also mention that I have seen a curious *lusus naturæ* while in the bush district this year—indeed, two that were very similar: one was that of a black cow with a young white calf, and the other a white mare with a sucking foal wholly black, presenting such a remarkable contrast. Piebald horses, some of them most strangely coloured, are pretty common about Woodville.

Art. LVIII.—*The Outlying Islands south of New Zealand.*

By F. R. Chapman.

[*Read before the Otago Institute, 13th May, 1890.*]

Plates XLVI.–XLIX.

The periodic visit of the Colonial Government steamer "Hinemoa" to the remote sub-arctic islands is now one of the ordinary services of the New Zealand Government, but it is still, and perhaps always must be, the most adventurous. The story of that good steamer's last voyage, however, will contain little that is novel or startling; but I shall endeavour to set forth as faithful a picture as I can of what the islands are like to which the "Hinemoa" goes, and, so far as at present may be, what these islands are worth to us. The service on which they are visited is praiseworthy in the extreme, but at the same time it is undertaken at the most obvious call of duty. It is enough to justify the expenditure involved in sending the steamer, and replenishing the stores, that in later years the boat's crew of the "Sarah A. Hunt" was rescued from Campbell Island, and that the survivors of the "Derry Castle" lived at the Auckland Islands for some months upon our dépôt stores.

I. The Snares.

The steamer got away from the Bluff in the evening of the 8th January, 1890, sailing for the Snares. It matters very little which route is taken to these islands, which lie sixty-four miles south of Stewart Island, as the distance is almost exactly the same whether the vessel goes down the east or the west coast of that island. We chose the west coast, as it is clearer of rocks and islands, and the wind favoured that route. It turned out a slight mistake, as the wind veered a little, but the only result was a little more knocking about than we cared for. We arrived in the morning in a sheltered cove on the east side of the largest island, and found good anchorage in deep water. Long before we came to anchor we could smell the birds, which we soon saw crowding the rocks near the water's edge, and as we left the ship in boats the braying noise of the crested penguins became incessant.

The sea was smooth, and as we pulled the boats in towards the shore we noticed that the water was of a deep ocean-blue right up to the rocks. The north and east sides of the islands are comparatively low, and the south and west sides high and steep, but even where we anchored there are several tolerably high cliffs, and in them are seen numerous deep caves. One only of them is known to have a convenient entrance, and into this Captain Fairchild steered his boat, the other boat following. The boats went 40 yards into the dark cave, which was high and broad, and continued deeper still, but the further part was very low. There was easy turning-room for boats, and the height was more than we could see with the available light.

I could not help thinking that the attraction which a cave has for most people is but a survival of our troglodytic ancestral habit—a notion which is confirmed by the liking of the more conservative sex for darkened rooms, and of children for "building houses" in dark recesses.

As we came out, flocks of sea-birds flew and swam around us, and we headed up a great herd of nellies (*Ossifraga gigantea*, giant petrel or breakbones), and chased them awhile. One of them, instead of being nearly black, was a pure-white albino—a case which, though rare, is not unique—and efforts were made by Mr. H. Travers, who was collecting birds, to secure this, but without success. Gulls, prions, petrels, and other sea-birds flew in great numbers about the shore, making the scene a very lively one.

At a steep rocky place clear of all growth the boat was pulled up to the shore, so that the schoolboys, of whom we had six among the passengers, might enjoy a little penguin-hunting. The penguins in the water hopped out of the way of the boat in the most graceful style. They spring from the water, turn with a curve in the air, and plunge in again in exactly the manner in which we see porpoises jumping alongside steamers on the coast. The similitude is exact; indeed, at a certain season I have seen in Cook Strait baby-porpoises, no bigger than penguins, jumping exactly like them, and in the Sounds I have mistaken penguins for young porpoises.

The boys were anxious to begin the business of the voyage by catching a supply of penguins. These showed no undue fear, but naturally tried to avoid capture. They rushed in hundreds up the steep rocky face on which they had established their rookery in front of the line of boys who clambered after them, and when a boy outflanked a penguin the boy generally got very red in the face as he seized the penguin by the leg, and the penguin returned the seizure with interest. All sorts of ways of picking up penguins were tried with very limited success. Somehow the birds insisted on stretching their pliable necks and seizing the nearest part of the boy with their beaks. In the long-run the army of penguins, with many dignified protests, retreated in comparatively good order into the scrub at the top of the ladder-like rocky slope; but by manfully sticking to their point the boys had averaged about a penguin each, the prizes being carefully detached from the nether garments of the captors and slung into a coal-basket at the bottom of the boat. Had any boy individually turned his attention for a moment from his penguin he would have seen that the place to seize the bird was the neck, which had power to turn so many ways. The simplicity with which the captain seized his birds as by a handle and slung them like turnips into the coal-basket was a lesson, once learned, never forgotten.

After this excitement we entered a small and wonderfully snug boat-harbour, so sheltered that even craft of larger size, yachts, and cutters could anchor and brave all weathers there. Here we found a good landing in a clear space close to two old sealers' huts. Immediately on landing the tracks of seals were found. Two fur-seals live here constantly, and are almost personally known to Captain Fairchild.

The tracks are broad and well-defined, and they run up a low hill covered with heavy tussock-grass, and curve and course in various directions about the base of the hill.

A few minutes later the boys who accompanied us disturbed a seal some way up the hill, and down it came to the sea. This was the only fur-seal we saw throughout the cruise. It sat on its haunches, looking at the strange visitors, and seemed inclined to take alarm. The captain went up to the animal and rubbed its neck with a long slender manuka stick, which seemed first to astonish, then to please it, for in a minute or two it moved its head backwards and forwards as if it really liked it. Finally, as it was in the way, it was told to go to sea, and moved thereto more pointedly by the shouts of the bystanders; in another instant the ungainly creature shot across the little bay a foot under water as gracefully and rapidly as a fish, so totally different is the style of its performance as a merman from that as a land animal.

From this bay we commenced a tour of the island, this one being the largest of the Snares, the group containing in all four or five islands of small size. This country is covered with somewhat open timber, excepting a margin along the cliffs. This margin is densely clothed with two kinds of grass, which are never mixed. The grass forms high tussocks, and it is a matter of choice whether you walk on top of these or between them: if you choose the top you cannot always maintain your choice; if you choose the other route you have to drag your legs in the most wearisome way. The timber is mainly *Olearia lyallii* (a larger form than *Olearia colensoi*), a beautiful shrub or tree, here rising to the dignity of a minor forest-tree, with large, round, glossy leaves with flannelly backs, and bearing bunches of large but inconspicuous rayless flower-heads. When this grows a certain height it falls down with the weight of the leaves and the pressure of the wind, and takes root where it touches ground; then it grows upwards again; and after awhile it falls again, tearing its oldest roots up and rooting itself a third time: thus the trunk is almost gifted with a power of locomotion. It grows three times as thick as a man's body. This tree is known in Stewart Island as the mutton-bird tree; and we soon found the reason, for the whole of the ground on the island is honeycombed with mutton-bird holes. The traveller constantly breaks the surface and drops into these tunnels, but the depth is not great. At every turn crested penguins (*Eudyptes pachyrhynchus*), single and in pairs and small flocks, are met in the bush and in the grass. They are literally everywhere, and their harsh note never ceases. The whole of the upper soil of the island is guano, matted with the fibrous roots of the *Olearia*, the dead wood of which adds a little to the soil. Besides the bray of the penguins, whenever you stop you hear the gentle mewing of the mutton-birds (*Puffinus tristis*) underground—young birds, I presume. It was the nesting season, but few eggs were obtained, as there was no time to dig. We saw very few of these birds on land, whence I concluded that the old birds were abroad feeding and would return at night.

We found a few interesting plants. *Senecio mülleri*, a handsome shrub, otherwise rare, is plentiful here; a *Ligusticum* is found on the cliffs, and near it the pretty forget-me-not (*Myosotis capitata*), while the sweet-scented *Veronica elliptica*, of the variety called *odora* by the earlier botanists, borders the shore at every point. On the whole, the plants are not a striking feature of this group so far as variety goes.

Perhaps the most striking plant on the island is *Aralia lyallii*, or an allied species, which here grows to an immense size, and seems to do equally well under the trees or in the open, the rich guano soil evidently suiting it. Its leaves are sometimes 28in. in diameter, possibly even more. They stand 4ft. high, on stout rhizomes, and form, with the whitish-green masses of flowers and waxy seeds which rise in huge bunches from the centre of the plant, a very attractive object. The plant seemed to me to differ in habit from that seen at Stewart

Island, spreading by means of rhizomes instead of by turning down its stolons and rooting them.

Everywhere there is a strong smell of birds, not generally strong enough to be overpowering; in the penguin rookeries it is so strong that one feels inclined to bolt through them. These are numerous and extensive. There are many on the shores, and many in the forest or scrub. Wherever a rookery is formed the timber or scrub dies, and we often found places where the penguins had taken up new ground, killing a piece of scrub alongside a rookery. The noise in the large rookeries was deafening; the big penguins brayed and the young ones squealed. As we walked through the rookeries there was added to other sounds the roar caused by the tramp of thousands of lilliputian feet as the armies fled before us, raising a miniature cloud of dust as they went. Though very harmless birds, they were very pugnacious, and often preferred to stand and fight rather than get out of the narrow tracks.

There were no nestlings; we could only see the sites of downtrodden nests. At the top of the hill we were attacked by sea-hawks or skua-gulls (*Stercorarius antarcticus*), which watch constantly to surprise young and weak birds. They flew at us furiously, and we had frequently to hold up something to ward them off. Often we could hear the rush of their wings as they passed a foot from a man's head. They are pretty dark birds, with a light-checked colouring on the wings. They are called skua-gulls from their resemblance to a northern species (*Stercorarius catarractes*), and appear to be rare in New Zealand proper. One mollymawk was noticed nesting alone.

Of small birds we saw a good number—pretty black tomtits (*Miro traversi*), ground-larks (*Anthus novæ-zealandiæ*), grass-birds (*Sphenœacus fulvus*) of a species now rare in New Zealand, and beautiful little snipe. All these were very tame, and were often caught by hand. Mr. Reischek claims that several of them are new species, differing from those described by Sir W. Buller and other writers, but I think I am naming them correctly according to Dr. Otto Finsch.

The snipe (*Gallinago aucklandica*) is a very graceful little bird. It soon dies in captivity—I suspect of starvation. One got loose on the ship and visited my bed early one morning, and sat upon my chest, close to my face, jumping at flies about the porthole. I tried to catch some of these snipe, following them up closely by the sound as they whistled to each other within a yard of me among the tussocks, but I found that they slipped nimbly into the holes made in the ground by sea-birds.

In the course of the day I managed to secure specimens of nearly all the birds for the Otago Museum. There was one seen, however, said to be as large as a blackbird, which must be undescribed. All the land-birds were obviously weaker on the wing than their New Zealand congeners; they were also afflicted with a fatal tameness.

It is not known whether a vessel was ever lost on the Snares; they are rather far north for the course of Melbourne ships, but are often sighted. It would not be a nice place to be marooned on, as the water is all polluted by the birds, the penguins apparently taking an especial pleasure in turning the swampy ground at the head of each rivulet into a hideous pool of filth.

The only profit at present derivable from these islands is the young mutton-bird, which is an article of commerce; but they are not now visited for this purpose, as the market is fully supplied from the small islets off the coast of Stewart Island. At some future time they will be productive of considerable wealth as a source of food-supply. They ought, however, to be examined and tested for guano, which might be found to pay. The rocks appeared to be all granite, like those of Stewart Island.

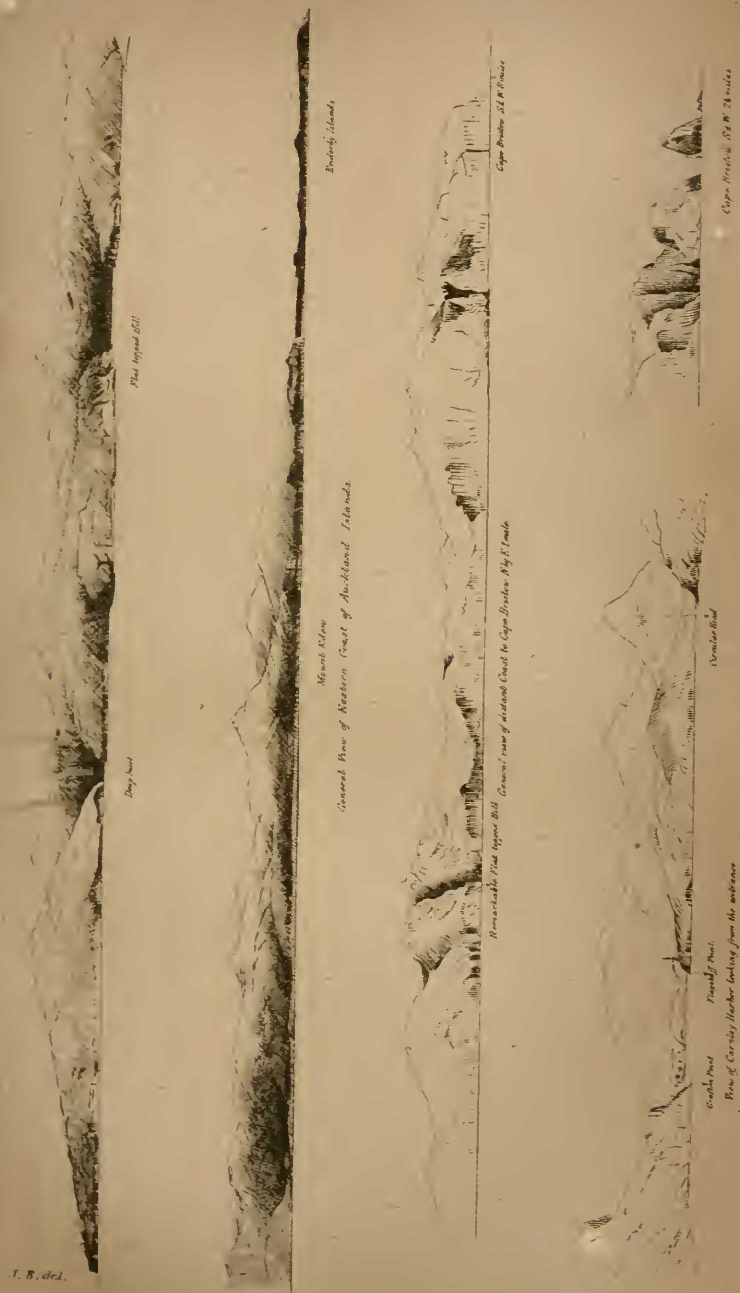
As we left the shore the air was literally dark with mutton-birds flying in every direction, the owners no doubt of the innumerable nests on the shore. I verily believe they might be numbered by millions as they followed their bewildering courses through the air. I am told that towards night they descend upon the land in such numbers as to overwhelm the fires and threaten the stability of the tent of any one encamped there. We all regretted leaving this curiously attractive spot; but in an hour we were at sea again, passing clear of the Snares, close past the rocky Western Snares, and thence turning south towards the Auckland Islands, sighting as we went the high bold cliffs of the western end of the main island, and passing close under them. No dépôt is maintained on the Snares. It is scarcely necessary, as the distance from good harbours in Stewart Island is not great. We had now before us a distance of about 140 miles to run, and with rare good fortune we had a favourable wind.

The Snares were, I believe, discovered by Vancouver, in the last century.

II. Auckland Islands, Northern End.

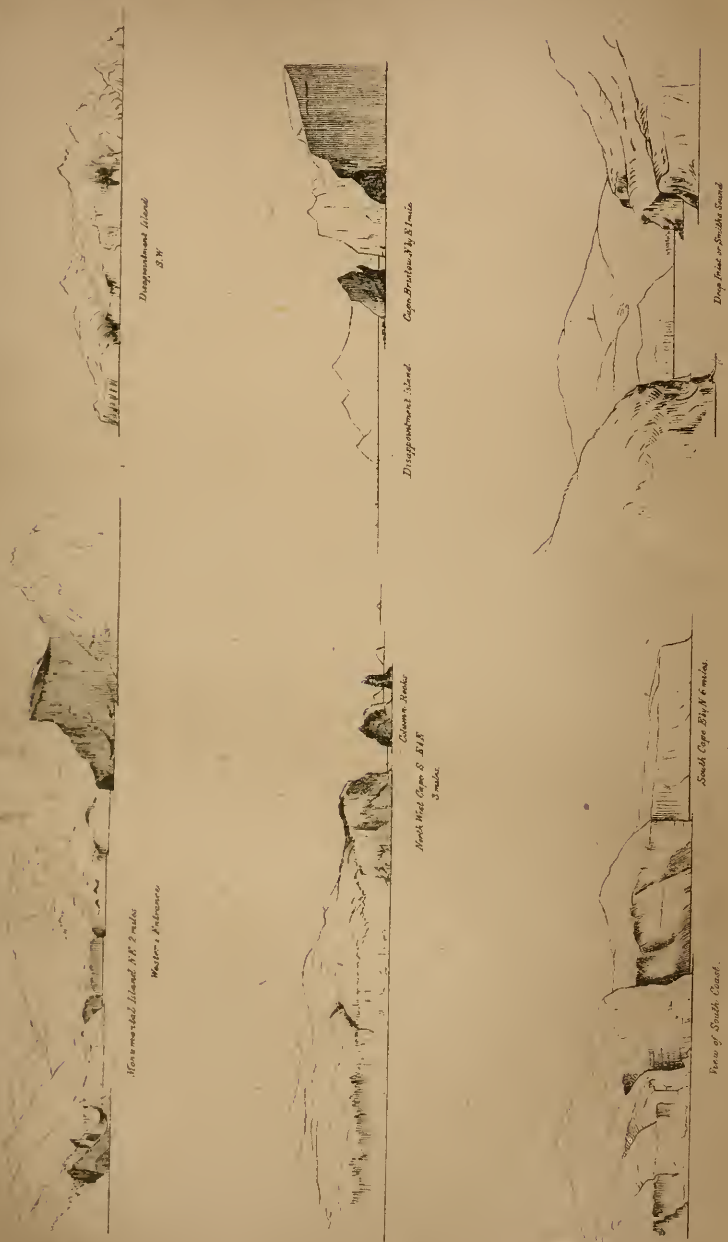
About breakfast time, after a night at sea, land was sighted. A high island, called Disappointment Island, lies five miles off the west coast of the main group, and this was first seen. It is the only outlier at any distance from the closely-compacted group forming the Auckland Islands. The whole group forms a triangle, of which the apex points to the north. This apex consists of three small and several smaller islands — viz.,


MAP
OF THE
LORD AUCKLAND ISLANDS.
From Admiralty & other Surveys.
Bristow Rk
Enderby Id.
N.E. Cape
Column Rks
Black Hd
North Har
Ross I.
Port Ross
Ewing I.
Crozier Pt.
N.W. Cape.
Mt. Eden
Kekeno Pt
Blanche Rk
Disappointment I.
Sugar-loaf Rks
Chambres Inlet
Granger Inlet
Griffith Inlet
Norman Inlet
Saddle Hill Inlet
Beehive Rks
Shag Rk
Musgrave Inlet
C. Bristow.
Flat-topped Mt.
Hanfield Inlet
Giants Tomb
Deep Inlet
C. Lovitt.
North Arm
Waterfall Inlet
Var. 17° 30' E.
Magnetic
S.W. Cape.
Western Entrance
Adams Rocks
Embrasure Pt
Camp Cove
Musgrave Pt
Flagstaff Pt
C. Bennett
Western Arm
Carnley Har
Perpendicular Hd.
Logan Pt
Adams . I.
Gilroy Hd.
Lantern Rks.
Castle Point
Fly Harb.
South Cape
C. Thomson
N.E. Cape. Lat 50° 30' 29" S. Long 166° 19' 12" E.
Scale.
0
5
10 Sea miles.
Depôts shown thus •.
Boat-houses " " ■.
C.H.P. del.



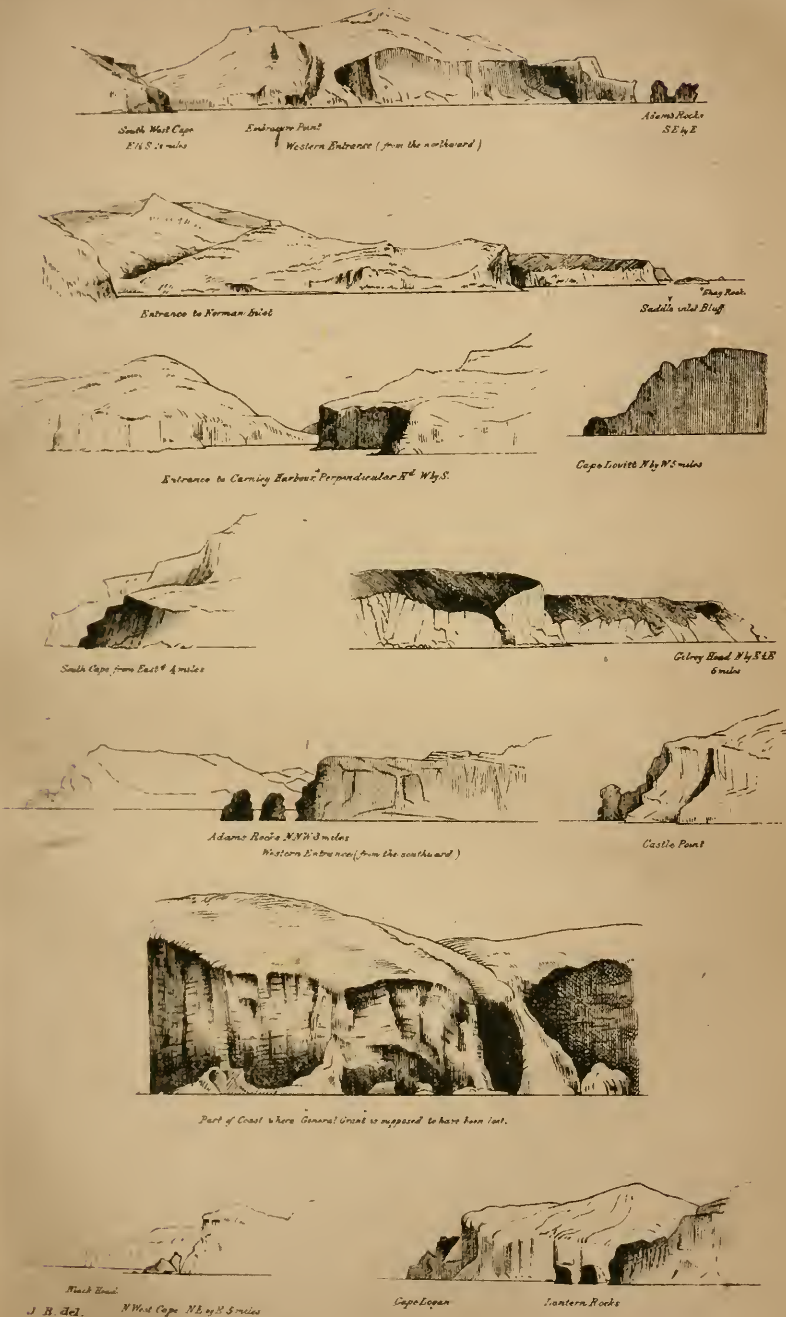
T. B. del.

SKETCHES OF HEADLANDS & HARBOURS OF THE LORD AUCKLAND Is.



J. R. del

SKETCHES OF HEADLANDS & HARBOURS OF THE LORD AUCKLAND I^s.



J. B. del.

SKETCHES OF HEADLANDS & HARBOURS OF THE LORD AUCKLAND IS.

Enderby Island on the extreme north, Ross Island on the west, Ewing Island on the east, and Ocean Island within the harbour. With the smaller islands, these three partly close the mouth of a deep inlet called Lauric Harbour, or more commonly Port Ross. It is completely sheltered, and the islands which shut it in leave a magnificent ship-entrance on the eastern or sheltered side, with smaller entrances for smaller vessels. These small islands are all flat, rough, and scrubby. I landed on Ross Island and Ewing Island, and others visited Enderby Island, but there was not time to cross it and visit the scene of the wreck of the "Derry Castle." To continue the general description of the group, the main island is the same shape as the group—viz., a triangle. The base of the larger triangle is Adam's Island, a long island running from east to west along the south side of the group, shutting in Carnley Harbour, which cuts right into the heart of the main island. Adam's Island is high land, being a ridge 2,000ft. above the sea, and occasionally higher. The main island is very rugged, and has peaks said to rise up to 1,600ft. or 1,800ft., but I think probably higher. In the whole group there are no less than ten fine harbours, one of which, Carnley Harbour, in the south, with its main entrance in the east, is divided into three branches, and would shelter all the Queen's ships at once. Port Ross was called, I think, by Dumont d'Urville the first harbour in the world. Carnley Harbour is in no way inferior, and is vastly larger.

A map of the islands, reduced from the Admiralty chart planned by the officers of H.M.S. "Blanche" in 1870, is attached to this paper (Pl. XLVI.); and, by permission of the Director of the Geological Survey, I am able to give a number of excellent illustrations of the coast scenery of the group, which were lithographed some years ago by Mr. John Buchanan, F.L.S., formerly draughtsman to the Geological Survey Department (Pl. XLVII.–XLIX.).

Our course before entering Port Ross took us close past the Derry Castle Reef, the extreme north point of the island, on which a ship of that name went to pieces in March, 1887. A few survivors dragged their way through the brushwood to the side nearest the harbour, and there spent five months, until, finding an old axe-head, they made a punt, with which they reached the dépôt, which lay in sight five miles off. They might have got there sooner had they used the skins of the numerous sea-lions to make a boat. We could see numbers of them on a sandy beach as we neared the entrance.

Passing through the fine eastern entrance, we anchored off Ross Island, also a flat piece of peaty land about a mile and a half each way. Here Captain Fairchild introduced us to the inhabitants. Anxious that we should see the sea-lions at their best, he rounded up a small mob with a manuka switch, flogging them occasionally gently, and not even seriously alarming them. The great clumsy beasts cantered over the rough ground through the tussocks and over the stones in the most ludicrous way. At last they appeared to become quite obedient, and when told to stop did so, turning and staring at their pursuers, literally appearing to obey the word of command. At last they were turned back and told "Now you may go," and away they capered back, dragging their heavy bodies along the edge of the cliff at a smart pace till they got a chance of sliding down and plunging into the sea. We came across more of them here and there in the tall grass on this island, and, indeed, during the whole of our stay in this group we found them everywhere in the vicinity of the sea, and seldom launched a boat without finding it accompanied to the shore by at least one sea-lion, always as tame as poodles.

Among the woods here,—mostly low rata (*Metrosideros lucida*) and *Coprosma*,—we saw and heard the bell-bird (*Anthornis melanura*) and other songsters; in the grass, the little island snipe were plentiful; terns flew about the cliffs, screaming above the heads of the boys who took their eggs. Among the tall grass grew great plants of the large *Ligusticum latifolium*, a very handsome plant with heavy masses of seed on the heads, having the general appearance of celery seed. Close to the shore we found beautiful gentians, covered with masses of bright flowers of several colours varying from white to purple, with intermediate shades; here, too, grew rare forms of plantain, and tiny creeping *Coprosmas* with bright berries, telling the visitor in the plainest terms that he was now entering a sub-arctic region, and that the sea-level plants here were equivalent to mountain plants nearly 3,000ft. above the sea in New Zealand. The grass was everywhere a coarse tussock.

In the afternoon we passed up to the dépôt in Erebus Cove, Port Ross. This may be called the historical centre of the island group, and about it may be found enough evidence to show that a country without inhabitants may have a sad and stirring history.

In the dépôt house a simple inscription in chalk upon a board told the story of the men of the "Derry Castle," their sufferings and rescue. On a slate in the same room was a record of the story of the "General Grant." In a little cemetery, a short way off among the scrub now covering the site of the clearing made by Mr. Enderby's settlers in 1850–52, were several graves. One neat stone recorded the death of the child of a settler in 1851. Hard by was the grave of a sailor who had starved to death. He was one of the crew of the

"Invercauld," wrecked on the west coast in 1864. Of the nineteen men who scrambled ashore, three only were rescued, after twelve months of fearful suffering, by a Peruvian barque which put in for repairs under the impression that the Enderby settlement was still in existence. This man had apparently temporarily left the party, and came back to find his companions and his last chance of life vanished. The author of the book "Les Naufragés, ou Vingt Mois sur un Récif des Îles Auckland," however, professes to identify this man, from some few letters scratched on a slate found with him, as one of the crew of the "I.E.H.," which left Melbourne in 1865, and was never heard of again. Here, too, were several traces of visitors, and amongst others an inscription, fresh and sharp as when cut on the tree in 1865, recording the visit of Captain Norman with the Victorian Government steamer "Victoria." A slate on the same tree told how four men of the "General Grant" had left for New Zealand without chart or nautical instrument. These unfortunates were never heard of again.

We spent a pleasant evening plant-hunting among the points and islets of Port Ross. At Shoe Island, a small island in Erebus Cove, where our ship lay, said to be highly magnetic, which Governor Enderby used as his State prison, we tried fishing, without much success. The poverty of the fisheries of these islands is the strongest feature against them, putting them far behind the desolate islands and coasts of Northern Europe. On the top of Shoe Island the boys found a baby sea-lion, which allowed us to pull him about by the flippers without more than an occasional protest, while his mother swam round waiting for the amusement to end. Here we got *Stilbocarpa polaris*, a splendid plant, allied to the ivy, and closely allied to the *Aralia* which we found at the Snares; *Cotula lanata*, with sweet-smelling flowers; and a number of interesting plants. The engineer's men, with shovels and knives, turned over large tussocks, and under them found eggs and young birds in the burrows of the blue petrels (*Procellaria cœrulea?*), and diving petrels (*Haladroma urinatrix*). The mother birds never attempted to get away, and the little fluffy, grey, young birds were so fat that they lived to the end of the voyage without appearing to want food.

All that remains of Governor Enderby's settlement—for he held an independent commission as governor of these islands, then a separate colony, and once paid something like a state visit to the governor of Van Diemen's Land—is a piece of country which looks as if it had been cleared, with stumps sticking up here and there, a few mouldering graves, and here and there a heap of roofing-slates. This is all that now represents a good deal of English capital, and a great deal of misapplied enthusiasm. Mr. Enderby went the length of recommending the islands for settlement in preference to the northern part of New Zealand.

Next morning we visited the head of the harbour, which penetrates some miles into the island, and ends in a thick forest-growth, under a mountain of considerable height. Thence we moved down to Ewing Island, on the eastern side near the entrance. We walked for some hours over this flat island, among fairly-grown rata trees, which occasionally bore bunches of glorious crimson flowers, finding magnificent *Olearias* on the sea-shore. The shrubs and plants were varied and interesting. Every now and then we stumbled upon huge sea-lions among the tussocks—tame enough when left alone, but certainly awkward customers to fall upon by accident.

On a flat piece of rocky ground near the ocean I found a remarkable plant, which cannot be identified, as it had neither flower nor fruit. I took it to be an undescribed plantain (*Plantago*), with very broad foliage, but it has been suggested that it may be a new *Pleurophyllum*.

Swimming in the sea, and occasionally sitting on the kelp and rocks about the shore of this island, we found numbers of the rare flightless duck, *Nesonetta aucklandica*. This bird is very little known, and is not mentioned in the first edition of Sir W. Buller's great book, but is described and beautifully figured in the second. Its habits seem not to be known. We found it swimming in considerable flocks, sometimes of a dozen birds, close to the shore. We saw none out in the open bay. When a shot was fired they did not dive like teal, but merely hastened their speed. They seemed anxious to make for the shore. We saw them occasionally—often solitary birds—in other parts of this group of islands. This genus is not represented anywhere else. On the point opposite this island there was a large Maori pa when the Enderby settlers arrived. Three hapus of Maoris had come from the Chatham Islands and settled here and in a small pa at Erebus Cove. They were numerous enough to alarm the settlers, but kept the peace, and left when the settlers abandoned the place.

III. Auckland Islands—West Coast, Southern Part.

The scrutiny of the west coast of these islands is one of the most important parts of the "Hinemoa's" duties. This we were able to perform in a very easy and complete fashion. We steamed out by the same entrance by which we had arrived at Port Ross, and repassed the masses of timber which represent what was once the good ship "Derry Castle." Binoculars were kept going; they only disclosed numerous sea-lions walking about the sandy beach, and the *débris* at Derry Castle

Reef. The aspect of the northern coast of the main island is by no means unattractive. A cursory inspection would lead the observer on a fine day, such as we had, to think that it was a well-grassed country, something like that of some of the bare hills of Banks Peninsula. Here is a fine-looking sheep-run, and at a good harbour at the north-west corner of the island is a fine site for a woolshed, stockyard, and shipping appliances. There is a sealers' track from Port Ross to this harbour. I am afraid, however, that the suggestion of a shipping harbour for the sheep-run, with sheds, &c., is a purely superficial view. What looks like rolling hills of grass is a wilderness of high tussocks standing in deep peat, such as we struggled through in other places, in struggling through which years ago the "Invercauld's" survivors lost four of their number, who died, I suppose, really of the fatigue consequent on traversing a few miles of this country. When the Auckland Islands come to be settled it will not be by sheep-farmers, but by people who can manage with their own labour to burn off this tussock and get at a good soil said to underlie the peat. A good deal of top-soil has from time to time passed through my hands with plants collected in the islands. I have worked it between my fingers, and even between my teeth, and am unable to find even a trace of grit in it, so entirely is it composed of dead vegetable matter. In lifting large-leaved herbaceous plants, their dead leaves, the accumulation of a number of years, are often found under the growing leaves, already forming themselves into a peaty soil. Here, too, may be seen the earlier stages of the formation of peat, lignite, and brown coal of the purest kind.

The north coast is almost without wood: this may be due to the want of shelter. The west coast is too steep for trees; so is the external part of the south coast. But everywhere within the extensive harbours timber is found. It forms a regular fringe along the shore, extending up to about 200ft. above the sea—a low limit which attests the severity of the climate; thence it merges into scrub for a few hundred feet more; then come tussock-grass and herbaceous plants. The wood is mainly rata, with several species of *Coprosma* and a large *Dracophyllum*—a timber-tree allied to the heaths, but in appearance resembling a pine, which is common in New Zealand, but does not grow so large. The forest is easy travelling near the shore, but even there you have often to bend to pass under branches. The scrub is extremely hard to pass through. I found a heavy hunting-knife of the greatest assistance in clearing the way. The bush is everywhere full of bell-birds or korimako, whose beautiful note, I was told by a passenger who listened carefully, varied in different localities, as it does in New Zealand.

The west coast, down which we soon commenced to pass, is very grand and extremely bold. It may be briefly described as a line of cliffs and steeps thirty-five miles long. Nearly everywhere in the world west coasts are steep and east coasts shelving. This is decidedly the case here. In Otago, in Norway, and in North and South America, deep fiords relieve the continuity of these steeps. Here there is nothing of the kind save the strait between the two islands; on the contrary the only apertures of the kind are six fine harbours, seldom visited, on the east coast. The search for castaways does not call for a visit to these, as they are not in the course of any ships, and would not be reached by wanderers from the west coast; moreover, seal-poachers have no occasion to go there, as the fur-seals only frequent the wild west coast.

We passed inside Disappointment Island—a high island lying some miles off the coast, only visited by seal-poachers. We endeavoured to pick out the site of the wreck of the "Invercauld." Not a stick of her timbers has ever been found. For the first twenty or twenty-five miles of the coast there are numerous places where, if men happened to escape at the right spot, they might scramble up to the high land. There is scarcely a stretch of a mile where they could not get up if strong enough. For the next ten miles there is scarcely any place where this could be done.

The romantic story of the loss on this coast of the fine ship "General Grant," whose figurehead is still seen a long way up the coast, and which, according to the survivors, drove into a cave 250ft. deep, has often been repeated. She was lost with more than sixty passengers and crew; and the few survivors, including the stewardess, were rescued after eighteen months' stay on the island. The fact that the ship carried ten thousand pounds' worth of gold has incited several parties to search for the cave wherein she was supposed to lie, but they have had no better fortune than we had, for, though we examined the coast with much care, and saw caves, we saw none that would answer this purpose.

At several points we saw vast rookeries of birds. Some of these appeared to be penguins; but, though Captain Fairchild makes a point of stopping and examining anything of the sort when there is spare time, he could not afford to do so then. Another of these was an immense area of mollymawk nests (*Diomedea melanophrys*). These birds, which are allied to the albatros, nest in the most inaccessible places. Here, as in most rookeries, they built among the grass on a slope, with cliffs both above and below it. We thought it might be possible, but difficult, to reach this from Carnley Harbour; but the distance is considerable. The grass where they build grows darker than when in its natural state, and from this we thought it was a different plant, while the innumerable white spots among the plants looked at the distance exactly like white flowers. Seeing this, I felt certain that I had found one of the plants I was in search of, until the captain disillusionized us by telling us that our white flowers were the heads of mollymawks. Another very striking object seen on this coast, and afterwards on the south coast, was a waterfall which might be said to flow upwards. Streams coming down from the mountains are pretty numerous, and they generally reach the sea down steeps leading from gullies. Here and there, however, they fall over the cliffs, forming small waterfalls. The pressure of wind against a high cliff even in a moderate breeze is very great, and it is well known that in such a case an immense draught is felt at the edge of the cliff, where the compressed air forms an up-rushing wall, while a few yards back this wall causes the neighbouring air to be quite still. Here the waterfall became incorporated with the up-rushing air, and, instead of falling, was carried up above the land in a column like smoke. Presumably it fell again, but apparently until the wind changes it cannot go down, but must saturate the surrounding country, as we could see no water going down the face of the cliff. At the foot of the cliff, however, in the sea was what looked like a perpetual whirlwind, which may have been caused by the interrupted water reaching the sea. Subsequently we saw this phenomenon of the column of spray from shore. Here it was exactly like a column of smoke; indeed, it is well known that Musgrave mistook one for a fire, and this mistake has often been made.

We now passed the western entrance to Carnley Harbour. It is too narrow or shallow for the "Hinemoa," otherwise a mile of navigation would have saved us twenty-five miles. We passed it, and turned the fine bold cliffs which form the western end of the southern or Adam's Island. This island, which is generally 2,000ft. high, and sometimes higher, is twelve miles long by from two to four wide, and contains, I believe, some 30,000 acres. It is bold with precipitous shores on the south and steep slopes on the north. Near its eastern end is a gap in the cliffs. We turned and entered this, and found ourselves within the beautiful and rarely visited Fly Harbour. The captain wished to know whether the country above was accessible from this harbour. Deep water goes right up to the head, which is a mile and a half from the entrance. Dense forest clothes the steep sides, the only break in which is under a sheer cliff. A curious bar of kelp rising in deep water comes to the surface half-way up the harbour, and is liable to foul the propeller of a steamer. This serves effectually to break any sea that may enter. It was soon evident that there was no chance of passing through the dense timber with less than a day's hard work; so we turned and steamed out. The shores close to the water were covered with masses of the most beautiful flowers: *Ligusticum, Pleurophyllum*, and other rare and beautiful flowering plants are huddled together with a lavish profusion which Nature alone can afford. We were sorry to go, but it could not be helped; so round we went past the last headland of this island, which promised us so much that was interesting, for we had seen on the high grassy uplands that rare sight—dozens of stately white birds sitting in solitude on their nests, and we knew that we were approaching what so few men are privileged to visit—the home of the wandering albatros. Flocks of mutton-birds (*Puffinus tristis*) accompanied us round the stormy cape, which, presenting an exception to the other parts of this strange land, was wooded to the height of 1,000ft. Heavy seas rolling in closed the mouth of a small cave under the cape, and thus compressing the air caused a loud explosion with a shower of snowy spray as the water plug became thinner with the recession of the wave. Sea-birds of several kinds swept to and fro; spotless albatroses soared high over the land; and in a few minutes we were well up the long, deep, wide fiord called Carnley Harbour, approaching the scene where Captain Thomas Musgrave lays the simple but wonderful story of his life as a castaway. Turning up towards the north arm we found his flagstaff still standing on Musgrave Peninsula, and soon after sighted the ruins of Epigwaitt House, where he lived so long with his men, near to which lay the bones of his ill-fated vessel on the beach. I was sorry to miss visiting this spot, but there was no object in going there; so we passed further up this arm, which led deep into the heart of the main island, and anchored off Figure Eight Island—a low piece of land in the centre of the harbour, so named by Musgrave from its shape—on which the captain of the "Hinemoa" had placed a few sheep and goats. We spent the rest of the afternoon there, some looking for sheep, others for plants. The sheep were found dead; the goats were alive and healthy. A few interesting plants were found. Sea-lions as usual grunted from the little gullies. I gathered here a few spiders, of which Mr. Goyen writes: "All but two of the spiders you collected on the islands to the south of New Zealand are one species, *Amamobioides maritima*. Of the two others, one is an *Epeira* (new, I think) and one a *Salticus* (new). Among the spiders there is a *Phalangium* which may turn out to be new."

It would be out of place to narrate Musgrave's interesting story here. The ill-found vessel, equipped to search for tin or some other mythical metal at Campbell Island, was blown ashore through her anchor-chains parting while lying here temporarily on her return voyage. After waiting nearly eighteen months for succour, the captain made his way to Stewart Island in a frail boat which had been improved a little by his mate, M. Raynal, a Frenchman, who had first to make his file, then with that his saw, out of a piece of old sheet-iron, then his nails, and then proceed with his work.

IV. Carnley Harbour, Adam's Island.

Early next morning we again passed down the deep harbour to the long strait which separates the two islands. We called at the dépôt, which is maintained at a very unsuitable place, on the edge of a densely-timbered point—accessible only by boat, and visible only from high land. It is, however, supplemented by a boat in a shed lower down the harbour. Then a boat was sent into a cove in Adam's Island to search for some sealers' huts said to exist there. They searched the wrong cove, and by chance came upon a brood of young m-ergansers (*Mergus australis*) with their parents. The old birds got away, but the chicks were seized; and I had the satisfaction, through the kindness of Mr. Neil (the chief officer), of securing a couple for our museum. This bird is common in the Northern Hemisphere, and is there represented by numerous arctic and sub-arctic species: in the Southern Hemisphere it is represented by this one species, found only in a limited part of this small island-group. At another landing I saw more specimens of the rare flightless Auckland Island duck, *Nesonetta aucklandica*, which were not disturbed. Here, too, I only saw them on or close to the shore. Anchoring close to Monumental Island, which stops the entrance from the ocean, we landed, and at once found ourselves in the true plant-gathering country. Here we first spent some time hunting for a wingless duck, different from *Nesonetta*, said to exist here, but we could not find it. This place will now be known by the name which we gave it—Fairchild's Garden. It extends from the strait at the north-west end of the island along the shore to the first piece of bush, and thence up to and over the summit of the hill—in all perhaps 400 acres—one of the most wonderful natural gardens the extra-tropical world can show. No doubt other parts of Adam's Island and other places in the group are equally beautiful, but the day we spent here can never be forgotten. A peaked rock overhead is 700ft. above the sea; the summit rocks are 1,100ft. by the aneroid. The whole of the ground up to these and beyond them for some distance is literally packed with beautiful flowering herbaceous plants. Near the shore the *Ligusticums*, *L. latifolium* and *L. antipodum*, grow in splendid profusion, their stout rhizomes and huge rigid leaves stopping the progress of pedestrians. Along the shore were masses of golden lily (*Anthericum rossii*) in seed. Here, too, grew sweet-scented *Cotula lanata*, and its handsome congener *Cotula plumosa*, both of which are worth cultivating. Over the whole country *Pleurophyllum speciosum* sends up, amid huge ribbed leaves, 2ft. long, its spikes of beautiful lilac or purple flowers. These spikes are usually four or five, sometimes eight or ten, in number. The regular imbrication of the large ribbed leaves, so strong as to push aside the rank grasses, renders these plants singularly beautiful. They form deep cups of crisp foliage, which gives way with a crash as you set your foot on it. We long endeavoured to avoid crushing these splendid plants until they grew too thick, and we too callous, but I could seldom avoid the reflection that often for hundreds of yards each step crushed a plant worth ten guineas in Covent Garden. The next species, *Pleurophyllum criniferum*, was also plentiful. Its leaves are even larger, and, though not so handsome, make it a very fine plant, especially as its tall, white flower-stalk, sometimes 3ft. high, covered with button-like, brown, rayless flower-heads, 1in. across, is a very striking object. A third species which seems to have escaped the notice of Sir Joseph Hooker is smaller, and has the most beautiful silvery leaves. It grows sparsely on the slopes, and in great profusion on the flat top. I had this in cultivation last year, but it failed me.

Here, too, we met in immense quantities the most beautiful of all the *Celmisias*, *C. vernicosa*, a little plant with leaves here seldom more than 2in. long, gleaming like polished nephrite newly from the lapidary's hands, arranged in the most perfect rosettes. I believe that I am almost the only cultivator in New Zealand of this beautiful plant. I find I can keep it alive well enough, but have not had it long enough to get it into flower. It often forms large patches, the pretty rosettes of leaves rising from spreading rhizomes. It was past flowering, but we obtained flowers at a higher altitude next day.

Stilbocarpa polaris is plentiful along the shore. This plant carries a large bunch of seeds on a rather slender stalk. When they ripen they turn black; then the stem, without fading, bends outwards and down to the ground as if by a muscular movement, and carries the mass of nuts to the ground so that they fall clear of the leaves.

Besides these beautiful plants, we gathered many that are curious and interesting to botanists, and many of which I expect to find improve under cultivation. We made two journeys up the hill, each time carrying down heavy baskets of plants, which were duly stored in boxes on board. I have but faintly described the charms of the most beautiful field of flowers I have ever seen. Mr. Kirk was on the hill most of the day in a rich harvest of botanical treasures, while Mr. Bell, with a ship's boat, was treating the boys to some shooting and boating in the sound. The walking was extremely heavy, and before the day was out we were pretty tired. On the summit, to our surprise, we found albatroses nesting: they were rather young birds, and nearly all the nests were new, the rarity of old nests showing that this place is little used: indeed, Captain Fairchild had not before noticed it as a nesting-place. We procured half a dozen eggs. As we descended we saw that the steamer's anchor was up and that we were wanted on board. It was near 8 p.m. when we reached the ship's boat, dragging our way through the heavy tangle. On the way down we saw pretty green parrakeets; and my brother, Mr. M. Chapman, caught a snipe with his hands.

The vessel moved to an anchorage some miles to the east, and we then found that the firemen and stewards had been gathering albatros eggs on the mountains; and all hands were kept up until two o'clock in the morning, getting down one of of their mates who had been knocked up. It was interesting to watch the movements of their lanterns and even hear their cheers at a height of 1,500ft. At 10 p.m. the twilight was still strong enough to enable me to read on deck.

Next morning the captain led a party of albatros-hunters. A few birds were wanted for museums, and everybody seemed to want eggs. We landed at the cove where the sealers' huts are, though we did not see them. The road led through a bit of bush, very dense, but traversed by a sealers' track. These sealers make an easy road across the island, and, when they arrive at the cliffs at the other side, lower some of their number to the ledges and caves where these slaughter seals. The slayers and the skins are then drawn up. It is wholly illegal, but it goes on, so that the fur-seals are nearly exterminated. From the rata bush (*Metrosideros lucida*) we climbed a spur which had been swept by snow, killing the grass and making the going easy. It was a steep climb, with some tiring work, but nothing very difficult. The men who had laid down their eggs the night before when carrying their mate got them again without difficulty, and we crossed the saddle at a height of 1,900ft. (by the aneroid) in one hour and ten minutes. From here, as from our point of vantage yesterday, we had a wide view of the islands. Carnley Harbour, with all its arms, lay as a map before us. Had we sought the summit, a few hundred feet higher, we might perhaps have seen Port Ross and mapped the country. Towards the south the view was uninterrupted as far as the horizon. About the summit of the ridge there were many interesting plants. *Celmisia vernicosa* covered acres of ground, and was in full flower, being somewhat later at this altitude than down below. This beautiful little perennial aster, with its delicate tints, forms one of the charms of this richly-endowed island, just as its numerous allies do in the high alps of New Zealand.

The smaller species of *Pleurophyllum* was plentiful; a rare fern, a *Geum, Plantago aucklandica*—a handsome ally of the common plantain, here only found on high land—and a small cress, said to be a rare plant, were in plenty on the storm-beaten heights. Mosses, small rushes, lichens, and other alpine plants grew on and near the rocks. Descending a little way towards the ocean, we came upon the albatroses. They are very numerous. A great many of them were sitting; others were billing and cooing; others seemed to have no particular business on hand; others were young ones waiting to be turned off the old nests; others, again, were turned off, but had not yet learned to fly. An albatros nest is much the shape of the old-fashioned dairy-churns of our early youth, only a little shorter, and solidly built of mud, grass, and weeds. When it has served a year the grass grows up in it, but it is often used again another year, being first raised and trimmed up by the bird. When building a nest, the albatros—I suppose the female—scrapes up the mud from about it, but when she has made a little pile she stands upon it, and the rest of the work is done standing thus, so that her weight—from 18lb. to 25lb. —always serves to solidify what has been completed. In working from this standpoint, the bird digs up bits of earth with its beak and lays them upon the pile. About five digs to the minute is the average rate, and when it has done about five it turns and digs from another place. In digging thus it makes a trench round the cone, which may serve to keep the nest drained. It nearly always builds among high tussock, but takes little or no pains to conceal the nest. Its sole idea of protection is the utter isolation of its nesting-home. Its one plan for protecting its egg is to sit on it and never leave it. When the albatros is building its nest its mouth is generally rather soiled inside. When the nest is built it is finished off with a slight and neatly-made basin-like depression at the top, and in this are placed a few leaves and bits of dry grass, but not enough to prevent the egg from coming into contact with the soil and getting very dirty before it is hatched. There is never more than one egg, which once a day is turned over by the bird to expose the other side to its breast. It is pure-white except at the big end, where it is reddish. It weighs about a pound. It is said to be good eating, but I never tried it. It has two yolks, one small and the other large—at least, so it appeared to me when blowing numerous eggs. Sometimes two albatroses make their nests close together, but this seems accidental. When we got to this ground we separated in collecting the eggs. Often I could not help stopping to admire the grandly beautiful birds. The oldest are pure-white excepting the wings, which are pencilled with brown; the youngest are nearly black. They are supposed to turn whiter and whiter as they grow older. As we found them here, there were very few quite white; they were generally beautifully pencilled with dark lines. I have given the received explanation as to colour and age, but I am bound to say it does not answer all observations, as some of the young birds not fully fledged in the Otago Museum are quite white. Many birds which could not fly had a little down hanging about their necks still. Their condition shows that there are many young birds not yet fully fledged when the old birds lay their next year's eggs. When a bird is put off its nest it goes over in a helpless way. As you approach it it makes a demonstration, clapping with its beak. This clapping noise, which is even more used by nestlings than by old birds, probably serves to intimidate sea-hawks, but it often betrayed to us the unsuspected presence of nests among the tall tussock-grass. It is said it will snap at flesh, but not at a gloved hand. I generally gave them a bit of stick to bite, and gently turned them off backwards. Thus treated, the bird will fall upon its back, with its head and the elbow-joints of its long wings in the tussock, kicking helplessly with its feet. As soon as possible it would scramble back upon the nest, sometimes looking down occasionally with one eye at a time like a duck to see if the egg was there. When a bird had not yet laid it usually stood up as we came to the nest. When it had an egg nothing would induce it to rise and show it. It would sit close to the nest with the egg in the folds of its abdomen. By its sitting so close we could tell that it had an egg. In some places male and female stood by a half-made nest. We could see them gently curtseying to each other, and then rubbing their bills together. This undemonstrative style of courtship was going on everywhere. I do not suppose that one-half of the nesting birds were laying yet. In many places four, in some eight or ten birds stood in solemn conclave together, and scarcely stirred when we walked among them. I presume they were waiting on 'change for eligible offers of marriage. Very few birds showed any departure from the universal habit. Once one rushed at me to attack me as a goose does. Once, too, one ran away from me in great haste. Occasionally, as I came up to a bird which was not nesting, it ran along the grass and took flight, soaring away as they do at sea: this, however, was rare. Now and then we found their castings, and these were always found to contain masses of undigested beaks of small cuttlefish. We soon gathered a hundred eggs between four of us. These were blown on the spot with a blowpipe. They were nearly all fresh, a few only showing signs of incubation. Overhead numerous albatroses soared about. I could not quite make out the order of business, but some authorities say the males come down to feed their mates. Certain it is that either male or female—and I suppose the latter—sits perpetually. If she were to show the colour of her egg a sea-hawk would certainly spike it. These creatures watch incessantly at the penguin rookeries for chances of this kind, and nothing comes amiss to them. We gathered these hundred eggs from about twenty-five acres of ground. Had we been so inclined, we might have walked further and got far more. If one-fifth of the island is albatros-nesting ground, 140,000 birds could nest upon it: in fact, the whole of the high land of the interior is probably nesting-ground, and four eggs to the acre is far below what we found must be the rule elsewhere. Nevertheless, solitary islands are few and small, and albatroses are numerous, so there must be some further explanation of the vast numbers bred. It is certain that the information collected by Sir W. Buller and others may yet be very largely supplemented. Professor Scott states that the albatros does not breed at Macquarie Island.* The landing-party from Commodore Wilkes's ship "Peacock," however, describe the birds as extremely bold, picking up penguin eggs the party had laid down. I suspect these good sailors had given the name "albatros" to the skua-gull or sea-hawk.

There is evidently a rule in albatros-nesting. Here the season was well on, and the birds were of medium age. At Campbell Island, a long way south, the season was much further advanced, the eggs having young birds in them, while the birds were quite white and far larger than here. At Antipodes Island, where the albatroses were enormously plentiful, eggs were extremely rare, and quite freshly laid and clean; while the birds were younger and much darker than at either of the other places. One must almost suppose that the birds do not return to their old nests, nor even to their former island, but pass on as they grow older to an island further south. The order in which we found them is evidently constant. The dates may vary a little. Captain Fairchild is endeavouring to collect more certain information. The tin clips which he occasionally puts upon them, with the date and place of capture, may serve some day to clear this up.

The dates and latitudes are as follow:—

Antipodes Island, 17th January.—Dark birds. Majority not yet nesting, but billing. Eggs rare; incubation not commenced. Nest-building active. Lat. 49° 42′.

Adam's Island, 5th January.—Medium birds. Majority

* Trans., vol. xv., p. 484.

nesting. Few billing. Eggs plentiful; incubation just commenced. Few nest-building. Lat. 51°.

Campbell Island, 5th December.—White birds; very large. Nest-building; billing and laying all finished: chicks in all eggs. Lat. 52° 33′.

Chatham Islands, earlier.—Colours not ascertained, but said to be dark. Lat. 44°.

A few birds were captured here, and taken back for museums. The process was simple and humiliating. The noble creature was tied by the beak to prevent it from biting; a bit made of wood was put into its mouth to allow it to breathe; it was trussed—*i.e.*, its wings tied up, and its feet too. Two were thus tied up and slung over the man's shoulders, so that a bird went under each arm, and so were held and carried. I did not carry any; and a companion who trudged down the mountain with a bird of 16lb. weight under each arm and a candle-box of eggs on his back, assured me that when his birds fought each other both with beaks and feet it was not a job to be courted. The fighting seemed to me to be incessant: it was going on whenever I chanced to look that way. Now and then at a critical moment, when there was a struggle with a tussock, it fairly disturbed the bearer's balance. The day was a glorious one, and the sights were most interesting, though, if albatroses sorrow for their eggs, somewhat cruel. On the top of the range were ground-larks, as usual; snipe, too, rose at our feet, and scattered hastily as if from a nest. These pretty little creatures are numerous, and would certainly be exterminated if much disturbed. As we descended in the evening I thought I heard the weka (*Ocydromus australis*). I do not know whether it was indigenous, but it was taken over from Stewart Island after the wreck of the "General Grant" or "Grafton" to add a little to the food-supply of the island; but these were liberated on the main island, and are not likely to have spread much. Mr. Travers thought he heard the kiwi (*Apteryx* sp.), which has never been reported from the group. If there it would probably prove a new species. That evening we sailed for Campbell Island, having again the good fortune to have a fair wind. Captain Fairchild had never before known a calm night in the Auckland Islands. We had enjoyed three as fine as could be wished for, with days to match.

V. CAMPBELL ISLAND.

We now spent a night at sea, and early in the morning saw a high island in our course. We came up to it, and found its appearance almost like a series of pyramids and towers rising from the sea. The coast is bold, and about it are studded some noble islets rising sheer out of the water, composed everywhere of columnar basalt. Inland are several peaked mountains with rocks almost like spikes upon them. The highest of these is 1,800ft., but rising from the ocean they look higher. The names of the peaks, points, and islets tell of the visit of the Antarctic expedition in 1840—Lyall Pyramid, Terror Point, &c.; and of the French Transit of Venus Expedition in 1874—Venus Cove, Vire Point, Jaquemart Island, and others named after Courjolles, Filhol, &c. The island was discovered in 1810 by Frederick Hazelburg—whose name appears appended to a small group of islands near Stewart Island—master of the "Perseverance," owned by Mr. Robert Campbell, of Sydney. It has several fine harbours, and was for this reason selected by the French in 1874. For some months the "Vire" lay there erecting the observatory under the superintendence of M. Bouquet de la Grye, the Hydrographer to the Navy, and his staff. The day was cloudy, and they never saw the transit. Dr. Filhol, the distinguished naturalist, was there with the ship; and collected and observed birds, fish, and marine animals.

My personal acquaintance with these men added to the interest I otherwise felt in this island, my previous knowledge of which was mainly derived from descriptions given by Dr. Filhol when we lived together fifteen years ago. This gentleman has since published a great work on the island, which I have not had the advantage of seeing. The only recent incident in its history is the story of the "Sarah A. Hunt," a seal-poacher from America, which was blown away with two men, abandoning two boatloads of men, one of which, after the vessel's arrival in New Zealand, was rescued by the "Stella." Mr. H. Armstrong, in a recent article in the *Leisure Hour*, described his visit there in the brig "Amherst" in search of castaways after the wreck of the "General Grant," and mentions finding wreckage and several graves there, including one of a Frenchwoman.

After passing round most of the west coast we put into North-west Bay. Here there is a small cliff of lithographic limestone, bearing fossils. It is much contorted by volcanic action. An underlying rock is studded with iron-pyrites, which may be the "tin" which tempted Musgrave's charterers. We landed, and went up the ridge in front of us to the height of 900ft. till we looked down a fine cliff facing southwards. From here we could see across the island to the head of Perseverance Harbour, in which was the white house of the dépôt. I felt tempted to walk down to it, but feared that some low land might contain a swamp. The walking was everywhere extremely heavy. The tussocks were very large, and their heads matted together. Among them were a few albatroses. These were very beautiful birds, almost all pure-white excepting the wings. Once when I turned one off its nest it did what I had not seen one do before—made a savage snap at its egg and punctured a small hole in it. Mr. Bell went more to the west, and climbed a steep hill called the Menhir. It had a stone peak at the summit like the menhirs or Druids' stones of Brittany, and had doubtless been named by a Breton. We had a good view of the island, which is circular, and is almost cut in two by Perseverance Harbour, a fiord of volcanic origin some miles long, with an entrance from the south-east. In the part of the island where we now were, the plants, though not as numerous as at Adam's Island, were even more beautiful. Here the *Pleurophyllum speciosum* was in better season, and the flowers were of a much deeper purple than those we had seen before. From being isolated the plants had grown better, and each was a picture in itself. Here, too, the *Celmisia vernicosa* grew leaves less polished than at the Aucklands, but 5in. and 6in. long—*i.e.*, usually twice as long as those we had gathered before. The flower-heads were numerous, from six to twelve on each plant, and were in full perfection. The figure in Hooker's "Flora Antarctica" is an admirable representation of this plant. Their centres were of two colours—light and dark purple—but we attributed this to difference in degree of maturity. I brought back some of them, but have found them more difficult to preserve alive than the small plants from Adam's Island. The grass was much drier; indeed, that appeared to be the character of the country, but, as other travellers do not bear this out, the season may be exceptional. The albatroses were of enormous size; some were brought down for museums. An ingenious man of the sea found that it was easier to tow them than to carry them. As he worked to leeward, according to the prevailing wind, he had the lie of the tussocks with him. A string was put round the beak, and the albatros was towed down to the ship without much trouble; the grass being dry they arrived quite clean and uninjured. We only got a few eggs, and these had chicks in them—an additional attraction at the museums. None of the eggs could be blown; the chicks had to be taken out through a square hole cut in the side. In many places I found pebbles and small angular pieces of stone resting on the ground or on the tops of the tussocks; one very large piece weighed a pound. These must have been dropped by seabirds bringing up food—shell-fish—from the rocks. It affords a mode of accounting for small stones in unexpected places near the sea.

In the afternoon we again went round the west coast and entered Perseverance Harbour, which is a very fine sheet of water, with straight shores. There are several good anchorages. Mount Honey, the highest hill on the island, is on one side, and Lyall Pyramid on the other. The ridges on either side are 800ft. high. Though we had only found a few albatroses, we saw them in great numbers in more inaccessible places. On the shore here we saw some white goats, part of Captain Fairchild's stock. Hitherto goats have done well and sheep badly at most of these dépôts, but I think the flocks of sheep put down are far too small. The shores of the harbour are fringed with scrub. This is composed of *Dracophyllum.* One writer says there are pine-trees; another sees manuka (*Leptospermum*, sp.). The *Dracophyllum*, allied to the heaths, but with leaves like grass, is presumably the pine; the *Cassinia*—a familiar shrub on our hills—is, I suppose, the manuka of the other observer. Another writer found ground-larks and wrens; we found neither, though the ground-larks may be there. Mr. Travers obtained no land-birds. Mr. Reischek only saw the blight-bird (*Zosterops lateralis*, vel *cærulescens*), which certainly crosses the ocean. Mr. Bell could see no ducks, though they are said to frequent the island. Landing near Venus Cove we were soon among beautiful and interesting plants. Here at 100ft. above the sea the *Celmisia vernicosa* was very fine and plentiful. I suspect that the reported existence of *Celmisia verbascifolia* (a well-known Otago plant) on this island is a mistake. On a small area of flat moist land my brother, Mr. Martin Chapman, discovered a new plant, which I identified as an unknown species of *Celmisia*, to which I have given the name *C. campbellensis*.* It is quite unlike any other, though its flower-heads are like those of *C. vernicosa*. We obtained ten plants, one being in flower and others in seed, and brought them all away for cultivation. Mr. Kirk subsequently had the good fortune to obtain one in flower. It seems singular that this should be found within half a mile of the French camp, and close to the spot where, I presume, Sir Joseph Hooker lay, but it appeared to us to be locally confined to less than an acre of ground. Higher on the range it may be more plentiful. One plant growing here, which was generally past flowering at Adam's Island, is *Pleurophyllum criniferum*. The flowers are by no means so pretty as those of *P. speciosum*, but the general effect of the plant, with flower-bearing scapes 4ft. high, is very striking. Here, too, we found in flower the beautiful golden lily called *Anthericum rossii*. This was plentiful enough at the Auckland Islands, but generally past flowering. When in perfection it is a beautiful flower, and I find it easy to cultivate.

The day was cool but fine, and the evenings had now become very long, with twilight like that of the Old Country. Early next day we moved down to a lower anchorage near

* See above, Art. XLIII.

the mouth of the harbour and landed on the hillside. Here we picked a spot clear of scrub and clambered up. Some were bent on albatros-egg hunting, and had fair success. I was searching for plants, but found little beyond what we had seen elsewhere. Mr. Kirk was more successful, and obtained some rare and obscure plants. This was the shady side of the harbour, and our experience satisfied us that it is far better to ascend the sunny side, as the vegetation is less rank. Here it was so rank as to make walking extremely difficult. The size of the *Ligusticum latifolium* of several varieties was amazing. Some of the *Coprosma* shrubs were laid so low and rendered so dense by the wind that we found it the best mode of progression to walk on top of them, though they sank down like spring beds with the weight.

On our return we steamed out and landed some sheep in the most promising place available in East Bay, another good harbour. These were provided, as much of the live-stock is, by the Invercargill Wreck Fund, an institution which has, under the supervision of Mr. John Macpherson, of Invercargill, for many years made thoughtful provision for shipwrecked seamen. East Bay is a pretty little harbour, not unlike Fly Harbour, in Adam's Island, in character, but without the forest. The flowering-plants along its margin were extremely beautiful. Hence we coasted to the north-east angle of the island, standing inshore to examine the vast rookeries of mollymawks, which occupy a large piece of ground inaccessible from below and difficult of approach from above owing to the necessity for making a long journey through the scrub to reach it. These birds have a singular faculty for picking out safe nesting-places. At this season their young are nearly hatched. Hence we steamed away in the evening, after two pleasant days of rambling, for Antipodes Island—a long journey which kept us all next day and night at sea. We experienced nothing of the vile climate said to prevail here.

VI. ANTIPODES ISLAND.

Early on the second day after leaving Campbell Island we were off another high island with a few steep outliers. This island has no harbours, and is surrounded by cliffs, under which, as at the Snares, were numerous rookeries of penguins. Wherever we went it was the crested penguin; we only obtained three specimens of other kinds in the whole trip—one being the great king penguin, and the others being somewhat similar but smaller birds, possibly immature specimens of the same kind. We anchored under a noble cliff of contorted basalt and tufa on the north-east side, well named Perpendicular Head. Outside of the anchorage were two islets never yet visited, one of which exhibits a fine natural arch of rock. The landing is at a rocky recess amid the smell and noise of penguins in a small rookery hard by. The dépôt was in good order, and two out of the three cattle left there looked well; the third was missing. The sheep were not seen, but recent traces of them were found. The cattle had begun to make tracks through the heavy tussock at the landing, and had eaten freely of the great rhizomes of the *Stilbocarpa* and the leaves of a large nettle. These plants and *Ligusticum antipodum* were common here, but the fine flowering-plants of the other islands were reduced to one species of *Pleurophyllum*. We started to walk through the island, and found the work very difficult. The high tussock and a fern (*Lomaria capensis*) covered very treacherous ground. Mountains rise on two sides of a sort of plain or basin. We crossed this, and made for Mount Galloway, 1,300ft. by the aneroid. As we approached it we found its sides scarred by slips and deeply cut by water-worn ravines. Here grew quantities of *Coprosma* scrub, the only shrub on the island. It was in fruit, and on the fruit were feeding two kinds of parrakeet unknown in New Zealand. I found it very difficult to see them, so completely did they match the colour of the scrub, but I got several for the museum. When I fired a shot they screamed all round, but remained invisible. At times they came close round me, so close that I could not fire without knocking them to pieces. I carried a small walking-stick gun with small shot. I found this gun more destructive than I had found a fowling-piece with large shot in the Sounds, when I procured some small birds now in the museum; indeed, my gun was so deadly that at Port Ross I killed shags with it easily. These parrakeets have acquired the habit of keeping low down and seldom flying, as to fly on so small an island would expose them to the danger of being blown away to sea. Near the head of the stream which flows down the mountain we found a fine large plot of beautiful *Sphagnum* moss, which could be seen as a patch on the mountain-side from the ship, two miles off. We failed to get a view from the mountain, as there was a dense fog up there. The summit was clear ground, matted with *Pleurophyllum* and low-growing *Ligusticum*. Owing to a fog we failed to see a clear lake said to exist there. There was a good deal of flat ground up there, which was literally alive with albatroses. Young, black, birds were very common; often their breasts were covered with down, and this was matted with piripiri (*Acæna adscendens*) seeds. The albatroses were building nests everywhere, and numbers of them were billing and cooing and gathered in large flocks as at Adam's Island. They took little notice of us as we walked among them, only clapping their beaks when we went right up to them. They went on with their nest-building and their billing while we stood close by them. They were as numerous as geese in a farmyard, and less active, for geese would either have run away from or after us. On the flanks of the mountain there were more albatroses, young and old, but very few old enough to be nearly white. The season was decidedly backward as compared with the other islands; we only got three eggs, and altogether only about twenty were found. With such a number of nests I am sure that a month later a thousand could be gathered in the same time, as at Adam's Island some four hundred were obtained. Sir W. Buller mentions parties of Maoris getting a thousand young albatroses from some small islets near the Chatham Islands. Captain Fairchild thinks that albatroses have become less numerous since his first visits to Antipodes Island, though at this season he disturbs them very little, and at other seasons still less; but this is probably due to the fact that his former visits were later in the year. Thinking they might be shifting their breeding-ground, I inquired if he knew of any nesting on the mainland of New Zealand. He replied that he had seen them flying over the high-level land at Dusky Sound, and during the last few years he had noticed immense numbers of birds off the coast of New Zealand, where he had never seen them numerous before. On this island we found young albatroses standing about the old nests quite low down on the plain, but they were far more numerous on the hill. On our way down the mountain we crossed some very wet ground at the source of the stream. Here we found all the leaves of the *Stilbocarpa* covered with dirt newly thrown out of burrows. We could not satisfy ourselves what birds were making these burrows. We could hear birds squeaking in some of them, and out of one got a young but grown sea-hawk, whether a denizen or a robber we could not tell. In another we got an egg which contained a fully matured nelly (*Ossifraga gigantea*) chick. On the mountain-side were numerous holes under tussocks which I took to be those of the *Prion*, or night-bird, or of some petrel. We did not obtain many plants worth cultivating, but everywhere we saw small but beautiful gentians in flower. Mr. Kirk obtained several interesting plants. Besides the birds mentioned we saw ground-larks paler in colour than those of New Zealand, and very tame. Snipe, too, were obtained, but I did not see any. They are said to be different from those of the other islands. There are, in fact, two species of snipe in the outlying islands, that of the Chatham Islands, *G. pusilla*, being distinct. All the land-birds are very tame, and are poor fliers. If they were better fliers they would more easily get blown to sea. At some seasons the parrakeets become very shy. This island was discovered by Captain Pendleton in 1800, but I know nothing of his voyage.

beyond the fact that his course is marked on large charts, and is often referred to in Dumont d'Urville's book on the South Pacific. It is the nearest land to the antipodes of Greenwich, which must be about one hundred and twenty miles away. There is a piece of wood on the island recording the accidental drowning of the mate of the ship "Prince of Denmark" in 1824, but this I failed to see. A few years since a sealer lived alone for a season here, and reported that at a certain season he saw the penguins migrate southwards in vast flocks. It is not known where they go to ; it is certain, however, that they leave this and the Bounty Islands in the winter, as Captain Fairchild on his visit in July does not find one. Sea-lions are unknown here ; fur-seals have disappeared. Fish are scarce here as elsewhere, and are shunned by sailors, as at one season they are full of worms. This is the case even at the Auckland Islands with fish caught in deep water, though there are good fish in the harbours. It is the case likewise at Macquarie and other outlying islands, but not at the Kermadecs.

The albatros-eggs had had a bad time of it as we stumbled through the heavy tussocks—one was broken, another slightly cracked. I carefully laid a sound one on a ledge of rock to keep it out of mischief while waiting for the boat to come off. My attention was attracted by a little ground-lark which played about on the stones. Thinking it might be a new one, I several times tried to knock it over with my hat, as I had done at other places. It narrowly eluded me, and I was just about to make a certainty of it when a shout from Mr. Miller, one of the engineers, who was descending the cliff, caused me to turn. A sea-hawk had spiked my last sound albatros-egg with his beak and was indulging in its delicious contents. When I struggled up to regain my egg the sea-hawk hopped knowingly away, and when the boat had got us off he leisurely returned to finish what he could find of the egg among the crevices of the rock. An hour later we were moving off towards the Bounty Islands in a jumping sea, which was anything but pleasant to any of us, and sufficiently depressing to some to send them to bed. The sea is always worst near the islands. When we got well away to sea it moderated somewhat.

VII. The Bounty Islands.

A fearful stench pervaded my cabin when I awoke. I dreamed of it before I awoke—indeed, it was that and nothing else that awakened me. I have slept in strange places and amid a thousand strange smells, but never did I endure anything so sickening as this. I knew my room was full of fearful things, and visions of broken albatros-eggs haunted my shattered senses, though my almost hermetically-closed box looked all right. I rushed out to the bath half awake. The galleries smelt as my room did. The bathroom was just as bad. Then I remembered the faint odours of the Snares (which, by the way, we had smelt a mile across the sea), and I knew what had happened: we were steaming among the bird islands. The Bounties are sixteen rocky islets, running up to a few hundred feet at the highest. They have no soil upon them. Wherever there is room there sits a crested penguin. The largest islet is 30 acres in extent, and under the lee of this we anchored. From the anchorage we could see half the islands; but the nearest one to us carried no birds, as the sea can wash over it. Even at the distance of half a mile the noise of the birds was deafening. It rose and fell with a cadence like that observable in the forests of Australia when the locusts or *cigale* are numerous, or near marshes where frogs abound. I wanted to land, and as boats were sent ashore two of us ventured in them. We found the rocks too steep to get up any distance, so we gave it up. The steward and the carpenter went up a short way. Here the stench was simply awful. We watched the penguins swarming over the rocks for awhile. The great nellies swam about us; the molly-mawks sat beside their big young ones among the penguins on the rocks; the whale-birds, too, made their homes in the deeper crevices. It is good to think that some creatures can stand the smell of penguins. Heavens! what a place to be marooned in! There was a dépôt here too, but lightning has destroyed it, and the sea is rarely fine enough to allow material to be landed to repair it. A sail is provided to catch water. Fortunately there is no suspicion that anybody was ever wrecked here. It is, however, a fact worth noting that, though no homeward-bound ship from Otago has ever been missed, half a dozen from Lyttelton have gone out which have never been heard of. The last of these, the "Marlborough," left on the 11th January. She is not likely to have touched either this or the Antipodes group, as we should probably have found some trace of her. We sighted the "Rangitikei," from Otago, two days out, soon after leaving these islands. We were glad to get back to the ship with her evil smell—away from the noise and the intolerable stench of the island. In moving away the captain took us slowly past the largest face of the largest island; it was one mass of penguins. Crowded as they were, I judged that there were a million penguins on the 100 acres of land in the group. There must have been fully as many—perhaps twice as many—in the water, for they were in flocks for miles out. Sir William Jervois and Captain Fairchild once made a calculation, and, I believe, concluded that five million penguins resorted there.

The captain assured us that they were often packed far closer than we saw them, and then there were fewer in the water.

The penguin gets out of the water in a heavy sea with great ease. It dives towards a sloping face of rock; then the sea carries it on as it swims under water high up towards it. It bounds like a fish upwards just as the sea is retreating, and lands flat-footed on the face of the rock. Long before another wave washes up it makes two or three vigorous jumps and is out of its reach. A land-animal would get smashed to atoms in the process. I shall never forget the quaint and beautiful sight presented by the rows of penguins as we passed slowly along the face of this desolate rock. We were now to windward, and the stench had vanished. The rocks are hard, coarse granite, and, as the penguins wholly desert them in winter, the rains wash them quite clean. There is not a blade of vegetation upon them; not a green thing, save the *Pleurococcus*, or green mould, which smeared the rocky walls here and there. The islands derive their name from the ship in which the brave and tyrannical Bligh sailed when he discovered them in 1788. We now started for home again. I understand it was originally the intention of our Government to annex Macquarie Island, further south than Campbell Island, but, finding that it was included in the Commission of the Governor of Tasmania, this could not be done. It is to be hoped that this will ultimately be arranged, as the island can be of no use to Tasmania—from which it is far distant—and its exclusion from New Zealand leaves us exposed to the depredations of seal-poachers. This island is the resort of sea-elephant hunters from New Zealand, and I am sorry to say that these have not always respected our laws for the protection of fur-seals. Professor Scott and Mr. (now Dr.) Reginald Strode visited it some years ago, and the former wrote an interesting account of his fortnight's stay there.*

There is said to be another island farther south called Emerald Island. All that is definitely said of it in authentic books is that the ship "Emerald," in December, 1821, in lat. 57° 30′ S., long. 162° 12′ E., saw the resemblance of an island, very high, with peaked mountains. A gentleman living at Port Chalmers tells me that a sea-captain told him that he had seen it and had been round it, but could see no place for landing. It was a small, high, rocky island. This, however, has not been reported to navigators in these seas. Some maps and gazetteers now omit it. Commodore Wilkes sailed over the site of it in the "Vincennes," and, separately, his vessel, the "Porpoise," did the same. As the position was uncertain, and the weather thick, there is still a possibility of its being found, but it may

* Transactions, vol. xv., p. 484.

have been a cloud-effect only. A suggestion that it was an iceberg would not answer, as it was distant twenty-five miles, a distance at which the highest floating berg could not be seen. As seals were at one time numerous at Macquarie Island, and numerous ships visited it in pursuit of them until they were exterminated, it is not likely that they left Emerald Island unsought for.

We made a quick run to Port Chalmers, and so ended this most successful and enjoyable expedition. From all classes—officers, stewards, and sailors—we met with nothing but kindness and attention.

Addenda.

Captain Fairchild writes me on the subject of dates of nesting of the albatros and crested penguin as follows: "I find that the albatros lays—Campbell Island, lat. 52° 33′ 26″ S., 5th December; Auckland Islands, lat. 50° 0′ 32″ S., 5th January; Antipodes Island, lat. 49° 42′ 5″ S., 20th January. They must take nearly 50 days to hatch, as we found them just beginning to lay on the Antipodes Island the 17th January last; and when I was on the Antipodes on the 18th March, 1886, I found them just beginning to hatch out. The penguins lay—On the Snares, lat. 48° S., 1st October, and hatch out about 5th November; on Campbell Island, about 5th September; on Antipodes, about 25th September; on the Bounties, lat. 47° 46′ 24″ S., about 1st October, the same time as on the Snares. I have not been able to see the man I wanted to see from the Chatham Islands, so I cannot tell you when the albatroses lay there, but I know that it is later than it is on the islands farther south."

Raynal, Musgrave's mate, mentions gathering several eggs at Campbell Island on the 2nd December, only one of which was fresh enough to eat. The evidence in the recent case of deserting seamen tried in Dunedin showed also that at Campbell Island the birds were nesting in November. The advanced state in which we found a certain proportion of the eggs at Auckland Islands showed that the earliest eggs are laid at an earlier date than Captain Fairchild gives.

Captain Fairchild visited the islands again in October, 1890, and experienced terrible weather. The barometer three times recorded 28·62. He tells me he found very few albatroses on the islands excepting young ones. This confirms the statement that the old birds abandon their large full-grown chicks, and these have to live on their own fat until they are strong enough *and light enough* to fly.

As I have been asked by many people as to whether valuable minerals exist in the islands, I can only say that the appearances seem to me to render this improbable. The Snares and

Bounty Islands are granite. The other three groups are recent volcanic, but at Campbell Island the floor of the ocean—an ancient limestone-bed—has been lifted up, and appears in the face of a cliff. At the Auckland Islands an immense dyke of dark rock, cutting the high cliffs of the west coast from the summit to the sea, was visible for miles, and some singular dykes were observed crossing each other, but covered with tussock grass, at Adam's Island. These should be examined, but are not likely to give any valuable result. I saw no stratified rocks in the group, though I am aware that others have fancied they found them. Most of the plants are doing well in good moist soil in shaded positions in my garden.

Captain Fairchild, under date 15th February, 1891, writes, on his return from the second cruise in search of traces of the s.s. "Kakanui," as follows: "I find that the Auckland Islands albatros is quite a different bird from those we saw at Campbell Island. Those we saw on the Auckland Islands and the Antipodes have dark heads and blue eyelids, while those on Campbell Island have pure white heads with dark eyelids, and are a larger bird, being about 7lb. heavier than either the Auckland Islands or Antipodes birds. We have some on board now, and I was anxious for you to see them; they are so different when you see them together. All the birds on the islands were more numerous this year than they were when you were at the islands. We went up after albatros-eggs at the same place, where you were up at the Auckland Islands, and we got two hundred eggs on about 5 acres. It was marvellous to see them; they were within a few feet of each other, all sitting on their eggs."

I have compared the eggs in my possession. Two from Campbell Island measure respectively $5\frac{3}{16}$in. by 3in. and $5\frac{1}{8}$in. by $3\frac{1}{8}$in. They are more elongated towards the small end and rounder and blunter at that end than those from the Auckland Islands. A large number from the Auckland Islands run from $4\frac{10}{16}$in. by $3\frac{1}{16}$in. up to $5\frac{4}{16}$in. by 3in. Nearly all, however, are about $4\frac{14}{16}$in. by 3in. A few are as much as 5in. long, and a very few exceed 3in. in the shorter axis. I must still say that the whole subject requires more attention than can be given to it on a hurried visit.

ART. LIX.—*The Age of Pulp: a Speculation on the Future of the Wood-fibre Industry.*

By the Rev. P. WALSH.

[*Read before the Auckland Institute, 4th August, 1890.*]

MANY ages have passed over the world, each of them preparing the way for that which was to follow, and all in their turn contributing to make it what it is. Poets have sung the glories of the Golden Age, the history of the Stone and Bronze Ages has been brought to light by the labours of the traveller and the archæologist, and our own experience and observation have made us familiar with the marvels of the Age of Iron and Steel. But another age has already dawned upon us, which, for want of a better name, I will call "the Age of Pulp;" and I hope that I shall be able to show that it bids fair ere long to eclipse all the ages that have gone before it.

It is difficult to supply a definition of the term I have employed which will be at once concise and descriptive. For the purpose of this paper I will define pulp as "a metamorphic compound formed by the concretion of particles of disintegrated matter." In this sense concrete is pulp, felt is pulp, and paper is pulp; for in each of these substances all trace of the original form—the grain of the stone, the staple of the wool, and the disposition of the fibre of the vegetable matter—is absent in the new compound, has been lost in the process of manufacture.

From this it will appear that the term may be very extensively applied, and far more so now than in any other period of the world's history; in fact, almost every product of the age is more or less characterized by the pulp idea. Our literature, art, fashions in dress, are all pulp. The wisdom of the ancients, the traditions of mediæval times, classical and foreign art-forms, Greek, Roman, Gothic, and Oriental elements, are all represented in the modern compounds. Even in language, the old grammars and foreign modes of speech are pounded down, torn up, and mixed together to form material for the verbal amalgam in which we express our thoughts. And, to go even further, what are the nations and races of the present day but pulp? By colonization, by international intercourse, the same process of disintegration and concretion is taking place in an ever-increasing ratio. In fact, in all departments of life, in every plane of action—in physical, mental, and moral; in political, social, and artistic—the great pulp-manufacture is going on as it never went on before.

I think I have said enough to justify the title at the head of this paper—namely, to demonstrate that the period we live in may be fitly designated as, *par excellence*, "the Age of Pulp." I do not propose, however, at present to attempt a speculation on pulp in the abstract: I shall merely confine myself to an account of a single department of the subject, which is nevertheless a very large and important one—namely, that which relates to the manufacture and uses of pulp made from vegetable fibre.

Although the fibre-pulp industry is, comparatively speaking, still in its infancy, the principle involved in it is by no means a new one. As in the case of many other industries, it existed in an embryonic form long before its enormous capabilities were appreciated. The pulp idea was present when the first sheet of rag-paper was rudely made by hand many hundred years ago; it only required time and experience for it to reach its present development. The early stages were fitful and tentative. The now universal millboard was followed by various trivial attempts in *papier-maché*, but the first genuine step forward was taken when the pulp in a compressed and moulded form was used in the manufacture of articles hitherto laboriously made by hand. It had taken a long time to blow the spark into flame, but once the flame was properly kindled it spread with wildfire rapidity, and, as improved machinery multiplied the number of substances available, and enlarged the field of operations, it soon appeared that there was practically no limit to the variety of uses to which the pulp might be put.

A few instances, taken almost at random from current accounts of some of the more recent applications of the process, will serve to show that no speculation is too wild as to the ultimate destiny of this most plastic of materials. Doors and window-frames, and even entire houses, have been made of it, as well as articles of furniture, vessels of every description, musical instruments, and even stoves and cooking-utensils. It has been used in America for the floor of a skating-rink, for which it has answered better than either timber or asphalte. It has supplied the material for bottles in Austria and Germany, and for boats in France. In Russia it has been successfully employed in the manufacture of tramway-rails; and in Hudson, New York, is shown one of a set of wheels which travelled 300,000 miles under a Pullman car. From these few instances, which might be multiplied *ad infinitum*, it will readily appear that there is scarcely a substance for which the pulp is not an efficient substitute, scarcely a department of manufacture in which it cannot be used with economy and advantage.

I cannot pretend to give a detailed technical account of the process of manufacture, but I may state briefly that the raw material required includes all substances containing vegetable fibre. Straw and grasses, old ropes and sacking, moss, and even peat, find their way into the pulping-machine, as well as every kind of wood. These, having been crushed and torn until the fibre is thoroughly separated, and all foreign and useless matter eliminated by washing, &c., are compressed in moulds into the form required. By regulating the amount of pressure, as well as by the choice of materials, any desired degree of density may be obtained, and by an admixture of certain chemicals the substance may be rendered proof against damp and fire, as well as against the ravages of insects.

But, although the field of operations of the pulp-mill, already so large, is constantly extending, there is one department to which, so far as I have been able to learn, it has not reached as yet—at least, beyond the most elementary stages. I allude to the department of shipbuilding, for which a little consideration will show us, I think, that the material is most specially suited. The old "wooden walls" have had their day—and a glorious day it was: the ships of iron and steel are now having theirs; and, if I might be considered overbold in hazarding the opinion that this day is fast drawing to a close, it must at least be admitted that, when weighed in the balances of utility and economy, these marvels of creative and constructive skill are in many most important conditions found grievously wanting. A modern ocean liner is indeed a splendid object, but, in spite of the many advantages of perfection of model, structural strength, speed, comfort, and convenience, by which she excels all the types of vessel that have preceded her, she is still far from realising the perfection of the ideal ship. Indeed, the very qualities which enable her to surmount one class of the dangers of ocean travelling render her all the more vulnerable to another. If her huge bulk and high rate of speed cause her to make little of seas and storms, every increase of volume and power only serves to reduce her ability to withstand a shock; and experience has shown that in the case of a collision, or sudden impact on a hidden rock, all her modern improvements of watertight bulkheads and cellular bottom are too frequently powerless to prevent her cracking up like an egg-shell and going down like a stone.

Contrast a vessel of this class with one built either wholly or in part of the substance under consideration. The bulk, speed, perfection of model, and structural strength will still remain as constant quantities; but, in addition, instead of a thin, brittle plate, liable to corrosion, difficult of repair, and needing constant attention, you have a tough and elastic sheeting, strong enough to resist a considerable shock in the case of a collision, and of sufficient buoyancy, in the case of total wreck, to help to keep the crew and passengers afloat—every fragment, in fact, being a raft in itself. There can be no doubt as to the result of the comparison. The fitness of the material for boats and small steam-launches has already been demonstrated by actual experiment. It only needs an extension of the principle involved in the construction of these to arrive at the ship of the future, the ideal ship of the Pulp Age.

There is one circumstance which must not be lost sight of, which will, more than anything else, contribute to the development of the pulp industry—namely, the question of timber-supply, which is daily becoming one of increasing importance. The timber-supply of the world is by no means inexhaustible. A great part of the Old World has for many years been dependent on the forests of the New; but as the New World fills up by colonisation and settlement it will have enough to do to provide for its own home-consumption. In Canada and in the Western States of America the inroads already made by the farmer and the lumberman are such that in a comparatively short time the "forest primeval" will, with the exception of a few inaccessible patches, be a thing of the past. Conservation and replanting on any efficient scale are out of the question; such things are not generally thought of until it is too late. John Bull and Brother Jonathan and their colonial cousins are wont to take the goods the gods provide, without troubling themselves about the wants of posterity. And sooner or later we shall be brought face to face with the question as to how we shall find flooring for our houses and decking for our ships, not to mention material for our tables and chairs. The solution, I do not hesitate to predict, will be found in the pulp-mill. Under the present system of woodwork the available material is confined to portions of trees of a certain size, and of approved durability; while, for the manufacture of pulp, trees of small or imperfect growth, tops, brushwood, and timber-refuse of all kinds can be turned to advantage. The waste in a timber-bush is something appalling. The actual logs form but a very small fraction of the total growth, quantities of potentially useful stuff are crushed by the falling trees, or used up for skids, &c., and the bulk is left standing, to be swept off by fire during the first dry season. All this lamentable waste would be obviated under the pulp-system, the portion of forest attacked would be mowed off like a field of corn, and every fragment turned to account. Indeed, if the system were generally adopted it would probably be unnecessary to trench on the larger forests at all. In this country, at least, the supply would be kept up for many years from the logs which cumber the clearings of the bush-farmer, and other waste stuff which at present only serves to take up room and propagate destructive fires throughout the country.

Art. LX.—*Thermal Springs in Lake Waikare, Waikato.*

By H. D. M. Haszard.

[*Read before the Auckland Institute, 3rd November, 1890.*]

Plate XLIV.

The existence of hot springs arising from the bottom of Lake Waikare has been known to a limited number of people for a considerable time; but, so far as I am aware, the fact has not been recorded in any way, nor their position marked on any map.

Whilst surveying recently in the neighbourhood, I therefore took the opportunity to fix their locality, for future reference, as shown on accompanying plan (Pl. XLIV.), and I also append a few notes that may prove of interest.

The springs are situated about four miles south-east of the Rangiriri railway-station and fifty miles south-south-east of Auckland, being, I believe, the nearest thermal springs, in active existence, to the latter place on its southern side. As shown on the plan, they all rise to the west and south-west of Motukanae (Mullet Island), from the bottom of the lake; the most powerful one, which I have named Koropupu, being about 3½ chains distant, and innumerable small ones bubble up immediately surrounding the western half of the island.

Koropupu rises from a muddy bottom through 8ft. of water, and on a calm day bubbles 3in. to 4in. above the surface of the lake. Should the lake be at all rough, however, the position of the spring can easily be found by the strong sulphurous odour that pervades the air near it. At this season of the year (September) the temperature of the water when it reaches the surface is very slightly higher than that surrounding; but the natives tell me that this is owing to the amount of flood-water now in the lake, and that in summer, when it has only a thin stratum to force its way through, it is quite hot.

Motukanae, which is only about 45ft. long by 30ft. broad, is composed of a friable chocolate-coloured sandstone, through and upon which silica and other residuary matter from mineral waters have been deposited. The island is in places like a huge honeycomb, from the numberless steam-holes through the rock, though these are all quiescent now. The surface is fairly level, and is about 3ft. above the present water-line of the lake. A little mould has formed on the rock, and a few shrubs and grasses are growing upon it.

I have made a collection of the different minerals to be found, including the roots of a tree that had been silicified *in sitû*, also the casts of some leaves, and forward them herewith for inspection.

The fact of volcanic agency having been at work in this part of the country is interesting, in connection with the supposed changes in the course of the Waikato River, and would probably go a long way towards accounting for such changes.

I am informed that during the spawning season the mullet swarm round the island, hence I suppose the name; but I have also been told that they acquire such a disagreeable flavour that they are scarcely eatable. At the time of my visit a flock of geese had established their nests on the island.

In crossing and re-crossing Waikare in different directions I have taken soundings, and find that the bottom is of a very uniform level at a depth of from 6ft. to 8ft., and is composed of deep mud, the ever-increasing sediment which is being deposited by flood-water. The swamps on the south and west appear to be encroaching rapidly on the lake, and it is only a question of time for this grand sheet of water to be turned into a huge morass.

I also send with this a specimen of iron-sand from the eastern shore of the lake.

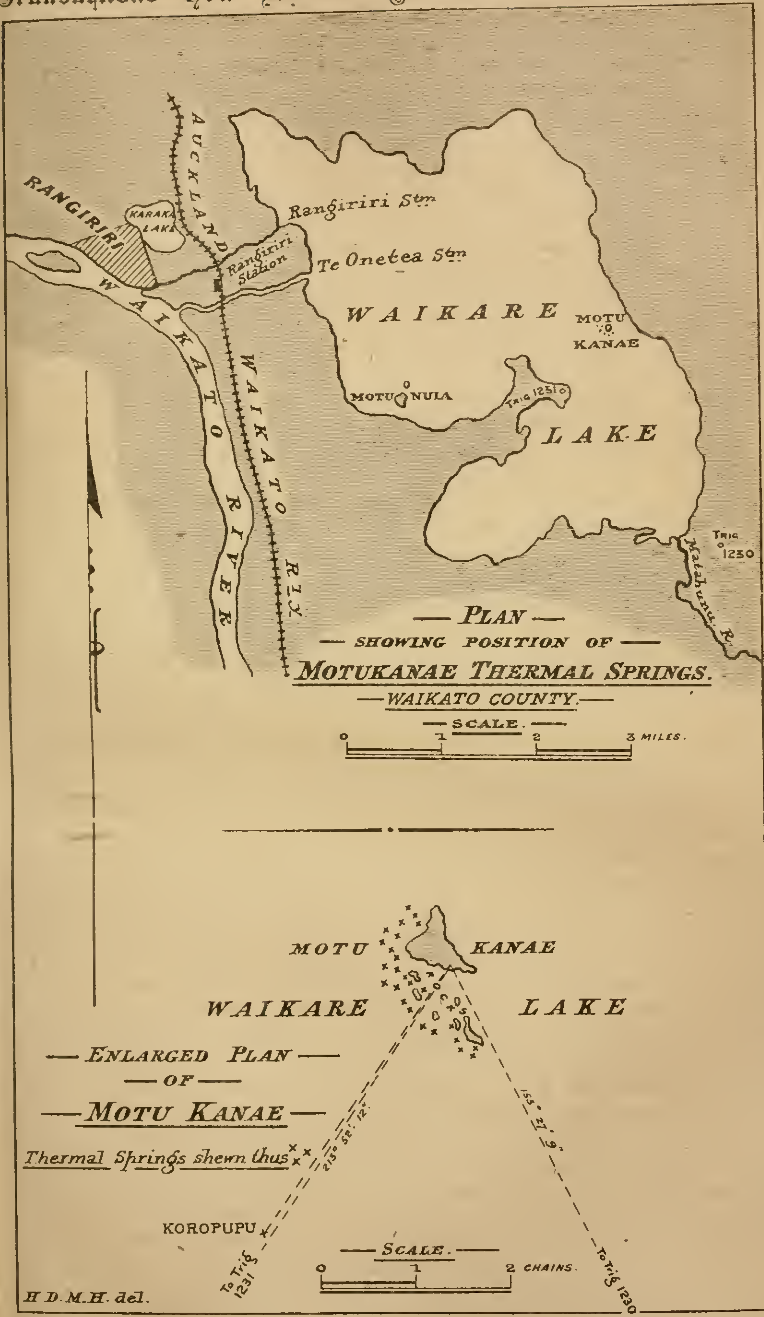
Art. LXI.—*On Vine-growing in Hawke's Bay.*

By the Rev. Father Yardin.

[*Read before the Hawke's Bay Philosophical Institute, 11th August, 1890.*]

When I had the honour to be admitted into your society I begged exemption from any literary or scientific contribution, having been condemned by sickness to suspend my favourite studies, and to avoid all serious mental exertion. It is then with hesitation that, yielding to kind solicitations, I have been persuaded, perhaps not wisely, to record a few remarks on a question of some interest to this province—namely, vine-growing in Hawke's Bay. The following remarks, written by fits and starts, are not a treatise on the matter, but simply the results of personal practical observations. Incomplete as they are, they may, perhaps, induce some industrious person to attempt the experiment.

My remarks do not refer either to vineries in hothouses, or to vines planted outside, along a wall, but to real vineyards, in the open air. These already exist in Hawke's Bay: some have been in full produce for many years past; some have been planted recently; and I am convinced that a great many more could be planted, even on a large scale, anywhere, under certain conditions. The principal points to which I shall refer are: a proper soil, a dry temperature, and a sunny exposure.


RANGIRIRI
KARAKA LAKE
AUCKLAND
Rangiriri Stn
Rangiriri Station
Te Onetea Stn
WAIKARE
MOTU KANAE
MOTU NUIA
TRIG 1231
LAKE
WAIKATO RIVER
WAIKATO RLY
TRIG 1230
Matahuru R.
PLAN
SHOWING POSITION OF
MOTUKANAE THERMAL SPRINGS.
WAIKATO COUNTY.
SCALE.
0 1 2 3 MILES.
MOTU KANAE
WAIKARE LAKE
ENLARGED PLAN
OF
MOTU KANAE
Thermal Springs shewn thus
213° 52' 12"
155° 27' 9"
KOROPUPU
To Trig 1231
To Trig 1230
SCALE.
0 1 2 CHAINS.
H. D. M. H. del.

1. *Soil.*—It is well known that the vine can grow in almost every soil; but to produce grapes fit for wine it requires an open soil with good drainage. Swampy lands, or lands exposed to periodical floods, or retaining surface-water, are unfit for grapes. The plant would not grow, or would soon decay and perish. Very high lands with hard clay are too cold, the grapes would not ripen.

With those exceptions the vine will thrive in any soil. On a rich deep land it grows luxuriantly, and produces abundance of large fruits; but the wine will often acquire a particular taste, sometimes disagreeable, and well known in France by the name of *goût de terroir.* Shallow dry soils will produce less grapes, but the wine is of a finer flavour. A sandy soil, as found in the Ahuriri plains and elsewhere, will form a good vineyard; but the slopes of hills are better suited for that purpose, wherever we find a calcareous, cretaceous, siliceous, or even volcanic subsoil. In France, and elsewhere, the vineyards most celebrated for the excellence of their wine are on stony soils: calcareous in Burgundy, along the Rhine and the Moselle; purely cretaceous in Champagne; rather marly around Bordeaux. In the best vineyards the land is so much covered with small stones that the soil itself has been completely hidden. It is, then, easy to understand how the grapes, receiving the action of the sun directly and through radiation, may attain their finest qualities. The vine is generally planted on the slopes of the hills; but when the declivities are too steep they are terraced, and vines planted on the patches of good land mingled with bare rocks. This mode of cultivation is used along the gorge of the Rhone, near Vienne, in France, and the wine produced there is well known by its superior quality, as *vin des côtes rôties.* The best claret, or Bordeaux wine, the best wines of Spain, Cyprus, and Hungary, are produced in the same manner.

2. *Climate.*—A very moist climate is not suitable for wine-making; nor is a mild climate the mean temperature of which is about the same all the year round, because the ripening of the wood as well as the fruit requires a considerable summer-heat continued for several months. This is the reason why vine-growing does not succeed well either in the south of England, or in the north-west of France, or in Belgium. On the contrary, we know of large vineyards producing excellent wine in the north-east, as in Champagne, along the Rhine and the Moselle, because the climate of those countries, though colder than in the south of England, is very hot in the summer months, even at night.

3. *Exposure.*—This condition supposes (1) an aspect sheltered both from the spray of the sea and the dampness of the valleys above which the vineyard may be planted, and from

the violent winds, most especially the cold south-west, to prevent the danger of frost in spring-time, or the injury of the young shoots and the grapes when they are already formed; (2) an aspect towards the sun, that the vines may receive in full the rays of the sun during all the day, if possible, or at least in the morning and at noon. It is by means of artificial shelter—for instance, a wall—that in countries unfit for large vineyards it is possible to have good grapes and even wine, if not in quantity, at least of a pretty good quality.

Now, by applying these conditions to Hawke's Bay, we may easily draw the conclusion that large tracts of it are eminently favourable to vine-growing. (1.) We have the proper soil in the greatest part of the Ahuriri plains, composed of sand or gravel, and which can be well drained; in the hills which surround them, and which are chalk-marls and limestones, or calcareous sands—and almost all the hills of the province are of the same formation. (2.) Our climate is warm enough, and even more than enough, in summer months to bring to proper maturity the plants and the grapes. The coldness of the nights may perhaps delay the development of the saccharine substance in the grapes, but it is easy to correct that defect by the means used in Australia. (3.) It would be the business of the vinegrowers to choose for the vineyards places well exposed to the sun, and protected from the dangerous winds and dampness. Many are those places, like the hills and valleys near Taradale, all over the province.

A fact will prove better than any argument the possibility of cultivating grapes and making good wine in Hawke's Bay. About twenty years ago, vines were planted in the garden of the Catholic Mission at Meanee for the purpose of making wine only for the service of the altar. The attempt was successful, and the small vineyard was increased to the extent of a little more than half an acre. The plants were of the best quality: Black Hamburg, White and Red Sweetwater, Chasselas, and Alexandria Tardif. They have produced every year a larger crop of grapes, which make wine of excellent quality. "When leaving New Zealand, Comte d'Abbans, the French Vice-Consul at Wellington, took with him some twenty bottles of 1885 to 1888 wine of different qualities, made at Meanee, and had it exhibited in his court at the Paris Exhibition. Unfortunately, owing to some omission of formality, the wine was not tasted by the jury: but the Comte subsequently obtained the opinion of some of the best wine merchants in Paris, who have unanimously pronounced it unmistakably superior to anything produced in Australia. They say that some of the wines are equal to the celebrated Cyprus brands, the red wines being very similar to the Hungarian or Tokay. One quality of wine tested was almost as sparkling; and the wine merchants state that any amount could be sold there in the best restaurants, provided it was produced in sufficient quantity. Comte d'Abbans is confident that Hawke's Bay could be made a great wine-producing district, as the dry climate is especially suitable to the cultivation of the grape. As collaborator to the Comte, Father Yardin, Superior of the Meanee Mission, has been awarded a silver medal." I have quoted from a Paris correspondent to a contemporary, whose name is unknown to me.

I need not enter into the particulars concerning vine-growing and wine-making: that would go far beyond the object I had in view in these simple observations. May it suffice to say that they both require a good practical knowledge, and a deal of careful labour, to secure a good return. With those conditions, an acre of land, planted with vines and in full produce, could bring to its owner a yearly income of two or three hundred pounds.

I beg to conclude by some remarks on the restrictive, or rather prohibitive, measures against the importation of grape-vines from foreign countries. Restrictions, to prevent the introduction of infected vines, were wise when the vines in the colony were free from any infection; but, now that the disease exists, what is the good of those prohibitions? It is absurd to shut up a sheep-pen when the wolf is already in. Those prohibitive measures are not only useless, but in contradiction of the intentions professed by the Government to favour vine-culture, and contrary to the interests of the colony, and, especially of the vine-growers, who could obtain from Europe or elsewhere the best kinds of grape-vines, perfectly sound. Perhaps they will do so, in spite of prohibition.

Art. LXII.—*Curious Polynesian Words.*

By Edward Tregear, F.R.G.S., F.R.Hist.Soc.

[*Read before the Wellington Philosophical Society, 23rd July, 1890.*]

Some years ago, when wishing to compare certain Maori words with those of other languages used on the Continents of Asia and Europe, one of the masters of modern philology assured me that the Maori tongue was not in a position for comparison. The Maori speech of New Zealand was but a dialect of the Polynesian language,* the conditions of which did not permit

* The Polynesians call themselves *maori* or *maoli*, as "natives;" but I shall, in this paper, confine the term Maori to its vernacular use —*i.e.*, applying it to the New-Zealander only.

it to be explored by the European linguist without much preparation and investigation. The only documents available presented to the philologist a broken and imperfect collection of vocabularies from the different groups of islands, in which even the mode of expressing the same sound varied. The European scholar, accustomed to the elaborate system of inflection and of general grammatical expression into which the oriental and classical forms of speech have crystallized themselves, needed a long and special preparation before he could grasp the mode or comprehend the genius of apparently simple tongues wherein shifting particles, arranging themselves about comparatively changeless major forms, were found to be capable of rendering very subtle and powerful modes of expression. Years of study would not enable the European to acquire the same insight into the delicacies of the Polynesian language that would be revealed to one resident among the people, and having a consequent acquaintance with the spirit of the spoken tongue. Added to this was the difficulty superinduced by the great dialectic differences: people inhabiting groups of islands scattered about the Pacific Ocean, thousands of miles apart in some cases, and holding little communication with each other, had in process of time developed speech quite unintelligible one to the other. Although the main words of each dialect are undoubtedly the same, and the system of grammatical construction very similar, still the loss of various letters and the substitution of others have created a confusion so great that the language of the Samoan or the Tongan is to the Maori the speech of a stranger and a barbarian. It remained for some Polynesian scholar to arrange and put into a form easy to manipulate, and to be comprehended at a glance, the various related words used in the different island-groups. The adventure may seem to be a bold one, and the power to achieve may have fallen short of the conception: still, I have, in my "Maori-Polynesian Comparative Dictionary," to offer as the result of years of untiring industry an original work to the Maori scholar and the European philologist. I trust that it may be merely the commencement of more full investigation into the comparison of the Oceanic languages, and I shall hail with delight more full research and new discovery in these almost unknown fields through which I have passed with the half-hesitation of an explorer.

Not a small part of my labour has been the correspondence required for the acquisition of necessary documents from friends (many of them personally unknown) at long distances from New Zealand; some of them dwelling in localities where communication with the outer world is both difficult and infrequent. I have received vocabularies, grammars, legends, songs, genealogies, &c., from all parts of the Pacific; and the pleasure which the accumulation and assimilation of this mass of new and curious information has given me kept the current of fresh interest daily flowing to refresh me through the long drudgery of the actual labour necessary for the production of a lexicon. I propose to lay before you some of the results of my work, and to share with others the pregnant suggestions which have unavoidably evolved themselves during consideration of the subject. Just as a comparative anatomist, taking the bodies of a dozen different creatures and laying them side by side, would find intense pleasure in comparing arm with wing, and muscle with muscle, and bone with bone, noticing the exquisite adaptations and dwelling on the curious differences, so I have found pleasure in laying side by side the *disjecta membra* of these Polynesian dialects, noting the coincidences, pondering over the discrepancies, and finding possibilities of historical research in the change of a letter or the metathesis of a form.

In the first part of my paper I will give an account of some of the interesting comparatives; in the second part I will attempt to show that it is possible that the Maori of New Zealand may not be properly understood at present in many of its words, and that the only way by which restoration can be attempted is the comparative method.

The races inhabiting the Pacific, broadly divided into the Polynesian, Melanesian, and Micronesian peoples, have among them a multiplicity of languages and dialects. The greater number of these are in the possession of the Melanesian people, the black-skinned and woolly-haired inhabitants of the Western Pacific. This people, occupying New Guinea, the Solomon Islands, the New Hebrides, New Caledonia, the Loyalty Islands, &c., have their eastern boundary in the Fiji Islands, which lie at the point of the wedge Melanesia drives into Polynesia proper, the home of the light-brown, straight-haired, level-eyed Polynesian. The Fijians, although the bulk of the people are of Papuan blood, have been crossed extensively by Polynesians from Tonga, especially on the coasts looking towards the Friendly Islands, and their language bears even more strong evidence of crossing than is betrayed by their physique. Nearly one-third of the Fijian language consists of Polynesian words, and of words in singularly pure and valuable preservation; but concerning the remainder of their vocabulary the Maori linguist feels himself in the presence of an utterly strange and foreign tongue. Had I to deal with a comparison of the Melanesian languages, it would indeed be a herculean task: I use the word "languages" advisedly, for they hardly appear to be mere dialects of a common language. In many cases Melanesians inhabiting different islands in the same group cannot understand or communicate with each other; and in the New Hebrides to such extremes is this differentiation carried that half a dozen different isolated languages are spoken on one small island in different villages. Not so with the Polynesians. Although the Samoan or Tongan dialect is incomprehensible to a Maori when spoken (and still more when written), the close correspondence of almost all vital words and the agreement in grammatical form prove that they differ only as the Devonshire peasant differs from a Glasgow weaver in speech based on a common Low Dutch dialect of the Teutonic branch of the Indo-European family.

Although the great bulk of my work has reference to Polynesian proper, still occasional words may be met with both in Polynesian and Malay which bear a very probable affinity with Maori words; and, although it cannot yet be decided which of these peoples have borrowed one from another, yet, as isolated words having resemblance to each other may be found from Madagascar to Easter Island, sometimes the interpretation given to these words by their possessors throws a startling light on possible derivations or primitive meanings.

The vowels, which have the Italian value, and nearly the same sound in all the islands, preserve a general purity and distinctness. In the examples I am about to select, a variation above the average may be found. In Maori itself a variant rendering of vowels may be found: *e.g.*, *tutai* and *tutei*, a spy (*a* and *e*); *inu* and *unu*, to drink (*i* and *u*); *kanapa* and *kanapu*, bright (*a* and *u*); *kanohi* and *konohi*, the eye (*a* and *o*).

The consonantal changes are as follows:—

Maori	H	K	M	N	NG	P	R	T	W	WH
Samoan	S, F	‘	M	N	G	P	L & N	T & L	V	F
Tahitian ..	H & F	—	M	N	—	P	R	T	V	F
Hawaiian ..	H	—	M	N	N	P	L	K	W	H
Tongan	H	K	M	N	G	B	L & N	T	V	F
Rarotongan ..	—	K	M	N	NG	P	R	T	V	—
Marquesan ..	H	K	M	N	K	P	—	T	V	F
Mangarevan ..	H & —	K	M	N	G	P	R	T	V	F
Paumotan ..	H	K	M	N	G	P	R	T	V	F

IKE (Maori) and IKEIKE signify *high, lofty*; PAIKEIKE, *to elevate*; HOIKE, *high, lofty*; POIKE, *to place aloft*. There are no Maori comparatives to show why IKE means *lofty*, nor is there any internal explanation in the formation of the word itself. Still less does there seem to be any connection with another meaning of IKE—viz., to *strike with a hammer* or other heavy instrument. If we consult the Polynesian comparatives, we shall find that in the dialects wherein the *k* is dropped (notably in Tahitian and Hawaiian) the corresponding words suggest a curious explanation and relationship. In Tahitian, IE is *the mallet for beating out the native cloth from bark;* it has also the same meaning in Hawaiian; but the Tahitian has also FAA-IE *to get a cloth-mallet,* and FAA-IEIE, *to act in a vain, foppish manner.* This is probably the relative of *high, lofty;* and this view is borne out by the Hawaiian HOO-IEIE, *to be ennobled; to be dignified; pompous; proud; vain-glorious.* Evidently the meanings are here, but the connection has yet to be made out between *beating with a hammer* and *proud, dignified.* In New Zealand we have a trailing or climbing plant named KIEKIE (*Freycinetia banksii*), and this was formerly, though rarely, used as a material for making clothing by the natives. In Samoa 'IE'IE means *a rag of cloth* and also the *Freycinetia.* IEIE, in Tahiti, is *the fibrous root* of the plant FARAPEPE, used for tying fences, making baskets, &c. In Hawaii IE means *coarse cloth, canvas, &c.; a vine* used in making baskets, also in decorating the person; *flexible, limber,* like cloth or a vine: IEIE, the *leaves of the* IE, formerly used in decorating the gods of Hawaii, generally made into wreaths; to be decorated with leaves, to be dressed in wreaths: HOO-IEIE, *to be ennobled, dignified, proud.* Thus it would seem that IEIE represents both IKEIKE and KIEKIE, and this can only be reconciled by the presumption that the original word was KIKEKIKE, the reason for being *proud* and *exalted* being that the person spoken of was likened to one arrayed in the wreaths such as divine personages were decorated with.

EHU (Maori), *turbid, muddy.* This word is allied to KAU-EHU, *muddy,* and perhaps to HU, *mud; to bubble up.* The corresponding words in Polynesian are similar. Samoan, EFU, *dust:* Tahitian, EHU, *discoloured,* as water by reddish earth; *muddy or disturbed water:* Tongan, EFU, *dust:* Mangarevan, EHU, *dust, ashes; trouble, commotion.* So far the direct correspondence. EHU, in Maori, has a second interpretation, that of *mist.* This is a much more interesting series of comparatives, especially in having a prefixed consonant, a variant of *r, l,* or *n.* In Maori we compare EHU, *mist,* with NEHU, *dust;* NEHUTAI, *sea-spray;* REHU, *mist, to doze;* REHUTAI, *sea-spray;* REHUREHU, *dimly visible;* PUNGAREHU, *ashes;* KAUREREHU, *dim, dusky:* Samoan, NEFU, *to be turbid;* LEFU, *ashes:* Tahitian, REHU, *ashes;* REHUFENUA, *haze over the land:* Hawaiian, EHU, the *spray* of the surf, the *steam* of boiling water; EHU-EHU, *darkness* arising from dust, fog, or vapour; HEHU, *mist* or *vapour;* KUEHU, *to shake the dust* from a mat; LEHU, *ashes:* Tongan, EFU, *dust;* EFUEFU, *ashes;* EFUHIA, *dusty;* AFU, the *spray* or *mist of the sea* when breaking on the shore; NENEFU, *dusky, dim.* We see here a complete interchange of ideas, not only small particles of earth as *dust* and small particles of water as *mist* being expressed by variants of the same word, but the notion of dusk and darkness being conveyed at the same time. The most singular application of the word is the exactly opposite meaning to "darkness" conveyed by one series of forms: thus, as KEHU, *fair, bright.* I have not yet found KEHU in Maori standing alone, but it may be traced in its compounds—viz., MAKEKEHU, *light-haired*, and URUKEHU, *light-haired.* The Polynesian shows this to be a strong secondary meaning. Samoan, 'EFU, *reddish-brown:* Tahitian, EHU, *red or sandy-coloured*, of the hair; ROURUEHU, *reddish or sandy hair:* Hawaiian, EHU, *red or sandy hair, ruddy, florid;* EHUAHIAHI, *the red of the evening*, or *old age;* EHUKAKAHIAKA, *the red of the morning*, or *youth:* Tongan, KEFU, *yellowish*, applied to the hair: Marquesan, KEHU, *fair, blonde;* HOKEHU, *red hair;* OIOIKEHUKEHU, *daybreak:* Mangarevan, KEUKEU-KURA, *blonde, fair:* Paumotan, KEHU, *blonde, fair-haired.* A single Tongan word probably supplies the missing link between *dusky, dusty*, and *fair-haired:* we have EFU, *dust*, but EFUI, *to wash the hair during the process of dyeing it.* In Polynesia, Malaysia, and Melanesia the custom of bleaching the hair with a preparation of lime or wood-ashes is in common use, and, if the idea of *ashes* is connected with that of *fair-haired*, it is easy to see how the tertiary meaning of *bright, fair as dawn*, &c., arose.

ENGARI, *it is better thus, it is more advantageous.* This word has a transposed form, ERANGI, less commonly used. It is evident by noting the comparatives that ERANGI is the most correct form, for, considering it as a compound of the word RANGI, *a chief*, we find in Hawaiian that, while the equivalent LANI means *a chief*, an expression equal to "your Highness," and is applied to anything noble, anything exalted or lofty, either in actual height or in dignity of character, a much less known form—viz., NALINALI, *to be or act the chief; bright; strong; royal*—furnishes exactly the same transposition as in Maori. Thus we may well feel assured that ERANGI meant originally—not *it is better*, but—*it is noble, chief-like*, to do so and so.

KUPU, *a word.* Two of the Polynesian dialects support the Maori reading. Samoan, 'UPU, *a word; speech; language* ('UPUTU'U, *a tradition:* MAU'UPU, *to have a command of language:* 'UPU'ATAGIA, *facetious*). So also the Tongan KUBU, *a speech, a saying.* On the other hand we have Tahitian UPU, *a prayer; a set of prayers* addressed to the gods by priests, or to the demons by sorcerers: HUAUPU, *fragments of old Tahitian prayers:* and UPUTARA, *a prayer or imprecation* of a sorcerer to procure evil. Hawaiian, UPU, *to swear or vow*, as when a man vows not to eat the food of his land till he catches a certain fish. Marquesan, kupu, *to insult, to affront.* Moriori, kupu, *to bewitch.* It seems difficult to connect these meanings of *oath, invocation, insult,* with *a word* or simple *speech*, but a probable key is given in Mangarevan, where we find that kupu means *an imprecation, a curse:* kupukupu, *to utter terms of hatred; to demand the entrails,* &c., of another, as "I will have your bowels!" If this was the original idea, then probably kupu is a transposition of puku, *the belly.*

KAIPUKE, *a ship.* Many ingenious and many wild guesses have been made as to the etymology of kaipuke, which is apparently a native word for a modern and foreign object. Good Maori scholars have not been ashamed to assert that the meaning was kai, *to eat;* puke, *a hill;* because the sails of the ships seemed to hide or devour the hills (ships were first seen, however, off the coast) as they passed. The word is more probably a survival of some Polynesian form, still partly preserved in Tongan, wherein buke means *the deck* of a canoe; the *outworks* of a fortress: faka-buke, covered with a deck; to cover over a paddling-canoe fore and aft. Thus kaipuke, as *a ship*, in distinction from an open canoe, is almost certainly "*that which has a deck.*"

KOI, *sharp*, as a blade or point: koikoi, *a point of land; a spear; thorny.* All Polynesian dialects, except Samoan, have the word with the same meaning. Tahitian, oi, *sharp*, as the edge of a tool; faa-oi, *to grind or sharpen* a tool. Hawaiian, oi, *the sharp edge or point* of a weapon; hoo-oi, to be *sharp*, as an axe, knife, or spade; oilua, *two-edged.* Rarotongan, koi, *sharp.* Mangarevan, koi, *pointed;* to cut to a sharp point: takoi, the crest of a mountain. A curious, but doubtless natural, employment of the word is in the sense of our idiom "*to look sharp,*" *to be quick, urgent.* Tahitian, oioi, *rapid, swift, quickly, briskly.* Rarotongan, kokoi, *quick, sharp, speedy.* Mangarevan, kokoi, *to hasten.* Paumotan, koikoi, *urgent, quick, precipitancy;* koikoimau, *sudden, unexpected.* There is a singular but doubtful comparative in the Hawaiian koi, *an axe.* As the Hawaiians lose the Maori *k* and change *t* to *k*, this word koi, *an axe*, really represents the Maori toki, *an axe*, and is perhaps only a coincidence to the eye; but, as the same Hawaiian word koi also means *a sharp voice*, it may be one of the few words unaffected by letter-change common to these two dialects.

KEROKERO, *to blink the eye, to wink:* kekero, *to look out of the corner* of the eye, has probably contracted its meaning somewhat. Mangarevan, kero, a *large extent* of land: aka-kero, *that which disappears; to see in a confused way; not plainly visible* on account of the great distance; *to look with one eye,* closing the other. This gives us a wider meaning, and suggests a reason for winking the eye.

KAO, dried kumara (sweet potatoes). Hawaiian, AO, dried taro, used as food. Tongan, KAKAO, to bore or thrust with the finger. Mangarevan, AKA-KAOKAO, to take food out of a hole on one side without touching the other. These meanings seem unconnected; but the Maori KAO was made by scraping with the fingers or a stick among the young kumara tubers and taking them away to be dried into KAO, while the plant was earthed up again, and the other tubers left to come to maturity.

MAHARA, *to think of frequently; to meditate upon.* These meanings are supported by Tahitian MAHARA, *to recollect,* and Rarotongan MAARA, *to consider,* but give us no clue to the composition of the word. In Hawaiian we find MAUHALA, to *keep up a grudge* against any one; *to remember his offence; envy, revenge, malice:* HOO-MAUHALA, *to lay up or remember the offences* of any one. In the Hawaiian, MAU means *to endure,* to continue, *to repeat* often and frequently; with HALA, *a sin, a trespass, an offence:* and Maori HARA is *a sin, an error,* with MAU, to *lay hold, to be steadfast* (strengthened by Maori MAUAHARA, *to cherish ill-feeling*). Thus it is probable that MAHARA originally meant not simply *to think of frequently,* but *to keep in remembrance another's fault, to bear a grudge.*

HURUHURU, *coarse hair, bristles, feathers.* This word is of very wide distribution, and in its meanings of coarse hair, wool, feathers, &c., is known in almost every part of the Polynesian, Melanesian, and Malay Islands. Samoan, FULU; Tahitian, HURU; Hawaiian, HULU; Tongan, FULUFULU; Rarotongan, URU; Marquesan, HUU; Futuna, FULU; Fijian, VULU; Malay, BULU; Javan, WULU; &c. I do not propose to bring to your notice any particular form of this word, but to call your attention to a singular instance of letter-change in a word of which HURU forms a part, and where likeness has been well concealed under outward unlikeness. This is the comparison of the Malagasy word VORONDOLO, *an owl,* with the Maori RURU, *an owl.* The people of Madagascar, inhabiting an island near the African coast, have in their language strong affinities, not with the Africans, but with the Malays. Many ingenious theories have been started to account for this community of language (or portions of language) between races separated by so vast an extent of ocean, but with these theories we have at present little to do. It is enough to say that there are such word-likenesses between the Malay and Malagasy people. The Malagasy VORONDOLO may be dissected thus: √ VORO, *a bird;* VORONA, the generic name for *bird;* VOROMAHAILALA, *a pigeon;* VOROMBOLA, *a peacock;* &c.. The *v* stands for Maori *h,* as VOA, *fruit,* for Maori HUA, *fruit;* VORIVORY, *round,* for HURI, to turn round. It will be noticed in above examples that (as Malagasy has no *u*) *o* stands for

Maori *u*, as it also does in TONA, a kind of *eel*, the Maori TUNA, *an eel*. Thus VOLO is equivalent to HURU, and the word is apparently applied to a bird as "the feathered" creature. The second part of the word, NDOLO, should be compared with the Fijian, where *d* is always sounded *nd*. So we get DOLO for DULU. *D* is the Maori *r* (which was written as *d* by early missionaries, who wrote Maori RUA, *two*, as DUA), and compares, as Malay DUA, *two*, with Maori RUA, *two*. Therefore DULU is equal to RURU. Then, putting the whole word together, we get HURU-RURU, the "owl-bird" (as in the other comparatives, "*peacock-bird*" and "*pigeon-bird*"), instead of VORONDOLO; and the coincidence with Maori RURU, *an owl*, is very marked.

HOA, *to aim a blow at by throwing*. Cf. NGAHOAHOA, *headache;* PAHOAHOA, *headache*. We shall find by the comparatives that the word generally means a fracture of the head. Samoan, FOA, *to chip*, as a hole in an egg-shell; *to break*, as a rock; *to break the head; a fracture of the head*. Tahitian, HOA, *the headache; to grasp* as an antagonist; *a wrestler:* MAHOAHOA, *a violent headache*. Tongan, FOA, *to fracture; to crack; to make an opening:* FOFOA, *to crack into small pieces; a good spearsman:* TAFOA, *to break, to crack:* FOAAGA, *a litter, a brood* (from chipping the egg-shell). Marquesan, HAHOA, *to beat bark* for native cloth. Mangaian, OA, *to strike*. Ext. Poly.: Malagasy, VOA, *to be struck, to be wounded*. The Hawaiian form suggests a curious etymology. Thus: HOA, *to strike on the head* with a stick; *to beat; to make native cloth* by beating bark on a stone with a stick; *to drive* as cattle. The last meaning is the vital one. The Maori prefixed causative WHAKA, to cause to do, to make to do anything, is represented in Hawaiian by HOO (*i.e.*, HOKO, with a lost *k*), and this is sometimes abbreviated to HO, as in HO-AUAU, *to wash the body* (for WHAKA-KAUKAU). If A is the verbal root of HO-A, we have the Hawaiian HO-A, *to drive* as cattle, equalling the Maori A, *to drive*—a connection before unthought of.

HONO, *to splice; to join; to unite*. This meaning is fully borne out in the other dialects, even when carried out into more abstract relations as to making agreements, &c. Samoan, FONO, *to hold a council, to patch, to inlay;* FA'AFONO, to gather to a meeting; LAUFONO, *a plank* of a canoe; TAFONO, to join the planks of a canoe. Tahitian, HONO, *to splice a rope, to join pieces of wood*; HONOA, *an agreement;* PAHONO, *to splice or join;* TAHONO, *to join together*. Hawaiian, HONO, *to join, to unite together;* MAKUA-HONOAI, *a parent by marriage;* PAHONO, *to sew up* as a rent. Mangarevan, HONO, *to adjust or place* sticks; *to lengthen* by splicing on another piece. Ext. Poly.: Fiji, VONO, *the joints* or pieces of which the body of a canoe is formed. We get a possible hint at the meaning of this word by considering the Marquesan HONO, a turtle. The Tongan FONO means *a piece of wood, ivory, &c., inlaid;* FONOFONO, *to inlay;* Samoan, FONO, *to inlay, to patch.* This suggests that the splicing-together, inlaying, &c., may have been inlaying with tortoiseshell, or, more probably, the piecing-together as the plates are set in a turtle's armour. This leads us to the consideration of the next word.

HONU, *deep;* HONUHONU, *deep water;* HOHONU, *deep.* The Marquesan form, HONO, *a turtle,* stands alone. Tahitian, HONU, *the sea-turtle;* HONUOFAI, *the land-tortoise:* Hawaiian, HONU, *the turtle:* Tongan, FONU, *the turtle:* Mangarevan, HONU, *the turtle.* These dialects also have the subrepeated form as full or deep—viz.: Tahitian, HOHONU, *deep, profound; the depths.* Hawaiian, HOHONU, *to be deep,* as water*; the deep sea.* Tongan, FONU, *full, fulness;* FOFONU, *full,* applied to vessels. Marquesan, HOHONU, *deep, profound.* Mangarevan, HOHONU, *the deep sea, the high seas;* HURUHOHONU, *high tide;* VAHIHOHONU, *a deep place in the sea.* Aniwan, FONU, *to be full.* Ext. Poly.: Motu, HONU, *to be full.* It seems irresistible to connect this notion of the *deep sea* having given a name to the *sea-turtle,* or else that the *turtle* has given a form of its name to the *deep sea:* the words are regular and persistent, with little or no variation.

WHENUA, *land.* The word HONU, *the deep sea,* would at first sight seem to bear little relation to the general Polynesian word for *land.* WHENUA varies more in its vowel values than perhaps any other word in our comparative vocabulary. It is the Samoan FANUA, Tahitian FENUA, Tongan FONUA, Rarotongan ENUA, Marquesan FENUA, Mangarevan ENUA, Futuna FENUA, Aniwan FANUA, Paumotan HENUA. Outside Polynesia proper, among Malays and Melanesians, the word varies as VANUA, BENUA, BANUWA, BANUA, VANUWA, VANUE, &c. The Hawaiian HONUA means *the earth; a country; flat land; a foundation; the bottom of any deep place,* as of a pit, of the sea, &c.; thus apparently making HONUA a derivative from HONU, *deep.* The evidence by agreement of the majority of the dialects as to their vowel sounds is against the Hawaiian HONUA and the Tongan FONUA, but nevertheless these may have kept the original form lost by the other dialects, their form having an apparent reason for its construction, whilst that of the other variations has yet to be found.

TAUREKAREKA, *a slave; a rascal, a scoundrel.* There is no such meaning to be found in the other island dialects. In Samoan TAULE'ALE'A is *a young man:* in Tahiti TAUREAREA means the *young, healthy, and vigorous* of the people. In Tongan TOULEKALEKA is *a beauty, a handsome man; goodly; well-proportioned.* Ext. Poly.: In Sikayana TAUREKAREKA is *handsome.* There is evidently a remarkable reversal of meaning in the New Zealand word, exactly akin to the European degradation of the word SLAV, *glorious* (a member of the Slavonic race), into our English *slave*. If the process by which TAUREKAREKA was thus degraded could be traced, it would doubtless have historical value.

RAUMATI, *summer*. The meaning of MATI is *dry; shrivelled; a dry branch:* and, as RAU means *leaf*, it would be perfectly natural without any great flight of imagination to give, as the derivation of RAUMATI, *summer*, "the time of shrivelled leaves."*

The comparatives, however, suggest caution. We have the Samoan NAUMATI, *dry, destitute of water :* MATI, *stale*, as water that has been kept for some time, or cocoanuts picked some days before. Tahitian, RAUMATI, *to cease from rain, to hold fair*, applied to the weather. Mangarevan, NOUMATI, *dryness, sultry, hot.* Marquesan, OUMATI, the sun. The meaning *destitute of water*, &c., brings us to the Hawaiian LAUMAKE, *the abating or subsiding of water, i.e.*, a drought : LAU, *the expanse ; the sea*, and hence *water* (obsolete). So we find that RAU is an old Polynesian word meaning *water*, and that RAU-MATI means—not *the shrivelling of leaves*, but—*the drying-up of water :* a lesson to us on hasty etymologies not based on comparative studies.

WHAKA-IRO, *to carve ; to adorn with carving ; tattooed.* I have remarked in former papers that there is a high probability that the Maori or Polynesian people have formerly known a much higher state of civilization than at present, and that evidence to that effect was to be found in the manner in which some of their words are used. Expressions relating to tattooing (forms of TA and TAU) also mean *to print, to paint* or *mark on the skin ; to make letters, to count, to designate ;* "*to print upon native cloth* as in former times;" *to put down for remembrance, to reckon descent, genealogy, to give publicity, to rehearse in the hearing of another* that he may learn, *to appoint boundaries*, &c.; the obvious inference being that the tattooing or printing was not for mere ornament, but was at some time an actual writing. Whaka-iro, *to carve*, is generally applied to *wood-carving*, but is, in an obsolete sense, used for *tattooing*. I will give as an example the line in Sir George Grey's "Polynesian Mythology" referring to the strife between Manaia and Ngatoro-i-rangi, when Ngatoro destroyed the host of his enemies in a storm raised by his incantations. Among the corpses of the drowned the body of Manaia was

* One author has done this, spelling the word incorrectly (RAU-MATE), in his usual fashion. The form he gives—viz., RAU, *a leaf;* MATE, *dead*—would be more suggestive to a European than to one living in New Zealand, where the native trees do not shed their leaves in summer or autumn (with one exception).

recognized by the tattooing (WHAKA-IRO) on his arm (page 94, Maori part). In Polynesia, WHAKA-IRO is not used in any way to denote *carving;* it has a far higher value. Samoan, FA'A-ILO, *to show, to make known.* Hawaiian, HOO-ILOILO, *to predict, to guess.* Tongan, ILO, *knowledge, understanding:* ILOGA, *a sign, a mark:* FAKA-ILOILO, *to distinguish, to call to mind:* ILOHELE, *cunning,* as a bird that knows the snare: TAIRO,* *to mark, to point out, to select:* TAIROIRO, *a soothsayer; to foretell.* Mangaian, TAIRO, *to mark, to take notice.* Mangarevan, AKA-IROGA, *a sign, a mark; to mark, to make a sign.* Aniwan, IRO, *to know.* Paumotan, TAIRO, *to mark, to stamp.* It is evident that these references to *knowledge, marking, distinguishing, foretelling,* &c., do not refer to ornamentation by carving, but have a far more subtle bearing on the real meaning of WHAKA-IRO. It may be that our word WHAIRO (*wha-iro*), *imperfectly understood, dimly seen,* may have been coined (or shortened) from WHAKAIRO, at a time when the true signification of the word was becoming obscured and dying down, until the *writing* assumed the appearance of mere unmeaning ornament and fanciful design.

ROMI, *to squeeze; to plunder; infanticide.* We have—Samoan, LOMI, *to squeeze; to knead gently:* Tahitian, ROMI, *to press and rub the limbs* when weary or in pain: Hawaiian, LOMI, *to rub; to squeeze with the hand* any one that is in pain or fatigued: Mangarevan, ROMIROMI, *to rub:* Mangaian, ROMIROMI, *to press.* In all these forms the leading idea is *to shampoo, to rub with the hand,* to relieve weariness or pain by massage. This meaning of *pressure* or *squeezing* is extended in two directions: one in that of gentleness, as in the Nguna ROROMI, to love; the other in that of cruelty, as in Tongan LOMI, to push and keep under; LOMILOMI, *to punish captives taken after war, to quell, to keep down;* in the Paumotan ROROMI, *to oppress;* and in the Maori ROMI, *infanticide.*

MUA, *the front.* This word is well preserved in all the dialects, and preserves nearly the same meaning everywhere. There is, however, a possible connection between MUA, *the front, the forepart,* and MATA, *the face.* In Hawaiian, MAKA is *the face;* in Malay, MUKA is *the face;* and in Madura (near Java), MUA is *the face.* It is possible that MUA has worn down from MATA, as MAKA, MUKA, MUA.

MANGERE, *lazy.* No similar form appears in any other dialect, but in Hawaiian the corresponding word MANELE means *a species of palanquin; to carry* on the shoulders of four men, as a palanquin or sedan-chair. Formerly the palanquin was used as a means of conveyance by great chiefs, until one very corpulent and irritable personage was thrown down a

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* A combination of IRO with TA, *to tattoo.*

precipice by his bearers. Palanquins (FATA) were also used in Samoa; but in Tahiti the king or any exalted person rode on the shoulders of a man. If the Maori word MANGERE, *lazy*, was a general word for *lazy*, it should show itself in some of the other dialects, but does not.

TAREPAREPA, *to flap in the wind, to flutter*. Several Polynesian words are akin to this both in sound and meaning. Tahitian, TAREPA, *to shake or flap*, as a loose sail in the wind; TAREPAREPA, *to shake repeatedly*. Hawaiian, KALEPALEPA, *to flap*, as the sails of a ship; *to flap in the wind*, as a flag or ensign. Paumotan, TAREPAREPA, *to shake, to shiver, to tremble*. But the Hawaiian KALEPA, *peddling, hawking, to sell merchandise from place to place*, introduces us to a new phase of meaning. It arises from the custom of flying flags on canoes as a signal that those on board have something to sell, and is a compound of LEPA, *a border, a hem or fringe of a garment, an ensign or flag*; LEPALEPA, *a torn fragment of native cloth*, used as a flag. The Samoan LEPA, *to lie to*, as a vessel, and the Tongan LEBA, *to heave to, to put the head of the canoe into the wind*, may be connected with either meaning—either *to lie to*, having something to sell as merchandise, or from the flapping of the sail when the bow of a vessel is brought up into the wind. There is a possible connection of TAREPAREPA with REWA, *to float*, the Tahitian REVAREVA meaning *flying*, as many flags.

KOKIRI, *to dart or thrust any long body end-foremost; to charge*, as a body of men. None of the Polynesian comparatives seem equivalent to the Maori, although the Mangarevan ETU-KOKIRI (for WHETU-KOKIRI), *a shooting-star*, shows some correspondence of meaning. There is nothing in the composition of the word itself to give an explanation of its etymology. Looking to the constant interchange in Maori-Polynesian dialects of *k* and *t*, it is almost certain that TOKIRI, *to shove, to thrust lengthwise*, is a variant of KOKIRI. The Tahitian TOIRI, *to drag a log, bark and all*, explains the etymology at once; the Maori TO, *to drag*, and KIRI, *the bark or skin*; although few would have suspected this to have been the primitive meaning of KOKIRI.

UA, *rain*. This word is well and faithfully represented in all the dialects, UA meaning *rain* in Samoan, Tahitian, Hawaiian, Rarotongan, Marquesan, Mangarevan, &c., and UHA *rain* in Tongan. The origin of this word and its radical does not appear directly in any of these, but the Hawaiian U means *the breast of a female; to ooze, to drip, to drizzle*, as rain. In Maori and in almost all Polynesian dialects the word U means the breast, and its compounds *milk*, even when U itself does not mean *milk*. The Maori form is WAIU (WAI-U); the Tahitian, U, *milk;* Hawaiian, UI, *to milk;* Rarotongan, U, *milk;* Tongan, HUA, *milk;* GAHU, *damp, moist;* Malay, SUSU, *milk.* If we acknowledge that U means in a general sense *to ooze, to be wet, to drip,* we have then to find the *a* of UA. We shall be accused of a poetical flight perhaps if we assert that it is probably a worn-down form of RANGI, *the sky* (Marquesan, ANI), and that UA may have formerly been URANGI, "*heaven-milk*" (or "*sky-drip*"?). The comparatives in the Malay Archipelago certainly point in that direction. The Malay form of RANGI, *the heavens,* is LANI, and we find in Cajeli, ULANI, *rain;* Camarian, ULANI, *rain;* Teor, HURANI, *rain;* Baju, HURAN, *rain;* Wahai, ULAN, *rain;* Bisaya, ULAN, *rain;* Gah, UAN, *rain;* Api, UA, *rain.* Here we can trace geographically at the present time each form of the word still in existence—U-LANI, U-LAN, U-AN, U-A, UA—a very extraordinary thing; and this abrasion of important words leads me to the consideration of the second and briefer part of my paper.

PART II. A POSSIBLE RECONSTRUCTION OF MAORI.

While searching for comparatives of Maori words in the other dialects, I took each dialect separately, and, in going through it, thoroughly indoctrinated myself into the systematic letter-change common to that particular dialect and to Maori. Thus, in reading Marquesan, wherein the letter *r* is almost wanting, it is necessary to mentally prefix an R to any word beginning with a vowel, or to insert an *r* between two vowels standing together, on the chance that *r* may here be a missing letter. Thus, *hae,* a house, with *r* inserted between *a* and *e,* becomes HARE, evidently the equivalent of the Maori WHARE, a house; IMU, *sea-moss,* is the Maori RIMU, *moss;* &c. In Hawaiian the *k* is lost, and, seeing PUE, *a hill,* I know it for the Maori PUKE, *a hill:* AI, *the neck,* is the Maori KAKI (*kakì*), *the neck.* (This in addition to the change of *k* for *t* which makes the Hawaiian KAKAA, *to roll* = Maori TATAKA, &c.) The Tahitian has a double loss; both *k* and *ng* are gone, and one has to read in either or both: thus the Tahitian AO, *fat,* is the Maori NGAKO, fat; the Tahitian AAU, *the bowels,* is Maori NGAKAU, *the bowels;* AA, *to insult,* is the Maori KANGA, *to curse.* So accustomed does one grow to the reading-in of missing consonants that the eye is apt to play one false, and it is difficult to write the dialectic word without making a mistake. But reading these consonants into the Polynesian words, and having before me constantly the idea that the original state of language was that "of open syllables of one consonant followed by a single vowel, or of a single vowel," I have unavoidably come to the conclusion that, although the Maori of New Zealand is by far the best preserved of all Polynesian dialects in its conservation of consonants, yet it is almost impossible for one trained in comparative study of words not to read in a lost consonant in Maori between a pair of vowels, or as the initial letter of a word commencing with a vowel. This lost consonant may be any consonant, but the most probable letter to try with is *k*.

First, we will notice those words where *k* is sometimes used, sometimes not:—

Maori.	
MAOA, *cooked*	Maori—MAOKA, *cooked*.
APITI, *a cleft*	„ KAPITI, *a crevice*.
AHUA, *appearance*	„ KAHUA, *appearance*.
ITA, *fast, secure*	„ KITA, *fast, tight*.
PAIAKA, *a root*	„ PAKIAKA, *a root*.
UA, *firmness*	„ UKA, *to be fixed*.
AKE, *upwards*	„ KAKE, *to mount, to rise*.
AHORE, *no; not*	„ KAHORE, *no; not*.
PUREI, *isolated tufts of grass* ..	„ PUREKIREKI, *tufts of grass*.
ATAE, *how great!*	„ KATAE, *how great!*

Also, having probable relation,—

Maori.	
TUI, *to pierce*	Maori—TUKI, *to thrust*.
APO, *to grasp*	„ KAPO, *to snatch*.
ORI, *to cause to wave to-and-fro* ..	„ KORIKORI, *to move, to wriggle*.
OKO, *a bowl*	„ KOKO, *a spoon*.

Probable Lost Letter.	Maori.	Probable Comparative.
K ..	UI, *to ask*	Tongan, UKI, *to inquire*.
K ..	WAO, *a nail*	Fijian, VAKO, *a nail*.
H or S ..	WAE, *to divide*	Fijian, WASE, *to divide*.
T or H ..	KANAE, *the mullet* ..	Fijian, KANACE (kana*the*), *the mullet*.
K ..	TAE, *to arrive*	*Cf.* Tahitian, TAATAE (*tangata-ke*, "*strange man*"), *a stranger*.
N or NG ..	TEITEI, *high up*	Tahitian, TENITENI, *exalted;* Mangarevan, TEKITEKI, *exalted*.
TH or S ..	AMA, *an outrigger* ..	Fijian, CAMA (*th*ama), *an outrigger;* Rotuma, SAMA, *an outrigger*.
T.. ..	RAU, *a hundred*	Solomon Islands, LATU, *a hundred*.
W ..	TOU, *the anus*	Fijian, TOVU, *the rump*.
R ..	AITU, *a deity*	Tahitian, RAITU, *the name of a deity* (for RANGI-TU).
K ..	URU, *the head* in Maori and Samoan; *the head* and *breadfruit* in Tahitian; *breadfruit* in Hawaiian; *head* in Paumotan	Sikayana, KURU, *breadfruit*.
R ..	TUTAI, *a scout*	Tahitian, TUTARI, *to lead, to conduct*.
H ..	VAO, *forest;* MOHOAO, "*man of the woods*" (for MOHO-VAO)	Mangarevan, TARAVAHO, *savage* (*cf.* Maori, WAHO, *outside*).

Probable Lost Letter.	Maori.	Probable Comparative.
TH ..	IWA, *nine*	Fijian, CIWA (*th*iwa), *nine*.
H or TH ..	MOE, *to sleep*	Fijian, MOCE (mo*th*e), *to sleep*; Tongan, MOHE, *to sleep*.
R ..	MAUA, *we two* (RUA, *two*)..	Marquesan, UA, *two*.
R ..	MATOU, *we* (*many*), (TORU, *three*)	Marquesan, TOU, *three*.
H ..	IHI, *to hiss*	Maori, HIHI, *to hiss*.
K ..	IWI, *a bone*	Samoan, 'IVI, *a bone*.
R ..	MAI, *hither*	Malay, MARI, *to come* (Aniwan, MY, *to come*; Sula, MAI, *to come*; Gani, MAI, *to come*; New Britain, MAI, *to come*, &c.).

These are a few examples selected to show that there is a high probability of lost consonants being capable of being replaceable in Maori. Of course, there is a possibility that consonants may be excrescent (*i.e.*, for instance, that AI may be the true form of the word for *neck*, and the *k*s of KAKI an aftergrowth); but this is very unlikely, because it is hard to suppose that many dialects in introducing consonants would have chanced upon the same consonant in almost every instance; the loss is far more probable than the gain. But enough has been shown to prove it unlikely that the Maori is quite the primitive, simple, virgin language which some have supposed it to be.

ART. LXIII.—*The Rainfall of New Zealand.*

By JOHN T. MEESON, B.A.

[*Read before the Philosophical Society of Canterbury, 7th May and 5th June, 1890.*]

Plate XLV.

PART I. THE AMOUNT AND DISTRIBUTION OF RAIN.

FOR the past twelve months or so we in New Zealand have been suffering from a spell of dry weather almost throughout the length and breadth of the colony. We cannot call it a drought, for that term would be altogether too strong. But the rainfall has been considerably below the average almost everywhere, and in some cases, as will appear when the statistics are published, remarkably so, a deficiency of over 25 per cent. being not infrequently recorded. The selection, therefore, for our consideration to-night, of such a subject as our rainfall would seem not inappropriate. For, when a little loss or inconvenience comes from weather of any kind, our agricultural and pastoral fellow-colonists are, as a rule, inclined to complain, and permit themselves, while experiencing the exceptional, to lose sight of the usual. When the skies for a few months consecutively fail to shower down their customary blessings, it is well for us to remember that, ordinarily, we in New Zealand are exceedingly fortunate as to both the annual amount and the general distribution of rain.

Among the factors which go to make up the climate of a country—of which heat, atmospherical pressure, wind, and rainfall may be considered the principal—not the least important, whether we take into account its effects on animal or vegetable life, is the rainfall. Not the amount alone, be it remembered: the manner in which the precipitation occurs—in other words, the number of days on which it falls—is almost as important a consideration as the mean annual number of inches. But the amount and distribution of rain, considered together, can scarcely be over-rated as factors producing human happiness. They explain the difference between the comparative barrenness of Australia and the fertility of New Zealand, the soils of the two countries being perhaps, as far as chemical and mineral constituents are concerned, equally good. Not only the productivity of the ground, but the healthy development of animals, whether lower or higher, and the enjoyment of existence by human beings, all depend upon the rainfall and its distribution.

All the different branches of meteorology are so intimately connected with one another that no single element of climate can be satisfactorily examined by itself. The weight of the air, the amount of moisture which it contains, the direction from which it comes, the velocity with which it moves, its electrical condition, and its temperature—these things really form the subject-matter of other departments of the science of weather, but they must be considered more or less in connection with the rainfall if we wish to understand it properly.

Any investigation of the rainfall of New Zealand, however, must of necessity be imperfect and unsatisfactory, because rain-gauges have been kept and properly used at so very few places and for such a short period of time; whereas, for mean annual statistics of rain, the greater the number of stations and the longer the period during which observations have been made, the more trustworthy the results will be. How different our position in this respect is from that in other parts of the world will be appreciated when we reflect that there are only three places in our colony where systematic observations are regularly taken by officers paid by Government, and only nineteen additional places where such observations have been recorded more or less intermittently, and for longer or shorter periods, within the past thirty years:* whereas in the United States there were, in 1882, 1,200 stations, and a few years earlier in Great Britain 2,200. To secure, continuously, careful daily observation of meteorological phenomena you cannot calculate in a young country like this upon the voluntary assistance of persons whose means, inclination, ability, and leisure prompt them to gratuitously gather statistics for the common benefit. It is therefore imperative that the work should be undertaken by the Government. Not that it is desirable to thoughtlessly increase still further the State functions. There has been far too much of that kind of thing already amongst us. But such work, of really trifling cost, as is not likely to be undertaken by individual effort or social co-operation, and is yet called for in the interests of the community, is precisely what the State should undertake, and do thoroughly. Something has, of course, already been done, but not nearly enough. In regard to our weather-forecasts perhaps less might be attempted without much loss being inflicted on the community; and the money saved by the suppression of the Weather-Signal Service Department could be advantageously disbursed in securing and publishing reliable meteorological statistics from the various parts of the colony. The value, industrial and commercial, of rainfall statistics particularly needs no demonstration. Drainage works, flood warnings, waterworks, sanitary considerations, agricultural operations, &c., will, in course of time, as population becomes denser and the interests involved consequently of greater magnitude, necessitate ampler returns than those available at present. However, what Scott says of the weather phenomena of the Old World applies also to the New: "Statistics are not so much wanted as brains to use them," though both perhaps are desiderata in reference to New Zealand meteorology.

Statistics of rain, even when ample, are liable to the same objections as meteorological figures generally. In other parts of the world large masses of these have been collected for long periods of time, and yet Abercrombie considers it is difficult "to attach any physical significance to them." Mean temperatures, *e.g.*, and average rainfalls are just the things that scarcely ever occur in actual experience. They can be produced, moreover, by such widely different factors that they connote nothing reliably. In weather, more than in anything else, it is true that "*rien n'est certain que l'imprévu.*" The destruction of Napoleon's army by unusually early winter in 1812—considerably earlier than Laplace had foretold it—

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* Omitting the seven places where observations have been only made for twelve months or less.

shows the fallacy of general averages for determining weather at any particular season and at any particular place. There are, however, many facts connected with the law of storms and meteorology generally that we can only get at properly by means of statistics.

Up to 1859 observations in our colony were of a very irregular character. The following table—compiled from the Meteorological Reports since that date—shows approximately the mean annual average of rainfall, and also the average number of days on which that rainfall occurs:—

—	Period.	Mean Annual Average in Inches.	Average Number of Rainy Days.
Auckland..	1866–88 inclusive	43·213	187
Wellington	" "	50·178	159
Dunedin	" "	33·612	164
Christchurch	1866–84 "	25·774	107
Napier	1866–80 "	37·260	74
Taranaki	" "	58·084	157
Hokitika	" "	112·156	206
Wallacetown	" "	43·674	168
Bealey	1866–79 "	104·138	214
Mongonui	1866–80 "	58·152	152
Wanganui	1866–72 "	38·12	135
Nelson*	" "	62·634	84
Foxton	1874–82 "	37·14	133
Gisborne	1875–81 "	49·721	145
Blenheim	1862–81 "	26·84	88
Cape Campbell	1874–80 "	21·197	..
Pakawau, Golden Bay ..	1869–77 "	108·3	152
Oamaru	1869–74 "	22·696	96
Queenstown	1872–79 "	36·612	117
Wairarapa	July, 1870, to June, 1872	42·59	..
Wellington Reservoir ..	1881–82 inclusive	45·57	..
Farewell Spit	" "	37·802	..
Rotorua	1887	53·55	..
The Brothers	1882	33·33	..
Puysegur Point	11 months of 1882 †	110·59	..
Milford Sound	June–Dec., 1863	87·00	..
Bluff	1869	64·67	184
Waiau	1881	37·38	110
Chatham Islands	1882	31·15	..

* See subsequent remarks; only 38·28in. in 1880, and only 30in. now.
† All save April.

It will be seen that, although this table deals with twenty-nine places, anything like a mean annual average of rainfall for a number of consecutive years is only given in the case of the first nineteen places. As far as the others are concerned, the figures given are only the mean of the rainfall of two or three consecutive years; and as regards seven places, there is given merely the number of inches for a particular year or part of a year. This is, however, the most complete table I can make from a careful examination of the various returns available. It is, therefore, very evident that our materials for generalization on the subject are very meagre. We are justified, however, in saying that New Zealand as a whole is remarkably well watered. The average amount of rain all over the world, including, therefore, the excessive precipitation of the tropics, is said—on questionable authority, certainly—to be about 30in. Our average will be much more than that, and we are in a latitude where, comparatively speaking, a little rain goes a long way.

Moreover, the table shows that New Zealand, though of no very great area, has very considerable diversity in the amount of its rainfall. It varies from nearly 120in. on the West Coast to 26in. at Christchurch, 23in. at Oamaru, and perhaps even less in the interior of Otago, where, however, accurate observations have not as yet been recorded. For the sake of comparison we may call to mind that Australia, though subject to frequent local and general droughts, and occasionally excessive rainfall, still has no mean annual average of more than 74·84in. (at Mackay, Queensland: Loomis), nor any one less than 6·37in. (at Eucla, South Australia: Loomis). (Mr. Todd says 6in. at Charlotte Waters; 5in. at Cowarie, South Australia.) Our mean annual average, therefore, though it never sinks so low as in the great anticyclonic belt of the interior of Australia, yet mounts much higher among and on the western side of our Southern Alps. Again, the yearly average number of rainy days in some parts of New Zealand is nearly three times as great as in others: Auckland with 187, Wellington with 159, and Bealey with 214, may be compared with Napier which has 74, Nelson which has 84, and Oamaru which has 96. The rain in some places, in fact, comes down in heavy occasional falls—9½in. having been registered in Nelson in one day, and as much as 16·39in. at Pakawau (Golden Bay) in the twenty-four hours of 24th July, 1872. In other places—Dunedin, *e.g.*—the precipitation comes down by a succession of drizzles. Droughts lasting for some weeks, but not very severe, occur occasionally along the greater part of the East Coast; but Sir J. Hector says that "only in two cases do the records show a whole month at any station without rain." The figures from Hokitika and Bealey would indicate that three days out of every five are rainy on the West Coast, and amongst the Southern Alps. Generally speaking, in the wetter parts of the country rain falls, as in England, about every other day; but in the drier districts it comes one day in three or four; in Nelson and Napier one day in five. In some parts of the colony, rain is much more frequent by night-time than during the day—the great fall in temperature which takes place after the sun sets rendering the air incapable of holding the moisture which was easily borne during the warmer hours of the day.

Our heavy rains—particularly on the West Coast—must tend to render the air milder, because one gallon of rainfall gives out latent heat sufficient to melt 75lb. of ice (Scott): in other words, every inch of rain could melt 8in. of ice spread over the ground.

Some people might suppose that the copious rains of New Zealand are sufficiently accounted for by its insular position, but a moment's reflection will dispel such an illusion. Ascension Isle, in the middle of the Atlantic Ocean, is one of the driest places in the world. Its rainfall is only 2in. or 3in. annually, and except on the very summit of its solitary hill, Green Mountain, nothing grows on the island except Madagascar roses. Again, Malden Island, and others remarkable for guano deposits, in the Pacific Ocean, are absolutely rainless. St. Vincent, also, one of the Cape de Verde Islands, is sometimes without rain for three consecutive years. Neither will it do to give our mountain-chains the sole credit for causing our rains, for the rainless desert of Atacama lies at the feet of higher mountains than our Southern Alps. Of the various circumstances that affect climate—latitude, elevation, prevalent winds; position, direction, and height of neighbouring mountains; slope of ground, character of soil, proximity to sea, and degree of cultivation—not any one can be assigned as the cause of our rainfall, which is simply owing to a combination of several favourable circumstances. What this combination is, it will be for us—*inter alia*—to inquire, and thus we may arrive at the general features of our climate, apart from local, diurnal, seasonal, and cyclical variations.

Now the question arises, With such figures of the rainfall of New Zealand as have been exhibited, is it possible to construct a map of the colony showing by gradations of shading, or by different colours, the comparative amount of rain which falls in different parts? This, as far as I know, has never been attempted, and it must be borne in mind that, apart from the peculiar difficulty of scanty statistics, to construct a rainfall-map at all for a large area of country is no easy matter. Let us remember that the fall at any one spot is by no means an exact criterion of the precipitation elsewhere—even in the neighbourhood. Local circumstances, slope, proximity to sea or hills, &c., all affect the rainfall: and these circumstances are seldom or never exactly the same for any two places, though they may be near together. Yet we register the number of inches in a particular spot, and assume that it is the same over perhaps a wide area round about. Nothing can be more fallacious.

Among the circumstances which help to determine the rainfall in any place, none is more important than the *elevation*. Mainly because at a higher elevation the air, being colder, will not carry so much moisture as the warmer air lower down—rain is heavier up the side of a mountain than at its base, and gradually increases up to a certain height at the rate of 3 or 4 per cent. for each 100ft. of altitude. Yet, having no statistics of rainfall in the mountains of New Zealand—except at the Bealey, 2,155ft. high (Hochstetter), where one of our heaviest falls is recorded—we have for the most part to assume that the number of inches falling in the hills and mountains will be the same as are recorded at the nearest places, on the seashore, where records are kept. This must be productive of great error, particularly as to the rainfall on the west coast of the South Island. The observatory at Hokitika is only 12ft. above the sea, but the rainfall 2,000ft. up the western side of the Alps must be enormously heavier than that at Hokitika, though even the latter is regarded by Loomis as tropical; yet we have to draw our map as though the rainfall all along the West Coast was the same as that at Hokitika. The heaviest rainfalls in the world, such as that of Cherra Poonjee, which is situated 4,000ft. high on the Khasia Hills—200 miles from Chittagong, north-east of Calcutta—610in. in six months, and that of Mahabeleshwar in the West Ghauts, 300in. in twelve months, occur at places where warm humid winds strike against abrupt heights, corresponding in position to the western slopes of our Southern Alps at the elevation of 2,000ft. or 3,000ft. Therefore in these latter places it is quite likely that the rainfall is very much greater even than that recorded on the western sea-coast. But what it actually is must for some time to come be a matter of pure conjecture, though the time will arrive when there will be in New Zealand observatories corresponding in position to those on Ben Nevis and, perhaps, Pike's Peak. Of course, beyond a certain height snow falls, instead of rain, and there is no doubt, as has often been remarked, that the glaciers on the western side of our Alps descend so low as compared with those in many other parts of the world, and that our glaciers altogether are so extensive, simply in consequence of the excessive deposit of snow on the heights above them. A good illustration of the fact that elevation materially affects the amount of rainfall is seen in the case of the Bealey—over 2,000ft. high—where the number of inches recorded is greater than elsewhere in the colony; and this large precipitation—though there are other circumstances which help to account for it—is probably, in some measure, owing to exceptional altitude. Mainly from an appreciation of these arguments, Scott, in his "Elementary Meteorology," refrains from attempting any graphic representation of general rain-distribution.

But, besides elevation, there are other circumstances which invalidate the testimony of a few local figures as to the rainfall of a wide district. It is, indeed, no easy matter to place a rain-gauge in such a situation as will secure a fair average for the immediate neighbourhood within the radius of a few miles. Every peculiarity of geographical configuration affects the precipitation. A river-valley attracts thunderstorms; dense neighbouring woods will diminish local temperature, and so, to some small extent, attract rain; a single neighbouring hill will produce ascending currents of air, and a circle of hills round about the observatory, particularly if facing the prevailing rain-bringing winds, will considerably increase the rainfall. The observations made at Nelson in the earlier days of the colony—assuming them to have been accurately taken—may, perhaps, in this latter way be explained. They were taken, as Sir James Hector observes, in a situation too much surrounded by hills—namely, in the City of Nelson itself—to be by any means a fair criterion of the general rainfall of the district. They give an average of 62in.; whereas, from my own observations during the years 1883–86, I feel justified in saying that the average (mean annual) in the immediate neighbourhood—the Waimea Plains—was not more than half that amount. But there must have been something altogether wrong about the figures for even Nelson itself, or else the rainfall must have diminished very much within twenty years. My friend Dr. Hudson, who resides in Nelson, has made careful observations for some years back on the rainfall, amongst other matters meteorological, and he gives me the fall of 29·04in. for 1887, 28in. for 1888, and 26·93in. for 1889 (the latter year, it will be remembered, had a very scanty rainfall generally in New Zealand); and he says that, although there may be some truth in what is commonly asserted,—that the climate of Nelson was wetter in the earlier days of the colony than now,—he does not think that the fall has averaged as much as 30in. for the last ten years, during which he has lived in that city, or that the precipitation has lessened materially as the years have rolled onward. Dr. Hudson's observations are borne out by those of Dr. Müller, of Blenheim, who gives for the past twenty years an average of 26·84in., with a slight increase during the latter decade, attributed—rightly or wrongly—to increased cultivation and arboriculture. Nelson and Marlborough have very similar climates—that of the former being, as shown, somewhat the wetter of the two, but certainly not so materially different as to double the Blenheim average. Marlborough gets its rain mainly from the north-west; Nelson, strangely enough, from the north-east, though it lies fully exposed to the north-west. Perhaps the great heat of the Nelson district, lying as it does so directly to the sun, accounts for the north-west winds not precipitating their moisture there. But both places have northerly rains, and the trend and height of the mountain-ranges between them may explain local differences. The trend would be likely to give a direction, as from north-east, to such tempests as come from the north and perhaps north-west, and so account for the quarter and amount of rain at the head of Blind Bay; while the height of the hills, not being very considerable, allows a good deal of north-west weather to pass over them to their leeward—*i.e.*, Marlborough-side. The north-east rains of Nelson, however, may be coincident with those from the same quarter on the east coast, and so arise from cyclones passing from the south-west to the north of New Zealand. I observed a curious fact concerning these north-eastern rains of Nelson during my residence there. The weather forecasts from Wellington invariably foretold these rains correctly; but as to rains from any other point of the compass the prognostications of Captain Edwin invariably failed.

Notwithstanding that much of what has just been said weakens confidence in the earlier figures for the Nelson Province, I have accepted them, as they cover a greater number of years than recent observations.

For the above and other reasons it will be clearly impossible for us to very sharply divide New Zealand into rainfall provinces. We can only roughly approximate to the truth from such information as we do possess. We know certain points where precipitation is heavy, and round these we place our darker tints; others where the fall is light, and to the districts round these we give light hues. An acquaintance with the leading principles of the law of storms and with local geographical peculiarities will help to give firmness to our touch; but, after all, such a map for a colony of such area as ours, and such diversity in its rainfall, and so few observing-stations, must be largely a matter of conjecture, based on slight premisses. I give it for what it is worth, merely remarking that I have found it convenient, in view of the data possessed, to divide the colony into five zones or belts, two of which are only found in the South Island—viz., that of 20in. to 30in. (on the eastern side), and that of over 75in. (on the western); the other three—30in. to 40in., 40in. to 50in., and 50in. to 75in.—extend, in all probability, more or less continuously through the entire length of both Islands.

PART II. RAIN-BRINGING WINDS AND CYCLONIC TRACKS.

To understand the rainfall of a country and its causes we must inquire what are the winds which, in the various places where observatories have been made, bring the rain. Existing differences of climate mainly have their origin in prevailing winds, and the science of meteorology is for the most part comprised in the law of storms, since that law deals chiefly with wind and rain. To be more precise, rainfall is determined by prevailing winds considered in relation to the regions from which they come and the physical configuration and temperature of the country blown over; the maximum occurring where winds, after traversing the ocean, come against mountain-chains in their passage to colder places, and the minimum where the prevalent winds come over mountain-ridges to warmer lands.—(Loomis.)

Now, in our attempts to get at the rain-bringing winds of New Zealand, the want of statistics is again painfully evident. The full particulars which we need for the investigation are only given for the three first-class meteorological stations. It is so far fortunate that these places are situate as widely apart in the colony as they well could be—Auckland in the north, Wellington in the centre, and Dunedin in the south. They are, moreover, places more exposed to western weather, as it happens, and therefore more representative of the climate of the colony than many places on the east coast which could have been chosen. For these places the rainfall of each day in the year is recorded, with the direction of the wind, so we can construct for them what are called "wind-roses." It is to be regretted, however, that the tables do not seem to be compiled precisely on a uniform system. Unless they are, the figures are misleading. For example, in the year 1880 there was not recorded a single calm day in Auckland, only two in Wellington, but 115 in Dunedin! On examining the figures carefully we find an explanation of this remarkable testimony to the tranquillity of the Dunedin climate. In Auckland, if the air moves only at an average of two miles an hour, the direction of the wind is given, and no calm is recorded, though, according to the Beaufort scale, the average velocity of wind in a calm is taken at as much as three miles an hour. In Wellington, similarly, no calm is returned, even when the total motion of the air during the day is only ten miles; but yet, as it would seem, inconsistently enough, on the 29th June and on the 4th August, on each of which days the wind travelled fifty miles, calm is recorded. In Dunedin the meaning of "calm" is even more incomprehensible, for under the heading "Direction of Wind" we see "calm" recorded even when the wind travelled as much as

320 miles in the day. Taking, however, the returns for the years 1880–82 as they stand, and analysing them, we find that in Auckland, in 1880,—

W.	wind blew on	64	days, during which	11·825in.	rain fell on	39	days.
S.W.	„	72	„	5·885in.	„	42	„
N.W.	„	37	„	5·740in.	„	25	„
S.	„	46	„	5·505in.	„	26	„
N.	„	28	„	3·445in.	„	14	„
N.E.	„	54	„	2·550in.	„	19	„
E.	„	43	„	2·215in.	„	18	„
S.E.	„	22	„	1·525in.	„	6	„

But it would be misleading to confine our inquiry, as far as Auckland is concerned, to the year 1880; for the rainfall there that year was 6·416in. below the mean annual. In 1882, when the rainfall was only 0·324 above the average,—

Rain came from	S.W.	on	61	days, to amount of	10·425in.
„	W.	„	49	„	10·390in.
„	N.W.	„	19	„	7·365in.
„	N.E.	„	19	„	8·360in.
„	N.	„	13	„	3·730in.
„	S.	„	16	„	2·795in.
„	E.	„	5	„	2·080in.
„	S.E.	„	9	„	1·520in.

A similarly-compiled table for 1881 gives—

S.W.	as bringing	10·092in.	in	46	days.
W.	„	6·440in.	„	43	„
E.	„	3·850in.	„	17	„
N.E.	„	3·790in.	„	14	„
N.	„	3·045in.	„	13	„
N.W.	„	3·010in.	„	18	„
S.	„	2·475in.	„	17	„
S.E.	„	1·425in.	„	7	„

But the rainfall in 1881 was 11·069in. below the mean annual, and so, as in the case of 1880, must not be relied on for showing us whence the rain usually comes. 1882 gives more trustworthy figures, and from it we argue that the rain-bringing winds in Auckland, in the order of their importance, are south-west, west, north-east, and north-west, and much corroboration of this view is obtained from the returns of the preceding and following years.

In Wellington, during 1880,—

S.E.	wind blew on	118	days, during which	22·437in.	fell on	77	days.
N.W.	„	189	„	16·146in.	„	70	„
N.E.	„	36	„	3·570in.	„	9	„
S.W.	„	16	„	3·464in.	„	16	„
E.	„	4	„	0·850in.	„	1	„
W.	„	1	„	0·000in.	„	0	„

From north and south there was neither wind nor rain. But the rainfall in 1880 was 4·014in. below the mean annual. So we take another year, 1881, when the fall was only

0·649 below the average, and we get for this year the following:—

21·872in.	fell on	46	days, wind being	S.E.
15·150in.	„	25	„	S.W.
11·788in.	„	56	„	N.W.
0·943in.	„	6	„	N.E.
0·340in.	„	3	„	E.
0·070in.	„	1	„	W.

and, as in 1880, nothing from north and south. This table probably represents what we want fairly correctly. Combined with the other, it shows us that, while the wind in Wellington comes almost entirely from south-east and north-west—as we might suppose from the peculiar configuration of the surrounding country—the rain comes from south-east, north-west, and south-west. Wind from the last-mentioned quarter is rare in Wellington, but when it does blow it almost invariably brings heavy rain. *En passant* it may be remarked that the great prevalence of north-west weather at Wellington must be owing to more than local physical features, for it predominates also largely at Wanganui, where the country round about is comparatively open.

For Dunedin the year 1880 had a rainfall sufficiently near the average (only 1·044in. below it) to justify us in accepting the results deducible therefrom.

S.W. blew on	77	days, and	12·324in.	fell on	50	of those days
Calm prevailed on	115	„	6·544in.	„	49	„
N.E. blew on	73	„	5·005in.	„	31	„
S.E. „	14	„	4·864in.	„	8	„
W. „	47	„	3·454in.	„	26	„
E. „	22	„	0·338in.	„	9	„
N.W. „	6	„	0·320in.	„	2	„
S. „	6	„	0·182in.	„	2	„
N. „	6	„	0·002in.	„	1	„

It would not help us much to compare with these the returns from 1881 and 1882, for the rainfall in the former of these years was nearly 6in. below the average, and that in the latter nearly 10in. above it. So we may consider the quarters from which the rain comes in Dunedin to be south-west, north-east, south-east, and west, though a summary given in the Meteorological Report of 1868 makes the rain for the years 1853 to 1860 to have come principally from west, south-west, south, and north-east. It will be noticed that the disparity is not great.

As regards Christchurch, the returns for the period in question are too meagre to enable me to construct such tables as the above. But fuller and more reliable statistics are available if we accept those recorded at Lincoln Agricultural College. The average annual rainfall is 2in. or 3in. greater at Lincoln than at Christchurch, though the places are so near to one another, which is an illustration of what has been previously mentioned about the difficulty of getting fairly representative figures of rainfall: but the rain-bringing winds may be taken as about the same at the two places; and a table prepared by Mr. G. Gray, of the Agricultural College, in his 1886 report as to the chemical department, exhibits the following facts for the year 1885:—

Of the total rainfall of the year,—

71·9	per cent.	came from	S.W.	on	74	days.
12·0	„	„	N.E.	„	19	„
5·6	„	„	S.E.	„	4	„
3·1	„	came during calm		„	12	„
2·4	„	came from	E.	„	1	„
2·1	„	„	W.	„	2	„
2·1	„	„	N.W.	„	3	„
0·6	„	„	S.	„	2	„
0·2	„	„	N.	„	1	„

Similarly, for the past year, 1889, through the kindness of Mr. Ivey, who has supplied me with the daily records of wind and rain, I find—

S.W.	wind brought	12·337in.	of rain on	43	days.
N.E.	„	2·405in.	„	25	„
S.E.	„	1·847in.	„	4	„
W.	„	1·499in.	„	11	„
Calm	prevailed while	0·830in.	„	13	„
S.	wind brought	0·615in.	„	3	„
N.W.	„	0·360in.	„	4	„
N.	„	0·312in.	„	3	„
E.	„	0·203in.	„	3	„
		20·408in.	„	109	„

Whence we see conclusively that the rain-bringing wind with us is—even more conspicuously than elsewhere in New Zealand—the south-west; after that north-east and south-east.

In regard to Nelson, through the kindness of Dr. Hudson I am able to give the following facts pertaining to the year 1888. In that year rain fell to the amount of—

11·64in.	on	21	days of	N.E.	weather.
4·08in.	„	20	„	N.W.	„
2·81in.	„	15	„	calm	„
2·58in.	„	18	„	S.W.	„
2·54in.	„	10	„	N.	„
2·46in.	„	10	„	S.E.	„
1·87in.	„	5	„	E.	„
0·41in.	„	5	„	W.	„
0·05in.	„	1	„	S.	„

So that the rain-bringing winds of Nelson are north-east, north-west, south-west.

Whence the rain comes at other stations in the colony I have no means of telling; but an analysis of the tables of the

Meteorological Reports of 1869–79, giving the prevailing winds at all the principal stations, presents the following results:—

Mongonui	S.W.	N.W.	
Auckland	S.W.	N.E.	W.
Taranaki	S.W.	N.E.	S.E.
Wanganui	N.W.	S.W.	
Napier	N.E.	S.W.	S.E.
Wellington	N.W.	S.E.	
Nelson	N.E.	N.	N.W.
Cape Campbell ..	N.W.	S.	S.E.
Hokitika	S.E.	S.W.	N.E.
Bealey	N.W.*		
Christchurch	S.W.	N.E.	
Dunedin	W.	S.W.	N.E.
Queenstown	N.W.	S.W.	
Southland	W.	S.E.	N.W.
Bluff (1869)	S.W.	N.W.	S.E.

Dr. Hann, in his essay on the climate of New Zealand, and Buchan in the "Mean Pressure over the Globe," make the most prevalent winds of the North Island to be south-west, west, and north-west; and of the South Island, west, south-west, north-west, and north-east; and of Hokitika in particular, south-west and north-east—which, notwithstanding a general agreement, does not seem exactly to tally with the meteorological tables of 1869–79 just referred to. But into a criticism of this matter it does not seem desirable to enter at present, for, whatever the prevalent winds may be, it does not follow that those are the rain-bringers: indeed, we know well that in many cases they are not. The north-east wind, *e.g.*, although in many parts of the Islands, and specially on the east coasts, a very prevalent wind, does not seem, except at Nelson, to bring anywhere the bulk of the yearly supply of moisture, though very heavy rain comes occasionally from the north-east at Auckland, and probably elsewhere on the east coast of the North Island. The north-east wind of Christchurch, so common and so trying in spring and early summer, brings only 12 per cent. of the yearly rainfall, and is, as a rule, a hard and dry wind, very biting and yet not sending down the thermometer at all low. The south-east and north-east winds of Hokitika, though very frequent, are not heavy rain-bringers, and can scarcely be expected to be so considering whence they come. They are probably reflex under-currents, produced by the north-west and south-west winds respectively. That the north-west is the most frequent upper wind in Westland is shown by the fact that at the Bealey it is recorded as blowing 220 days in the year.

But if the prevalent winds blow from the sea to a mountainous shore—and from whatever quarter the wind comes in

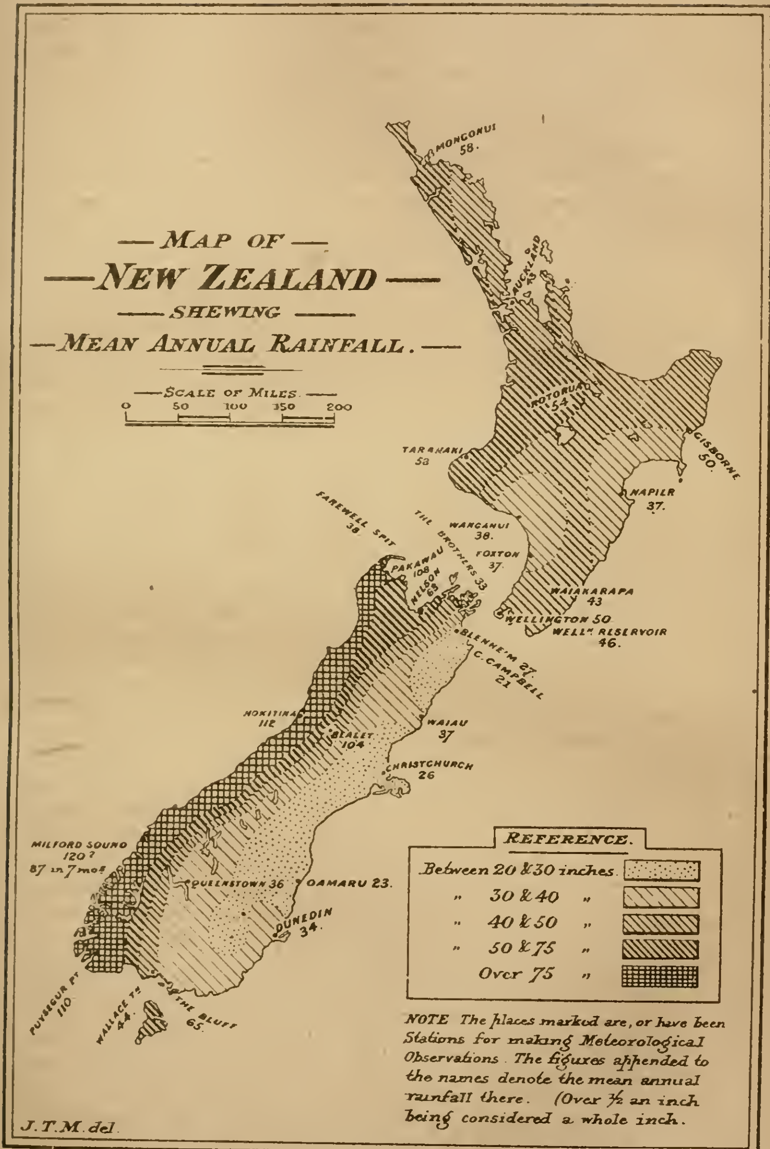
* 220 days in year.

New Zealand that condition in most places would be fulfilled —then the prevalent winds would be the rain-bringers, particularly if they came from a lower to a higher latitude. The north-east of Christchurch seems an exception to this rule, and, I confess, it is to me an inexplicable wind. It may not, however, be so dry as it appears, and its peculiar power to affect human sensations may be owing to some electrical property arising from its opposing the revolutionary motion of the earth. Perhaps it is quite local and is more of the nature of a tropical sea-breeze, particularly as it always seems to gather extra force and virulence towards the afternoon. Or it may be a diverted south-east—*i.e.*, polar—wind, drawn out of its course by the warm Canterbury plains, with their excessive radiation. Moreover, it must be remembered that it does not strike directly against mountain-sides, but, before it reaches them, has to blow over a wide extent of land.

Combining now the results obtained in the previous tables, and ignoring for the present what has been said as to prevalent winds, the rain-bringing winds seem to be at—

Auckland	S.W.	W.	N.E.	N.W.	N.
Wellington ..	S.E.	S.W.	N.W.	N.E.	
Nelson	N.E.	N.W.	S.W.	N.	
Christchurch ..	S.W.	N.E.	S.E.		
Dunedin	S.W.	N.E.	S.E.	W.	

Now, if the results which we have thus obtained for five places widely separated, and mostly on the eastern coasts, though exposed to western weather, may be taken as indicative of the rain-bearing winds generally in the colony, as I think is the case, and if the general law may be deduced from the figures of a few consecutive years, as I think it can, and if we may assume that the wind recorded at 8 o'clock in the morning was in the great majority of cases the wind which prevailed while the rain of each day was falling—for there is no tri-daily observation here as in the Old-World observatories —then it would appear that without doubt the wind which brings most rain in New Zealand is the south-west. We see that it comes first everywhere in the table except at Wellington and Nelson. We considered the peculiar north-east rains of the latter place in Part I. of this paper; and the heavy south-east rains of the former place are a purely local phenomenon. They are really south-west rains—the result of cyclonic storms sweeping up the eastern coasts of the South Island, but diverted by the direction of the mountains bounding the eastern entrance to Cook Strait. Similar diversions of wind by the configuration of the land are very common in our colony, abounding as it does with gorges and river-valleys hemmed in by lofty mountains—*e.g.*, at the Rakaia Gorge, at the head of Lake Wakatipu, and elsewhere.


MAP OF
NEW ZEALAND
SHEWING
MEAN ANNUAL RAINFALL.
SCALE OF MILES
0 50 100 150 200
MONGONUI 58.
AUCKLAND 43
ROTORUA 54
GISBORNE 50.
TARANAKI 58
NAPIER 37.
WANGANUI 38.
FOXTON 37.
FAREWELL SPIT 38
THE BROTHERS 33
PAKAWAU 108
NELSON 63
WAIAKARAPA 43
WELLINGTON 50
WELLN. RESERVOIR 46.
BLENHEIM 27.
C. CAMPBELL 21
HOKITIKA 112
BEALEY 104
WAIAU 37
CHRISTCHURCH 26
MILFORD SOUND 120?
87 in 7 mos
QUEENSTOWN 36
OAMARU 23.
DUNEDIN 34.
PUYSEGUR PT 110
WALLACE TN 44.
THE BLUFF 65.
REFERENCE.
Between 20 & 30 inches.
" 30 & 40 "
" 40 & 50 "
" 50 & 75 "
Over 75 "
NOTE The places marked are, or have been Stations for making Meteorological Observations. The figures appended to the names denote the mean annual rainfall there. (Over ½ an inch being considered a whole inch.
J. T. M. del.

Moreover, generally the rain comes with a westerly wind of some kind rather than with one from any other quarter. Very little indeed comes from north or south upon the whole, and not much from any quarter of east, although occasional heavy storms from north-east or south-east make one or the other of those points of the compass take the second place here and there in the tables.

The prevalence of westerly weather in New Zealand is not at all exceptional, but just what our latitude would lead us to expect. In the Temperate Zone twenty-miles-an-hour westerly winds usually predominate, as in the Torrid Zone easterly winds blow almost continuously. The latter are nothing but the Trades, as the former are the Return Trades, which, overflowing in the first place from the equatorial regions, set off as upper currents towards the lower pressures of high latitudes—*i.e.*, in our Southern Hemisphere, in a southerly direction; but on account of their coming from a portion of the earth where the rotatory motion is greatest to a part where it is less, we see, by adapting Hadley's law, that they get an easterly tendency—*i.e.*, come to us in the first place as north-west and then as west or south-west winds. Up to lat. 23½° they are upper winds, the currents of air below them being, of course, the south-east trades. But at the Tropic of Capricorn these upper winds cross the lower ones, and sweep the surface of the earth. At some seasons the point of crossing is nearer the equator than at other seasons, but wherever it may be it produces a belt of calms and variable winds or cyclones rotating and succeeding one another in the opposite direction to the hands of a watch. But the north-west or anti-trade winds move on polewards. Being equatorial in origin, they are warm and moist. They lose and gain heat in their travels by ascending and descending intervening mountain-chains; also by licking up moisture as they pass over the ocean, and discharging it again when by any means whatever their temperature is lowered. Although they are interfered with by the irregularities of pressure consequent on the variation of temperature which arises from difference of latitude and the unequal distribution of land and water, they are wonderfully persistent even so far as 50° S. lat.; and for some degrees before they reach that latitude, following the general law which expresses the regular succession of the winds to one another, they haul or veer to the right hand—*i.e.*, to the place where prevails the lowest pressure—and become the well-marked and widely-extended westerly winds of the "roaring forties." These, in their various forms of cyclones, V-depressions, wedges, and secondaries, dash up against our western mountains, which lie right athwart their course, and there quickly lose their moisture, and are largely deflected to the south-east of New Zealand by the coast-line and mountain-chain combined. As accounting for the persistency of these north-west and west and south-west winds in the Southern Hemisphere, and assisting in their formation, the uniformly low barometric pressure which, to judge from the observations of Sir J. Ross, seems to prevail between the 70th and 75th parallels of south latitude, must be regarded as of primary importance, though the higher latitudes of the Southern Hemisphere have as yet been so little explored that it is not safe to build any theories upon the few observations that have been made.

The prevalence of westerly weather with us, however, clearly explains the main feature of our rain-map, which is that of the heaviest fall on the west coast, and lighter as the east coasts are approached. A similar law obtains in a very marked degree in Tasmania, of which a rain-map recently published shows a fall of over 50in. on the west coast, from 40in. to 50in. in the central third of the island, and from 20in. to 40in. over the eastern third. Symon's map of the rainfall of the British Isles may also be called to mind with advantage. It shows a marked excess of precipitation along the high lands of the western counties, the deep tints denoting over 75in. on the western coasts gradually giving place to the lighter lines denoting under 25in. along the eastern. In some of the mountain districts of Westmoreland the annual fall is as much as 150in. to 200in., while in the eastern half of England there are many places with less than 20in. The western counties, in consequence, are characterized as pasture counties, the eastern as grain-growing. Symon's general law is, "The rainfall of a district [in England, presumably] is mainly influenced by its proximity to the western coasts of the country, and by the lie of the mountain-ranges by which it is traversed or encircled."

This law undoubtedly obtains in New Zealand. Wind from some quarter of the west prevails through the greater part of the year, even at places like Bealey and Queenstown, quite in the interior—and the north-east winds of the eastern coasts, as we have said, do not interfere with this law largely—and the west wind, except where it has to cross high mountains and so gets robbed of its moisture, will be undoubtedly rain-bringing. Moreover, as a rule, those places most exposed to the west will have the heaviest rainfall. Compare, *e.g.*,—

Taranaki,	with	58in.,	to Napier,	with	37in.
Wellington,	„	52in.,	„ Wairarapa,	„	42in.
Nelson,	„	60in.,(?)	„ Blenheim,	„	27in.
Hokitika,	„	112in.,	„ Christchurch,	„	26in.
Milford Sound,	„	87in.,*	„ Oamaru,	„	23in.
Wallacetown,	„	50in.,	„ Dunedin,	„	35in.

* In six months.

For this comparison, as will be seen, places are chosen as nearly as possible on the same parallel. There is thus a marked diminution of rainfall on the eastern side of the Islands, and this diminution is greatest where the mountains are highest. "The excess of precipitation on the [west?] coast is clearly illustrated," says Sir J. Hector, "by the descent of the glaciers on the opposite sides of the range: those on the west slope descend to a line where the mean annual temperature is 50°, while on the eastern slope they descend only to the mean annual temperature of 37°. The winter snow-line on the Southern Alps is 3,000ft. on the east side, while that on the western rises to 3,700ft."

The small amount of rain in Marlborough, Canterbury, Otago, and Hawke's Bay—*i.e.*, generally on the east side of our Islands—is paralleled in many other parts of the world similarly situated as regards the prevailing winds and neighbouring mountain-ranges. In Patagonia, east of the Andes; in Sweden, east of the Dovrefeld Mountains; in British North America, east of the Rockies; in eastern Europe as compared with western (Dr. Krümmel: Gesellschaft für Erdkunde, 1878); and, as already observed, in the eastern counties of Great Britain as compared with the western, we see precisely similar phenomena. Also in the Atacama Desert of Peru, for in that latitude the prevailing winds are east, and so the precipitation occurs on the Brazilian and Paraguayan slopes of the Andes, while the western slopes in North Chili and Peru are dry. What western rain we do get in Canterbury comes mostly from the south-west, because the South Island lies from south-west to north-east, and its main range runs in the same general direction; therefore the western rains can only, as a rule, reach us by coming round the south end of the Island, and, as the equinoctial winds gyrate from north-west by west to south-west, we thus sometimes get the benefit of the rains carried by the fag-end of western storms. The ordinary south-west, however, is more like a polar than an equinoctial wind, being accompanied by high barometer and low thermometer, and winds from higher latitudes cannot, as a rule, bring heavy annual rainfall because, coming as cold winds, and therefore carrying little moisture to warmer regions, their temperature rises, and so their capacity for holding moisture increases.

The excessive fall at the Bealey is probably, as already observed, owing to its altitude, and the contiguity of a pass (Arthur's, 3,038ft. high) sufficiently low to let much of the north-west weather cross over the Southern Alps.

It has been observed that in England a range of hills 1,500ft. high running athwart the south-west or rainy wind will have the largest precipitation on the eastward or leeward side:

whereas when the range is over 1,500ft. in height the rainfall will be heaviest on the western or windward side. In this colony the 1,500ft. limit will have to be raised to perhaps 3,000ft. or more, on account of the lower latitude. Remembering this, it is not difficult to explain a good many anomalously heavy rainfalls in the colony. In the Rakaia Gorge, *e.g.*, rain comes often heavily from the north-west, admitted presumably over the lower passes or *cols* in the vicinity. So in the neighbourhood of Mount Cook and elsewhere there is seen something similar, as described by Mr. McKay.* Even at the head of Lake Wakatipu the heaviest rainfall is from the north-west, so that some portion of the rainfall which is generally considered to fall almost entirely on the western flanks of the Southern Alps must pass over the lower elevations on the western side and reach the central portion of the range, and even the eastern flanks, in diminished quantity.

Loomis gives the following causes of excessive rainfall :—

(1.) Mountain-sides deflecting prevalent ocean-winds upward, so that much of their vapour is condensed by the cold of elevation.

(2.) The high temperature and great humidity of those winds.

(3.) Proximity of district to sea.

(4.) Influence of storm-tracks.

And as causes of deficient rainfall he mentions—

(1.) Absence of adequate cause to produce strong upward movements of air.

(2.) Chains of mountains between the place in question and the sea, which obstruct the prevalent winds and rob them of their moisture.

In the light of these general principles, it is not difficult to understand most of the local peculiarities as well as general features of the rainfall of New Zealand. Its mountains run along its greatest length—*i.e.*, from north to south—minor ranges deviating only a few points from this direction. The weather coming from the west, the eastern plains are comparatively dry, and the west coast is very rainy.

Dr. Hann confesses "that, on the whole, he has not succeeded in coming to a clear understanding of the winds of these Islands and their causes." He attributes this partly to all the stations being on the coast, and so subject to the disturbances of land- and sea-breezes. But Sir James Hector points out that the influence of mountains and gorges has been still greater in affecting the observations, and thinks the only reli-

* Trans. N.Z. Inst., vol. vii.

able observations as to the winds are those taken from the motion of the clouds. I cannot help thinking, however, that the difficulty of getting reliable observations as to wind in the ordinary ways is less formidable than would appear from our Director's statement; and also that the clouds are no perfectly trustworthy guide, inasmuch as there are often, if not ordinarily, opposing currents of air one above the other, and it is very difficult to say whether the clouds are in the upper or lower stratum. The following quotation from Dove confirms this view: "Although we may admit that the direction of the wind which is given by the drift of the clouds is not affected by so many of the disturbing actions exerted by the surface of the earth on the air which flows over it, yet a material complication is introduced by the fact that the clouds give the direction at times of the lower, at times of the upper, current, while the vane of the weathercock only indicates the point from which the undercurrent is blowing."* Notwithstanding this objection to the suggestion made, there is no doubt that the mountains and gorges of New Zealand do materially affect local wind, and therefore local observations.

Now, what the particular difficulties were that Dr. Hann found while studying the winds of our colony he does not tell us. But, apart from local peculiarities, the characters of the two opposite winds—north-east and south-west—seem to me very perplexing. About the former, particularly at Christchurch, I have already spoken, and, as to the latter, let us bear in mind that, while corresponding to the north-west of the British Isles,—which is not there the wind that brings most rain,—our south-west *is* our great rain-bearer. Our north-west winds, corresponding to the British south-west, should be our great rain-bringers, being equatorial, moisture-laden winds, coming with low barometer to higher latitudes. And I believe they do bring the rain and discharge it heavily in the mountains of our Southern Alps; but they do not discharge it so heavily on the lowlands (even when those lands lie open to them and are not protected as are our Canterbury plains by intervening ranges), because, since New Zealand is 10° or 15° nearer to the equator, the average temperature is much higher than in Great Britain; and, until the cold polar blasts of the south-west commence their struggle with the equatorial current, there does not, as a rule, take place the inevitable heavy precipitation.

Our rains do not come with a low glass, neither the north-easterly nor south-westerly. With the latter, of course, the barometer almost invariably rises. The quarter of low glass in the Southern Hemisphere is north-west, and it is presum-

* "Law of Storms," p. 152.

ably thence that the greater part of our cyclones approach us, just as 90 per cent. of those of the British Isles come from the south-west.

Now, what are these cyclones which are accompanied by low barometer, high wind, and heavy rain? They are simply eddies and whirlpools—not upright, but inverted and sloping—formed in the broad stream of the equatorial current of air as it passes on to polar regions. And here it will be fitting to make some remarks on what Loomis refers to as the influence of storm-tracks in producing heavy rains. If it be true, as Mr. Russell, the Meteorologist of New South Wales, says, that nine-tenths of the rain of a country is brought by cyclonic disturbances, it is clearly of the greatest importance to a knowledge of New Zealand weather that we should, if possible, ascertain what are the prevailing paths that cyclonic disturbances with us take.

Dove doubts whether there be such a thing as a polar storm—*i.e.*, a storm coming with its usual accompaniments of rain and low barometer from higher latitudes to lower. Our experience, however, in Australia and New Zealand seems to show that south-west storms are very frequent: but are these polar storms? They may be equatorial storms diverted from their course, having first started south-eastwards from sub-tropical starting-places, but subsequently drifted into aërial channels skirting anticyclonic areas, and thus doubled to some extent backwards; or, as already suggested, they may be the result of a contest between the warm north-west and the cold polar wind, which by lowering the temperature of the equatorial wind as it gradually masters it, causes the heavy precipitation which characterizes a good deal of south-west weather. In any case they come to us and the southern points of Australia, apparently, from the south-west. Their centres sometimes pass over these Islands; and thus places on the east coasts—Dunedin and Wellington, *e.g.*—will get south-east storms, for the rain, it must be remembered, does not come from the quarter indicated by the path of lowest pressure. When the centre passes to the north of New Zealand, as Sir James Hector observes, north-east storms of wind and rain will come along the east coast, and hence, probably, the heavy north-east rains of Nelson.

But cyclones from west and north-west, accompanied by heavy rains from west and south-west, would seem to be much more usual than those from the south-west. Sometimes storms have been traced from Mauritius to New Zealand, skirting the huge anticyclone that generally rests over Australia, carrying rain to the southern points of that land, passing over Bass's Straits and Tasmania to New Zealand in twenty-four hours, striking against our Southern Alps with deluges of rain on the west coast, and then sheering off eventually to the south-east. Even the south-west storms that pass through Bass's Straits and skirt the coasts of New South Wales are considered by Mr. Todd, of South Australia, to turn when they reach the Tropic and make off to New Zealand in the south-east, communicating their motion to or being taken up, I presume, by the return trades. But probably very many of our north-west storms have an independent origin near the coast of Queensland.

We know that cyclones are always formed and travel along by the sides of an anticyclone. Now, anticyclones are not erratic, rapidly-moving twenty-miles-an-hour creatures like cyclones, but decidedly sluggish, some of them hanging for months indifferently over sea or land almost motionless. Certain latitudes are particularly anticyclonic. In the Southern Hemisphere such a one in the winter season extends north-west of New Zealand, from about 20° to 35° south latitude, brooding over the greater part of Australia and a belt of contiguous ocean. Just north of New Zealand this belt becomes thinner, and, as a consequence, the cyclones formed south of Australia and Tasmania come to the North Island from the south-west, and bring the copious winter rains, which are a marked feature in that portion of the colony. Much of this is also seen in the South Island; but in Wanganui, Taranaki, and Auckland Dr. Hann has calculated the frequency of south-west in winter as 26 per cent. (greatest of all); in autumn, 25 per cent. (also greatest); in spring, 21 per cent. (second); and in summer, 18 per cent. (second).

The anticyclone which hugs the Tropic of Capricorn more or less right round the earth during the winter season, and is especially marked, as we should expect, over the central mass of Australia, thins out and changes its character completely as summer approaches over the three great masses of land in the Southern Hemisphere. The mean pressure over Australia falls from 30·2in. in July to 29·8in. in January. The anticyclone north of New Zealand and east of Australia contracts to a comparatively small area, and only affects or hangs over the extreme northern tip of our colony. It leaves a continuous belt of low pressure from the southern seas well into the tropics. Now is the season—spring and summer—when the north-west cyclones blow most persistently, their direction being given by the sides of the great anticyclone. These cyclones, born as would appear mostly between the anticyclone and the coast of Queensland, in the neighbourhood of the Tropic of Capricorn, strike New Zealand from north to south, but heaviest in the middle of the South Island; and are drawn, if they do not previously exhaust themselves, by the coast-line and the mountain-range, through and over which they break here and there, down towards the extreme south of the colony, and then pass on to the south-east or turn up the east coast as south-west storms. Dr. Hann has calculated the percentage of frequency of north-west weather in Hokitika to be 23 in summer and 20 in spring, but very much less in autumn and winter. Between the winter and summer solstices of the Southern Hemisphere the path of the cyclones that affect New Zealand will be found probably to change gradually from south-west to north-west, and in the opposite season of the year it will move again to the south-west.

Such, apparently—*i.e.*, from the south-west and north-west—are the main paths of the cyclones which produce our most characteristic weather. But this presentment is only of the general tendency as regards barometric pressure and the climate that it produces; and in our latitude, we must remember, irregular barometric fluctuations are so common as to defy any perfectly and universally accurate general statements. "Shifting areas of high and low pressure" continuously cross and sometimes recross our Islands, and the configuration of the country, its varying elevation, and the alternation of water- and land-surfaces, interfere with the prevailing types of weather and produce all kinds of unexpected local modifications. Into a full and complete examination of these it would be impossible on this occasion to enter.

The main difference between the rainfall of the two Islands of New Zealand lies in the fact that the North Island, being almost subtropical, is subject, as already said, to the heavy winter rains that accompany the descent of the return trades between latitudes 30° and 40° (Scott, p. 331), whereas the South Island is in the zone of rain at all seasons, as pointed out by Dr. Hann and Mr. Scott. Here rain therefore depends on the irregular succession of barometric depressions and anticyclones, and these are most frequent on the west coast in spring and early summer. Summer rains are more frequent on the east side and in the interior; but these depend on secondaries, which come in the most unexpected manner, puzzle the weather prophet, and have very little, if anything, to do with the general character of the weather.

The even distribution of rain throughout the year in most parts is the grand feature of the New Zealand climate—the cause of its constant verdure and great productivity. Local circumstances, we repeat, modify the general weather considerably: not so much local development of heat, for that does not seem to be so important as is usually supposed, though the flow of air from the hot equator to the poles is the primary cause of cyclonic development; but the geographical features of a neighbourhood largely affect its climate. For example, Mount Egmont, in Taranaki, probably largely increases the rainfall of the country immediately around it; for, if rain be caused by the chilling of air charged with moisture, and this chilling can be brought about by (1) currents of such air ascending, or (2) striking against cold ground, or (3) mixing with air of lower temperature, it is easy to see how the moisture-laden winds from the ocean striking against a peak 8,000ft. high and close on the shore must be obliged to precipitate largely their precious burden.

There are many other special and interesting questions in connection with the rainfall that it would be well worth our while to investigate, such as—the influence of neighbouring oceanic currents, the proportion of our rainfall which is carried into the sea by our impetuous rivers, the average number of days in the year when rain comes at the several seasons and in the different districts, the time of maximum rainfall, the cycles of dry and wet years, the precise localities and periodicity of droughts and excessive rainfall, the heaviest daily falls recorded, the monthly rain-probability for different districts, the relation between indigenous forest and rainfall, &c.

The subject of weather is a very important one, and one which is not, as far as New Zealand is concerned, by any means worked out, or even, as yet, well understood. Indeed, this remark need not be limited to New Zealand. Weather-saws, smacking of bygone times, are plentiful enough, and a species of forecasting was probably practised in ages rendered to us indistinct by the mists of antiquity; but systematic forecasting, founded on isobaric charts (Buchan's) and accurate knowledge of physical phenomena, is a science of yesterday, if, indeed, it be a science at all as yet. It is, however, not quite true now that "the wind bloweth where it listeth, and man cannot tell whence it cometh or whither it goeth," for patient and skilful workers have long been gathering meteorological facts, and, according to the Baconian inductive method, building theories thereon, many of which must be considered as incontestably established. What we have to do in respect to our colony is to make exact observations, gather accurate statistics, and examine them by the light of the general principles which have been worked out for us by such men as Dove, Loomis, Hann, Buchan, Scott, Abercrombie, Ley, and Ferrel. Thus, and only thus, we may hope to understand the weather to which we are subject.

Art. LXIV.—*Milk as a Vehicle of Disease.*

By Ernest Roberton, M.D.

[*Read before the Auckland Institute, 27th October, 1890.*]

The present age is remarkable for the interest taken by the general public in the public health. From times immemorial it has been regarded as the duty of governing authorities to protect the communities under their care from such forces as might occasion disease and death. Indeed, the cities of Greece and Rome in the days of their ancient splendour might in many ways compare favourably with modern towns as regards their sanitary arrangements.

With the advance of civilization it has been found necessary to cope with new enemies to health. For example, as villages have become towns vast systems of drainage have been demanded, and with the influx of population into manufacturing centres, and the resulting overcrowding, legislation has had to be provided regulating the arrangement of buildings designed for the accommodation of the poorer working-classes.

There is, however, another direction in which it has been necessary to advance with the times. Science, ever searching for explanations of facts, has been able to point out causes of prevalent disease—causes previously unsuspected, or, if suspected, not proved. A recognition of the fact that typhus fever required for its propagation the poisoned air and squalid surroundings once so frequent in the alleys and closes of the larger cities of Britain was followed by legislation which so vastly improved the homes and surroundings of the poorest working-classes that typhus is now almost unkown where it was once rampant. With increased knowledge also of the conditions favouring the development of typhoid fever, even it, still a scourge in almost every country, is gradually being overcome, and its ravages decreased.

The progress of sanitary science and the consequent advance in the direction of preventive medicine has been especially marked during the last twenty or thirty years, and probably what is popularly known as the "germ theory" has had the greatest influence in effecting this. At present especial interest is being taken by those concerned in preserving the public health in the consideration of the influence which our animal food has in propagating disease. That it is at present a means of spreading disease there is no doubt. Most interest is shown probably in the question as to whether the bodies of animals affected by certain diseases are fit for food; but closely allied to this subject, and I believe of even greater importance, is that which more especially concerns us to-night—"The extent to which milk may serve as a vehicle of disease."

The importance of the matter cannot be understood unless we have a fair idea of the part which milk plays as an article of human food, and it may be well for us to turn our attention to this for a few minutes.

Milk has been called by an author famous as an authority on the subject of diet a complete and perfect food. It contains all those elements which are constituents of a sufficient and healthy food for man. These elements are—(1) Substances containing nitrogen; (2) carbohydrates, a name given to a class of chemical bodies in which are the starches and sugars; (3) fats; (4) mineral salts.

Children and adults usually take what is called a mixed diet, some parts of their food (such as meat) containing mostly nitrogenous matter; potatoes are chiefly starch; butter is nearly all fat. Their different foods are taken in no fixed proportions, but as taste or opportunity may direct—more of one and less of another. Although, however, one may put into one's mouth very indefinite quantities of each element of food, one's digestive apparatus has only limited capabilities for the digestion of each of them, and only a limited amount of the whole food is really digested. The remainder simply goes to waste, and is eliminated.

The stomachs of all individuals are not equally strong—*i.e.*, they have not equal powers of digestion—and in the extremes of life (both in infancy and in old age) the digestive powers are comparatively weak. The same Providence which endues an infant with a weak stomach provides for it in milk a food in which the fats, the matter containing nitrogen, the sugar, and the salts are mixed in the quantities and form best for their easy digestion.

All milks are not exactly alike as to the proportion of their various ingredients. What will suit a foal is not the best for a lamb, nor, as a rule, is the milk of a cow so good for a human infant as that from its own mother's breast. Still, in cases where a mother may not or will not nurse her own offspring, and a good wet-nurse is not procurable, the best substitute for the child's natural food is undoubtedly milk from some other animal. Among most European nations the cow is the chosen animal, but the goat, ewe, mare, and reindeer are used in some districts.

Not only, however, to infants is it an advantage to have a good supply of milk—as we have seen, a complete food in a form easy for digestion; for the old and the invalid it is at times invaluable, and for the rest of mankind, especially for the children, the experience of centuries has proved its worth. Its value compared with that of other common foods can be appreciated by any one acquainted with the difference in strength and appearance between children reared where a supply of milk is abundant and those whose stomachs are constantly oppressed by the heavy work of trying to digest bacon and other cheap meats, which, washed down by copious libations of tea, form the staple food of the poor in many large towns in Britain. Even in country districts not far distant from our own town, settlers do not see the advantage of a good supply of milk for their children, and the pale dyspeptic countenances of the young folks are the reward of a diet arranged by the ignorance, carelessness, or laziness of their parents.

The milk of domestic animals has from remote ages been generally used by civilized peoples, but there is at the present time an increased recognition of its value as a food, and a growing demand for it. The extension of railways and other facilities for its speedy conveyance to centres of population have enabled an increasing demand to be satisfied; and enactments against adulteration have given confidence to consumers and protection to honest farmers and dairymen. It has been estimated that in England there is a daily consumption of such an amount of fresh milk as would, if equally divided amongst the whole population, allow one-fifth of a pint to each individual in the country; and this amount, great as it is, represents only one-third of the total milk-consumption: the remainder is made into butter and cheese and other manufactured articles of food. The fact of such an enormous consumption of milk is sufficient to suggest the greatly injurious influence the milk-supply may have on the health of the nation unless adequate precautions are taken to insure that a pure article is supplied—milk neither adulterated nor containing in it the germs of disease.

That much preventible sickness is due to the use of a bad quality of milk is certain, and it may also be regarded as decided that milk may be the means of transmitting diseases of a specific nature, such as the fevers, typhoid, scarlatina, measles, and diphtheria; also tuberculosis or consumption, and possibly leprosy.

For convenience we may consider diseases caused by means of milk under two heads—(1) Derangements of digestion due to a bad quality of milk consumed; (2) specific infectious diseases.

We will first deal shortly with the derangements of digestion which occur chiefly in children under two years of age. These digestive troubles may follow the use of milk from cows fed upon some food which, passing into their milk, renders it more difficult of digestion, or itself exerts a directly harmful influence on the child; or they ensue from the use of milk from cows themselves in a bad state of health. But the usual fault on the part of the milk causing digestive disturbance is that it has become fermented—it has been exposed to the influence of germs which have set up a fermentative process, the products of which are irritating to the stomach and bowels.

If milk is kept from the action of germs it remains good, and, although germs must enter it if exposed to the air, still the probability of a sufficient number of germs of the kinds necessary to cause harmful fermentation, getting access to it, is much lessened if only cleanliness is observed in connection with the operations of milking, distributing, and storing the milk.

The surroundings of a milking-shed of the ordinary type are by no means fitted to insure cleanliness. The cows usually, at any rate in winter-time, have to splash through mud and filth to reach the shed. The milking is done by hands not over-clean, and without cleansing the teats. The buckets in which the milk is first placed are cleansed by being rinsed in water the purity of which would not stand the test required to establish it as fit for drinking by man; the same with regard to the cleansing of the cans in which the milk is conveyed to the consumers. These cans, too, are often not dust-proof, which is a by no means unimportant essential in a place where, as in Auckland, so little attention is paid to the thorough laying of the dust which rises from the filth of the streets. Even when milk has reached the consumer's house it has yet to run the risk of exposure to dust in vessels probably themselves imperfectly cleaned; the wonder, indeed, is that so little milk is actually spoiled by becoming soured.

Sourness, however, is not a test as to whether milk is harmful or not. The germ which causes ordinary sourness of milk is not particularly harmful; but usually associated with it are others with a more noxious influence. These, indeed, may be present although the milk remains quite sweet.

The ills resulting in children from the use of fermented milk are to be avoided, in the first place, by having the utmost care for cleanliness—by seeing that the teats of the cow, the hands of the milker, all cans and other utensils through which the milk may pass, are thoroughly and well cleaned. All water used for the purpose should be such as is fit for man to drink. It is strange that folk most fastidious as to the water that passes their lips should yet wash their milk-cans in water from a source into which, perhaps, the drainage of the stockyard passes. I have seen such a state of things on more than one occasion. In first-class dairies in Britain it is usual not only to rinse the cans with cold water, but, in addition, to cleanse them with steam. Cans for the conveyance of milk should be dust-proof, and so, too, the vessels in which the milk is kept after reaching the house of the consumer. The finding at the bottom of a glass of milk small pieces of hay and other dirt usually leads to the imputation of a want of cleanliness on the part of the dairyman, while in reality these impurities often proceed from street-dust, which, in fact, consists largely of manure. The blame should be laid on the city authorities who allow such a dust nuisance to prevail.

Where a consumer is in doubt regarding the condition of the milk it should be boiled before use. This proceeding destroys not only the germs causing ordinary fermentation, but also those which are the cause of the infectious diseases to which presently I will more especially refer. It is doubtful if boiling in any way impairs the digestibility of milk.

The process of boiling, as it destroys germs and thus effectually prevents their multiplication, is said to be a process of sterilization—milk when boiled is said to be sterilized. It has been proposed, and in some places actually accomplished, to place sterilized milk in the market. In St. Petersburg, in the Children's Hospital, also in some large dairies and private families, the milk is heated in flasks to boiling-point, and hermetically sealed while in a state of ebullition. A similar process has been carried out on a smaller scale in Norway and in London.

In Copenhagen milk for children is sold by the druggists. All cows from which the milk proceeds are specially chosen, and subjected regularly to examination by veterinary surgeons. The cows are specially fed, and special precautions are taken to preserve the purity and freshness of the milk, which is placed in sealed bottles before being sent to the druggists, by whom families are supplied.

It is clear from what I have said that the prevention of harm to children through their being supplied with unwholesome milk lies to a very great extent in the hands of consumers. They must themselves see that they take precautions to exclude dust from the milk, to cleanse thoroughly all vessels in which milk is placed, and should insist on being supplied with milk free from dirt, and otherwise, so far as they are capable of judging, entirely sound. Such insistence will compel the dairyman and dairy-farmer for the sake of their trade to regulate to some extent the sanitary arrangements of their premises and the methods in which the milking and the distribution are carried out. Is this sufficient? It has been decided in most civilized countries that something further is required—that the public authorities should have some control over the milk-supply. Through ignorance or carelessness, or through temptation or gain, suppliers are liable, in spite of all care on the part of consumers, to supply unwholesome milk. We have seen that unwholesome milk does not necessarily give signs of its unwholesomeness prior to its consumption, and in such cases the consumer is at the mercy of his milkman. It is necessary for cowsheds, dairies, and other buildings connected with the trade to be open for inspection to an authorized official competent to detect such arrangements as may be prejudicial to the wholesomeness of the milk. Such supervision is, however, required much less on account of the liability of children to be affected by digestive derangements from the use of unsound milk than because of another great danger to which we have hitherto only incidentally referred—the danger of milk being a means of carrying infectious disease. Milk serving such a purpose may give no sign that it is in any way impure. It is only after an epidemic shows itself that a chain of evidence is put together proving that the milk-supply is at fault. Then it is found that with proper precautions the epidemic might have been prevented.

For instance, scarlet fever breaks out in some neighbourhood; there is a simultaneous outbreak in several families, and in the different families one, two, or more are affected at the first appearance of the disease. The children from the several infected houses have never come in contact with each other nor with any known to be suffering from scarlet fever; but it is noticed that all the families are supplied with milk from the same dairy, and that those first affected have all partaken of milk supplied during one or two special days. Others in the same families using milk from another dairy, or absent from home on these special days, have all escaped—at any rate, in the first instance. Attention being directed to the dairy from which the milk is derived, it is found that there is an explanation of the way in which the milk may have become infected. Very frequently one of the milkers has children suffering from scarlet fever, or has himself shown symptoms, but so mild as not to compel him to give up his work. Families supplied from the same dairy, but with milk kept apart from that in which the affected individual has been concerned, have all kept free of the disease. The evidence that the milk was a cause of the epidemic is conclusive, but only after it is too late to prevent the mischief. In such a case the consumer has no opportunity whatever of preventing his family from participating in the infection, and so we find in all cases of epidemics arising from the milk-supply. A guarantee of prevention lies only in the taking of such measures as will abolish all possible source of infection from the time the milk leaves the cow until it is delivered to the consumer. The interest of the community in preventing epidemics of infectious disease is such as to warrant the adoption of the strictest regulations necessary to insure a pure milk-supply. Of course, all cases of infectious disease do not originate in the milk-supply—probably only a small proportion of them; but the repression is urgently required of any factor in maintaining such a death-rate from infectious disease as at present prevails. The deaths from such diseases do not form the whole of their evil results: the temporary illness and suffering of those that recover and the permanent injury done to numbers of them must also be taken into account.

Infectious diseases, it must now be allowed, are probably all due to specific germs. Some of them have been absolutely proved due to the presence of a special kind of germ in the body. The evidence in the cases of the other fevers, so far as it goes, makes the theory very probably true as regards them. One kind of germ causes one special fever and no other. The germ of scarlet fever is quite distinct from that causing typhoid or any other infectious disease. This is what is meant by saying that each infectious disease is due to a specific germ.

In order for a man to be infected with any infectious fever the specific germ of that fever must be introduced into his system; and when milk is the vehicle of infection the milk the individual takes must contain the specific germ. Now, many germs placed in milk find in it all that they require to thrive and propagate their kind. Just as in good ground weeds thrive and multiply because they are in circumstances favourable for their nourishment and growth, so germs find in milk a first-class soil, and multiply at an amazing rate. In a few hours from the introduction of a germ or two the whole of the milk is swarming with them. We can thus understand how one or two specific germs finding access to a large quantity of milk are able to cause disease in many individuals. The fact that in many dairies the milk from all the cows is mixed, and that in milk-shops the milk from different farms is not always kept distinct, adds to the danger of spreading disease. Of course, when milk from different sources is mixed, the infecting germs, if present in only one of the mixed lots, are not so abundant in the same quantity of milk immediately after mixing, but the whole being now infected the germs may go on multiplying in it. To cause disease, however, it is not necessary for a large number of the disease-causing germs to be swallowed, for one or two getting access to the body are capable of soon becoming many under certain circumstances. They multiply within the body.

The principal infectious diseases, epidemics of which have been traced to originate in the milk-supply, are typhoid fever, scarlet fever, and diphtheria.

Typhoid, or enteric, or gastric, or low fever is the most common of the specific fevers, and is endemic in almost every quarter of the globe. It is probably caused by a germ which was discovered and described some eight years ago. This germ is present in the excreta of those suffering from typhoid fever, and most cases of infection are caused directly or indirectly from the excreta of typhoid patients contaminating water, food, or perhaps the air. It must be well known to all here how frequently the prevalence of typhoid fever is ascribed to defective drainage. When drainage is defective the waste material from houses is not properly removed. It lodges in some depression in the ground, or perhaps saturates the ground. At any rate, there is an accumulation of organic matter with plenty of moisture, just the condition necessary for the thriving of germs. Should the typhoid germ find access to this accumulation, in time the collection of filth becomes a very successful typhoid-breeding establishment. Soakage from this filth finds its way to some well, which is thus polluted and infected. Or dry weather comes; some of the filth dries up, is powdered, and is blown hither and thither into wells, tanks, food, or, it may be, directly into the nose or mouth of some one. The germs are not killed by being dried up; they are only for the time being prevented from multiplying. So soon as they become moist they again begin to develope. Milk is usually infected with the typhoid germs from an impure water-supply; possibly it is diluted with impure water, or polluted water is used to wash the cans and other dairy-utensils. In either case the germ is added to the milk. It may be that dust containing the typhoid germ reaches the milk. Hence one great necessity for placing milk in dust-proof cans during its distribution. In Auckland the night-soil carts (containing excreta from typhoid folk as well as healthy) are very capable of distributing filth along the streets they traverse, and, as we know, the street-dust is not the least of the nuisances existing in the town.

Some assert that milk may become capable of conveying typhoid fever through water polluted with the typhoid poison being given to the cows. This theory, however, is not proved. Were this the case the system of the cow must be first infected, and evidence sufficient to prove that this is possible has not yet been brought forward.

As examples of the evidence often found connecting a typhoid epidemic with milk from a special dairy, let me mention one or two cases which have actually occurred.

In February, 1889, some fifty cases of typhoid fever occurred in Stirling and its neighbourhood, and were traced to be caused by milk from one farm. It was found that a case of fever had occurred at the farm-house, and the excreta were disposed of by the watercloset, the soil-pipe from which went into a badly-jointed drain passing close to the milk-house. It seemed as if the milk became contaminated in consequence of the proximity of the defective drain to the milk-house, for families supplied direct from the milk-sheds escaped infection, and all families where infection did occur were supplied with milk which had been kept over night in the milk-house.

In Leeds, in 1873, an outbreak of typhoid fever was traced to the milk-supply from a special dairy. It was found that the dairyman had been ill with typhoid fever, that the excreta had been cast partly into a privy and partly on to a dunghill, and that drainage from each of these found its way into a well used both for domestic and for dairy purposes. The sudden outbreak of fever among families supplied from this dairy corresponded with the time necessary for the development of the fever after the first pollution of the well; and the cessation of the epidemic corresponded also with an interval after its being closed, consistent with the theory that its water had been infected.

Scarlet fever, like typhoid, is most probably due to a germ, but, unfortunately, in its case it is not decided on which germ the responsibility of such a scourge is to be cast. A London scientist, Dr. Klein, has discovered one germ which he regards as certainly the specific germ of scarlet fever. In Edinburgh, Dr. Edington has equally convinced himself and others that scarlet fever is not caused by Klein's germ, but by one quite different, which he himself has discovered. Till this question is settled we must be content to know that general evidence is in favour of some germ or other being at the root of the mischief known as scarlet fever. Granting that this specific germ does exist, it is present especially in the scales given off from the skin of scarlet-fever patients during convalescence, as well as during the more acute stage of the disease. In these scales the germs are blown about until perhaps they find a resting-place in the alimentary tract or air-passages of some other unfortunate individual, who thus becomes infected. It is, however, not only by the scales from the skin that the infection is carried, but probably by other excretions of the body. Scarlet fever is one of the most infectious of diseases, and to expose milk to the air in the immediate vicinity of a scarlet-fever patient, to allow any one recovering from the disease to partake in the duties of the dairy, or even any one who comes in contact with such a patient, is to court the risk of an epidemic. That scarlet fever has occasionally been conveyed to man through the agency of milk has been known for some fifteen or sixteen years. It was for long taken for granted that the milk became contaminated directly from a human source, but in 1886 a new question was raised with regard to the contamination of milk with the poison of scarlet fever. It was suggested that cows suffered from the disease as well as man, and that an epidemic might arise from the use of milk from cows affected with it. The question was raised in consequence of a limited epidemic of the fever occurring in London, evidently due to the supply of milk from a certain farm at Hendon. It was proved that the milk must have been infected before it left the farm. It seemed, however, for a long time that the infection could not have come directly from a human source, and, as certain cows introduced into the dairy about that time were suffering from a feverish disease, investigations were set on foot to see if scarlet fever and this feverish disease in the cows were not identical. Dr. Klein, whom I have before mentioned, made experiments, and found apparently the same germ in both scarlet-fever patients and the diseased cows; and, according to him, this germ, whether obtained from a scarlet-fever patient or from a cow, when inoculated into calves, produced in them, with only slight differences, the original cow fever. This seemed conclusive, but later investigations threw some doubts on the results of Klein's research. Another outbreak of the same cow fever occurred at Hendon and elsewhere in 1887–88, but was accompanied by no outbreak of scarlet fever, although the milk of the diseased cows was sold and used. The animals which had originally brought the cow fever to Hendon came from Derbyshire, and it was ascertained that other cows from the same district sold at the same time had developed the same disease; but, although their milk had also been sold, no epidemic of scarlet fever had resulted. Finally it was shown that after all there was a possible source of infection of the milk through human agency. During one or two other epidemics of scarlet fever it was found that there was a feverish disease prevalent among cows in the neighbourhood, but this would appear to have been a mere coincidence. It has not been satisfactorily proved that scarlet fever does attack the cow, but it is very certain that it can readily be spread by the agency of a milk-supply. The same is probably true with regard to measles; but I can find no notices of epidemics of measles which have been traced to this source.

Diphtheria epidemics traced to the milk-supply have always been associated with an impure supply of water from the dairy in which the epidemic originated. In 1879 an epidemic at Leatherhead, in Surrey, affected thirty families almost simultaneously, and twenty-nine of these families had a supply from one dairy-farm. The water in use at this dairy came from a tank, and was decidedly impure from the presence of decaying organic matter. It was probably the means by which the milk became contaminated.

In speaking of scarlet fever, I have mentioned that it has been suggested that it affects the cow as well as man. The same has been suggested regarding diphtheria.

There are some acute cattle-diseases which, if not actually conveyable to man, at any rate cause the milk of cows affected with them to be unfit for human consumption. Such are the cattle plague, foot-and-mouth disease, and pleuro-pneumonia. The use of milk from cows suffering from these diseases may induce in man inflammation of the lungs of a severe and often fatal kind.

I now pass to another class of infectious disease affecting man which may be conveyed to him by means of milk. Those diseases of which I have hitherto been speaking are acute fevers in which the characteristic symptoms appear in a comparatively short time after infection, and in regard to which it is therefore a comparatively easy task to set on foot investigations to prove their possible connection with a milk-supply. Those diseases to which we now turn our attention are, as a rule, of a more chronic nature. Their symptoms are at first vague. Often it is not until months, even years, after they have been acquired that it is realised that the affected individual is suffering from them. To this class of diseases belong leprosy and tuberculosis.

With regard to leprosy and its connection with the milk-supply, I would mention merely as a matter of interest a suggestion made by Dr. Neve, a medical missionary stationed at Kashmir, a man whose academic career proved him a careful and reliant observer. Dr. Neve says that in Kashmir leprosy exists to a considerable extent among herdsmen, all of whom also consume largely milk and milk-products. One adult may eat from 6lb. to 12lb. of curds in twenty-four hours; putrid buttermilk is considered a delicacy. It is easy to see that a leprous milkman might spread infection, and in this connection Dr. Neve points out that Europeans who drink unboiled milk, if they chance to live in a district where leprosy is endemic, might thus contract the disease. In fact, he says, this may be the explanation of various recorded cases. So much for leprosy.

The subject of tuberculosis demands much more attention. Perhaps I ought in the first place to state for the benefit of some what is meant by tuberculosis. It is the scientific name for what is more generally known as consumption—that fell disease the cause of which has until quite recently been so imperfectly known, and the ravages of which have for ages been so vast among civilized peoples, seeking its victims too especially among those who should be entering on their life's work in all their vigour. It is estimated that from 10 to 14 per cent. of all deaths are due to tuberculosis. In Britain, 150,000 deaths are annually registered as due to it. In Paris, about 20 per cent. of all deaths result from it; in Vienna, 15 per cent. of all deaths, but in some quarters of the town no less than 90 per cent. In New Zealand, during 1888, the death-rate from tubercular disease was rather more than 11 per cent.

I mention these figures to give some idea of the magnitude of the evil; but the deaths represent only a part. We must take into consideration the suffering which precedes death, and the loss to the community from the impairment of the usefulness of the sufferers, and from the necessity of others being engaged in nursing and attending to their wants.

The popular idea regarding consumption is, I think, that of a wasting disease in which the lungs especially are affected. It is now known that other organs of the body become diseased from the same cause—a specific germ, the *Bacillus tuberculosis*, this name being applied to it because its presence and development in any part of the body gives rise after a time to the formation of little diseased masses known technically as tubercles.

There is no doubt that certain individuals and certain families are much more prone to consumption than others, but it would appear that it is necessary that in every case the specific germ should find its way into the body of the person affected. When once it has entered the body, should it be deposited in any part the vital power of which is lowered by disease, by heredity, or other cause, in that part of the body it is especially liable to develope and then spread to other parts of the body. How then, we may inquire, does the germ get into the system? Experiment and research show that it may enter the body either through the air-passages or through the alimentary tract (the stomach and bowels). It is with the latter that we have to concern ourselves to-night in considering what part milk may play in the spread of tuberculosis.

Among other facts which establish the view that the germ of tuberculosis may enter the system through the alimentary tract I may mention the following: A consumptive patient, being recommended to live in the country, went to a farmhouse at which a considerable number of poultry were kept. The spittoon used by him being emptied in the farm-yard, the fowls were in the habit of devouring the expectoration. After a few weeks an epidemic of consumption broke out among the poultry, causing a mortality of about fifty in three or four months.

Experiments conducted with a view to confirm the suspicion that food could convey tuberculosis have given a positive result. Guinea-pigs and rabbits fed constantly on food containing tubercle germs in time developed the disease, and the examination of their bodies showed that the germ evidently entered the system through the walls of the bowels and thence invaded the rest of the body.

While tuberculosis most frequently affects the lungs in young adults, it is found that in young children it is especially the bowels and the adjacent parts that are affected. The examination of the bodies of children thus dying points out conclusively that the germs have entered the body through the walls of the bowels and spread thence. Such disease in children is especially frequent between the first and sixth years of life, and forms one of the most common causes of death during this period. The difference of the localities in the body which tuberculosis especially affects in adults and in children is explained by the fact that during early childhood the digestive system is especially taxed. The rapid growth of the body causes a demand for a large amount of digested matter to supply material for building up the tissues, and this demand throws so heavy a strain on the digestive organs that they are especially liable to be thrown out of order and rendered less capable of resisting disease.

It being probable that the germ of tuberculosis is able to make its inroads on the human frame by way of the alimentary tract, introduced in the first place with the food, it will be readily perceived how important it became to find out in what form of food the germ is liable to be present. Many facts pointed to the probability of animal food being an agent of infection—in fact, that a vast unknown accidental infection by this means had been going on for ages.

In cattle a disease exists known as bovine tuberculosis, unfortunately at the present time on the increase, and affecting especially the best breeds of dairy-cattle. This disease has during the last few years been shown to be due to the very same cause as the similar disease which plays such havoc with the lives of men, and it exists to such an extent and under such circumstances as to leave little doubt that much of the tuberculosis in man is due to infection through the use of meat or milk from tuberculous cattle. In 1881 the authorities of the Grand Duchy of Baden issued a report which applied to fifty-two towns, and which showed that where tuberculosis was prevalent among cattle it was equally prevalent among the human population, and was more prevalent in those parts of a town where the butchers paid least attention to the quality of the meat sold. Sir Lyon Playfair has recently in a debate in the British House of Commons pointed out that it is a significant fact that where tuberculosis in cattle increases there also consumption in its different forms increases, but especially that form which attacks the digestive organs of children.

Professor Bang, of Copenhagen, by giving milk from tuberculous cows to pigs and rabbits has caused tuberculosis in them. Cream and buttermilk and butter made from the same milk showed the same infectivity.

An unintentional experiment was made in the following instance: A herd of valuable cows was found to contain several that were tuberculous. The owner withdrew their milk from sale, but, considering it would be a pity to waste so much of what he thought, at any rate, good feed for pigs, it was given fresh from the cow to the pigs. The result was that almost without exception the pigs became affected, and had to be slaughtered.

Some light, it is thought, has been thrown on the question by the fact that members of the Jewish religion, in communities where the meat eaten by them is subject to rigorous examination, and rejected unless the carcase is thoroughly sound, are much less subject to tuberculosis than other people in the same districts. In Melbourne and Sydney, according to Dr. McLaurin, there was during three years only one death from tuberculosis of the lungs among the Jews of these cities, while, if they had been affected in the same proportion as the rest of the population, thirteen or fourteen would have succumbed.

In many towns in Britain a considerable portion of the milk-supply is provided by stall-fed cows, which are especially liable to tuberculosis on account of their unnatural confinement in the stalls, the generally unhealthy nature of their surroundings, and the exhaustion resulting from long-continued lactation. When diseased, these cows, being no longer fit for dairy purposes, are sent to the slaughterhouses, and their flesh utilized for food. So, too, cattle from other sources similarly affected. In the last stages of tuberculosis these cattle are known as "wasters," from the most prominent symptom of their disease, or as "mincers," from their ultimate destination, they being favourite purchases of the sausage-makers, whose agents in different parts of the country are able to pick up such animals at comparatively cheap prices.

If, however, danger exists from the consumption of meat from such animals the danger from using milk of tuberculous cows is much greater. Meat is cooked, and the germs thus often perish; but milk, as a rule, is used uncooked, and still more so its products, butter and cheese. It is possible by the inspection of a carcase to tell if the meat is unfit for food, but milk infected by the *Bacillus tuberculosis* requires a minute microscopic examination, which, as a practical dairy test, is impossible. Further, in the cow the udder is especially liable to be affected by tubercle. In the human species the breast is rarely affected; but in the cow, very often while still "prime fat," and before any symptoms point to the general system being affected, the udder is so diseased that the milk drawn from it is a dilution of tubercular poison. In a large dairy one tuberculous cow may be the means of carrying the disease to hundreds of families, all ignorant of the danger they are incurring.

To sum up our knowledge of the influence of the milk-supply in causing tuberculosis in man, we may say that it is proved that tuberculosis in man and in cattle are the same disease—due to the *Bacillus tuberculosis*; that the milk from a tuberculous cow, especially if the udder is affected, is liable to contain the germ of tuberculosis; that the use of food containing this germ has been proved a means of infection, and that therefore the use of milk from tuberculous cows is attended by serious danger. There is good reason for believing that the use of such milk is responsible for some of the tuberculosis in man, especially of its manifestations in children.

I have endeavoured to bring under your notice the principal diseases by which man may become affected through his milk-supply. A knowledge of the dangers incurred by this means is of value only so far as it is applied to lessen or prevent the risk of disease. I hope you will bear with me a few minutes while I attempt to point out the ways in which we may take advantage of our knowledge. In the first place, in all duties connected with the milk-business—its production, its distribution, and its consumption—cleanliness is a first essential, and in securing this the consumer as well as the producer must bear his part. In his own house he should insist on the milk being kept in perfectly clean vessels, and free from dust. He will gain much also from seeing that it is boiled shortly before use, unless he is positively certain that it is in every way pure. If he is cognizant of a want of cleanliness in the dairy from which his milk is derived he must, of course, take the responsibility of any evil results should he continue a customer of that dairy. The consumer is able to effect much good by insisting that his milk shall come to him from such a source and under such conditions that its purity is guaranteed. Unfortunately, the majority of milk-consumers either do not care from whence their milk comes so long as they get it, or else have no opportunity of inquiring and satisfying themselves that all due precautions are taken to insure that a good article is being delivered to them.

The chief responsibility in insuring a pure milk-supply rests with the dairyman, and, although there is no doubt that the necessity of avoiding the suspicion of supplying contaminated milk exercises a salutary effect, yet I think we may safely say that it is a very small minority of milk-vendors who would knowingly distribute milk capable of causing disease. Most of those I have become acquainted with have shown themselves anxious to provide against dangers of this kind. Still, there are black sheep in every flock, and cases have come to light where milk has been deliberately adulterated with sewage from an open drain. Where the dairyman is at fault the deficiency probably arises chiefly from ignorance or carelessness, and until it is usual for dairymen to be proficient in sanitary science such causes must continue to operate. Hence the necessity that dairies and milk-shops should be under the supervision of some public authority, and that the law should demand that precautions be taken to insure a pure milk-supply. It is necessary to provide—

1. That cows whose milk is used for consumption by man should be free from disease:

2. That the sanitary arrangements of dairies and milk-shops and their surroundings should be complete:

3. That the water used for the cows should be good, and especially also that water intended for washing the teats before milking, and for cleansing the milk-cans and other dairy-utensils, should be such as man might drink with impunity:

4. That there should be proper appliances for efficiently cleansing all utensils in which the milk is placed:

5. That during its distribution the milk is kept from dust:

6. That all employed in dairies, or otherwise in the distribution of milk, should themselves be free from infectious disease, and should not come in contact with those thus affected.

In Britain, such provisions as these are in force, and to facilitate their being carried out it is provided also that each local authority should keep a register of all carrying on the business of cow-keepers, dairymen, or purveyors of milk. In some districts the Dairy, Cow-sheds, and Milk-shops Order seems to work fairly well, but it is now felt that further legislation is necessary, as almost universally there is great laxity in enforcing its provisions, owing to the want of efficient inspection. Dairies and milk-shops, as well as the cows themselves, ought to be subject to frequent systematic inspection by competent officials. There is also no provision against the importation of impure milk into any locality, although all dairies and shops within its boundaries may be rigidly controlled. For example, London dairies may be perfect, and yet milk of doubtful quality may be imported perhaps from the North of England without restraint. At present, in Britain, tuberculosis is not one of the diseases included among those which disable a cow from being used for dairy purposes.

The question as to whether it ought not to be included is now being discussed, and there is no question but that sooner or later the necessity will be recognized of preventing the sale of milk from tuberculous animals. The difficulties which at present lie in the way of such legislation are partly common to all attempts to legislate for the good of the community by controlling any special branch of trade. It is difficult to prevent injury to individual rights, and one serious part of the question is, whether compensation ought not to be allowed to the owners of cows which would thus be prevented from being a means of profit.

What the condition of the law in New Zealand may be with regard to the milk-supply it is difficult for one little acquainted with the statute-book to determine. Legal provisions on the subject are contained in clauses scattered through various Acts.

Adulteration of milk is provided against along with that of other foods. The Public Health Act contains a clause empowering the Governor in Council to provide for the registration of purveyors of milk, &c., for the appointment of inspectors, for the securing of efficient sanitation of dairies and milk-shops, and for the prevention of the sale of milk in cases where it would endanger the public health. Local Boards also may be authorized to make regulations for effecting these purposes. Regulations were gazetted to this effect in 1882. No practical result has, however, so far as I can learn, been the outcome of this part of the Public Health Act. There does not appear to be any registration of dairies; and only on special occasions, and then also only in limited districts, has any systematic inspection of dairies and dairy-cattle been made.

During the last session of Parliament some advance has been made by including tuberculosis among the diseases which when detected by the Inspector of Cattle necessitate the destruction of the animals affected. Tuberculosis, according to the report of the Live-stock Committee, is prevalent to a considerable extent in New Zealand, but accurate information as to the degree of its prevalence is still wanting. It is pleasing to find that the Live-stock Committee recognizes how serious a matter it is that tuberculosis should be prevalent in any country, and that the advice of the Committee has been acted on to circulate among stock-owners and others the admirable report on the subject drawn up in Britain by the Departmental Committee of the Privy Council.

In New Zealand we often congratulate ourselves that we are keeping up with the progress of the rest of the world. In sanitary matters generally we do not perhaps show quite as much activity as we ought, and in the matter of regulating the sanitary surroundings of the milk-trade it is evident that we are sadly deficient. Wholesome official control of the milk-supply ought to be a powerful factor in maintaining the exceptional healthiness of the population, which is one of the great privileges of the colony, and our gain would be not only in the direction of physical welfare. We are hoping and attempting to develope an export trade in dairy-produce. Throughout the world attention has been directed to the dangers to health lurking in food derived from milk and its products; and other countries—Denmark, for instance—have seen the necessity of providing legislation which will help to guarantee the harmlessness of the dairy-produce they export. If New Zealand is behind the times in doing likewise she must struggle the longer in opening a market for her surplus dairy-produce.

I have offered nothing original in what I have brought forward. I have attempted only to give an idea of the views at present held on the subject of milk as a vehicle of disease, and I trust that the importance of the subject may veil any defects of the method in which I have treated it.

NEW ZEALAND INSTITUTE.

NEW ZEALAND INSTITUTE.

Twenty-second Annual Report, 1889-90.

Meetings have been held during the past year on the following dates: 5th August, 4th October, 1889; and 7th February, 17th July, 1890.

The following are the Governors elected by the incorporated societies for the year: Mr. J. McKerrow, Mr. S. Percy Smith, and Mr. A. de B. Brandon.

The members retiring from the Board, in conformity with section 6 of the Act, were—Mr. W. T. L. Travers, the Hon. Mr. Waterhouse, and the Ven. Archdeacon Stock; and the following gentlemen have been appointed by His Excellency the Governor to fill the vacancies: Mr. W. T. L. Travers, the Hon. R. Pharazyn, and Mr. W. M. Maskell.

The members now on the roll of the Institute are,—

Honorary members	29
Ordinary members—	
Auckland Institute	216
Hawke's Bay Philosophical Institute ...	101
Wellington Philosophical Society ...	185
Philosophical Institute of Canterbury ...	86
Nelson Philosophical Society... ...	42
Westland Institute	71
Otago Institute	142
Southland Institute...	72
Making a total of	944

There is a vacancy in the list of honorary members, caused by the death of the Marquis of Normanby.

The volumes of Transactions now in stock are—Vol. I. (second edition), 270; Vol. V., 30; Vol. VI., 28; Vol. VII., 123; Vol. IX., 123; Vol. X., 156; Vol. XI., 45; Vol. XII., 50; Vol. XIII., 50; Vol. XIV., 73; Vol. XV., 185; Vol. XVI., 185; Vol. XVII., 220; Vol. XVIII., 167; Vol. XIX., 190; Vol. XX., 190; Vol. XXI., 200; Vol. XXII., not yet ully distributed.

The last volume of the Transactions (XXII.) was issued early in June, and contains sixty-two articles, also addresses and abstracts of articles which appear in the Proceedings. The volume contains 607 pages of letterpress and 32 plates.

The following is a comparison of the contents with that of the previous year's volume:—

	1890. Pages.	1889. Pages.
Miscellaneous	142	114
Zoology	244	148
Botany...	56	120
Chemistry	4	15
Geology	62	84
Proceedings	52	48
Appendix	47	54
	607	583

The expense of printing Vol. XXI. of the Transactions amounted to £248 11s. 4d. for 583 pages, and that for Vol. XXII. £284 6s. 9d. for 607 pages, the increase in cost being owing to extra expense on the plates.

The Honorary Treasurer's statement of accounts for the year is appended, and shows a balance in hand of £90 3s. 1d.

Appended is the correspondence regarding the handsome donation of books made by Mr. C. R. Carter.

James Hector,
Manager.

Approved by the Board.

Robert Pharazyn,
Chairman.

17th July, 1890.

New Zealand Institute Accounts, 1889–90.

Receipts.	£ s. d.	*Expenditure.*	£ s. d.
Balance in hand on 5th August, 1889 ..	95 14 11	For printing Vol. XXII.	284 6 9
Vote for 1889–90 ..	500 0 0	Miscellaneous items ..	46 15 1
Contribution from Wellington Philosophical Society	18 11 0	Carried to Memoir Account	200 0 0
Sale of Transactions ..	6 19 0	Balance	90 3 1
	£621 4 11		£621 4 11

W. T. L. Travers,
Honorary Treasurer.

23rd July, 1890.

Correspondence respecting Donation of Books.

No. 1.—Mr. Carter's Letter to the Board.

Dear Sir,— Wellington, 22nd January, 1890.

I am desirous of presenting to the New Zealand Institute and Colonial Museum my library of books on or relating to New Zealand, of the value of £300. One folio volume alone cost me £20. It is, I believe, the largest collection of books of its kind in any library in the colony, and contains over a hundred works more than are in the collection of similar books in the Melbourne Free Library. The collection consists of 395 works on New Zealand, of which sixty-four are pamphlets, forming (with the sixty-two duplicate copies) a selection of 557 volumes, to which I have added sixty printed catalogues of the same.

I respectfully offer the collection to the New Zealand Institute and Colonial Museum on the following conditions: (1.) It is to be placed in a suitable position in the library of the Institute. (2.) A properly-constructed book-case, with glass doors, is, without delay, to be provided for its reception. (3.) The books are to be used as works of reference only, and not to pass outside the Museum.

I should part with the collection with some regret did I not think it would be more useful to the public than by remaining in my possession. I do not anticipate that the present generation will appreciate its value, but I venture to hope that a succeeding one will.

To collect and collate this small library of books on New Zealand has been to me, I may say, a labour of love, the fruits of which I now wish to intrust to your safe keeping. I have also to present to the Museum a collection of arms gathered on the battle-fields of the Franco-German war of 1870–71, and a French chassepot rifle used during the siege of Paris in 1871. I have, &c.,

C. R. Carter.

Sir James Hector, K.C.M.G., Colonial Museum.

No. 2.—Reply to Mr. Carter, and Resolution of Board.

Colonial Museum of New Zealand,
Sir,— Wellington, 18th February, 1890.

By direction of the Board of Governors of the New Zealand Institute, I have the honour to forward for your information an extract from the minutes of a meeting of the Board held on the 7th instant, the Hon. W. B. D. Mantell, M.L.C., in the chair.

"The Manager laid before the Board a letter from Mr. C. R. Carter, dated the 22nd January, 1890, in which he proposes to make a donation to the New Zealand Institute and Colonial Museum of a collection of published works relating to New Zealand.

"*Resolved,* That Mr. Carter's letter be entered in the minutes for permanent record. That the offer of Mr. Carter be accepted on the conditions imposed, and that the Board, on behalf of the New Zealand Institute, desires to record its thanks and its high appreciation of the value of the gift which he thus makes, and of the great ability and industry which the acquisition and collation of such a complete collection of special literature must have entailed. The Board thoroughly recognizes that the liberal action of the donor, and the nature of the conditions he has imposed with the gift, prove that the motive which led Mr. Carter to accumulate this unique collection of rare works was purely the desire to secure a sound basis for the future study of the early history of this colony—a motive which is alike worthy of the donor's intelligence and generosity. That a copy of this resolution be transmitted to Mr. Carter."

I have, &c.,

J. Hector,

Manager.

C. R. Carter, Esq., Wellington.

PROCEEDINGS.

WELLINGTON PHILOSOPHICAL SOCIETY.

First Meeting: *8th June, 1890.*

C. Hulke, F.C.S., President, in the chair.

New Member.—W. M. Beetham.

1. Address by the President.

Abstract.

Mr. Hulke selected a most interesting subject for his address—viz., a review of the inventions and scientific discoveries of the half-century that had elapsed since the foundation of the colony. He said that no period in the world's history had been so prolific in inventions and discoveries as those fifty years. The advantages accruing from those inventions, the benefits resulting from the discoveries—so greatly beyond the expectations of those that made them that had any one at the time predicted such results he would have been deemed mad—we too often thanklessly and thoughtlessly enjoyed. The fruit of many an invention and many a discovery had often been prevented from ripening by the chill blasts of ridicule and prejudice, and we ought therefore not to criticize new theories too severely, for there was a great deal that we should like to know about our world, and too severe criticisms might delay the acquisition of that knowledge. He thought that the great progress which had been made in art and in science was due to the increased facilities for intercourse afforded by the development of the steam-engine, which he traced from the time of Dr. Papin, through James Watt's patents of 1769 and 1781, to Fulton's successful trip in the "Clermont" on the Hudson, in 1807, and finally to the establishment of the Cunard Line between Liverpool and New York, in 1840, the same year in which the English "penny post" was introduced. The latter was the greatest postal reform that had ever been introduced into any nation, and when we read of the opposition shown to the demand for a lower rate of ocean postage we should not forget the intense opposition offered by the English postal authorities to Rowland Hill's proposed scheme. Seldom had a nation the right to claim a great invention as its own: in one a thought had been uttered, in another that thought had been acted upon and partially developed, while in a third it had been rendered practically useful. The more frequent the repetition of such a course, the greater the benefit conferred upon mankind; and nothing could be so conducive to that repetition as the free interchange of ideas, which had been so greatly promoted, if not actually called into existence, by the postal reform he had spoken of. It was that rapid exchange of thought, that free communion between minds, that throwing-open the storehouses of genius and intellect, to which might be ascribed the great progress made in every department of art and science. Neither the telegraph nor photography would have attained their present perfection had their development been confined to some secluded valley or to the secret chamber of some guild. Referring to that meaningless expression "the good old times," he contrasted the

England of to-day with that of fifty years ago, saying that the best time was always the present, if we only strove to make good use of it. After giving a brief sketch of the history of Darwinism, and showing some pictures of Marsh's toothed birds from Kansas, he passed on to speak of the great improvements that had been effected in photography, and exhibited some exceedingly beautiful collotypes. After briefly noticing the modern applications of electricity—the telegraph, the telephone, electric light, and phonograph, which he intimated he intended to deal with more fully during the session—he said a few words about spectrum analysis. He then spoke of the revelations of the microscope in the matter of microbes and of their pathogenic tendencies, the remainder of his address being devoted to giving an account of the rise and growth of "organic chemistry," illustrating his remarks by a reference to some of the products obtained from coal. He concluded by expressing his regret that the more rational decimal system of weights and measures had not yet been made the legal standard of the colony.

Sir James Hector, in proposing a vote of thanks to the President, complimented him on the very able address he had just delivered, giving as it did a clear and most interesting sketch of the progress of science during the past fifty years. He congratulated the Society on the choice of its President, and said that, judging from the address, he was quite able to control the discussion in any branch of science that might be brought forward at the meetings.

Mr. Travers seconded the vote of thanks, which was carried. He said it was impossible on the spur of the moment to touch on all of the many points referred to by Mr. Hulke. The address he considered was most interesting, especially that part referring to the progress of photography. Mr. Travers gave examples of many new processes in this art, and, regarding technical education, alluded to the great need for the introduction of such instruction into our schools, saying that he believed the strong endeavour which was now being made to introduce it into the scholastic establishments of England was likely to meet with success. If, however, to-morrow we wished to introduce technical education into the schools of this country, he did not think there were a sufficient number of men in the colony capable of giving instruction. What we ought to have established were schools in which persons might be fitted for imparting such instruction to the young. Until that was done we could make no advance. At present we had no school of any kind in which technical education was taught, and yet he believed the Government were annually wasting enormous sums of money which might be devoted to this purpose.

Mr. Maskell said he would like to say a few words before the question was put. He very cordially indorsed all that had been said by the two former speakers in thanking the President for his excellent address. He would not himself have gone as far as the President did in expressing admiration for the evolution theory; but that was merely a matter of private opinion. He rose, however, principally to emphasize somewhat a point in the address, where the President drew attention to the fact that the first steps in every improvement were made by men working in science for purely scientific ends. It was true that a man of science gives the first notion of an improvement to the world; then comes the inventor who applies that notion, and so great practical benefits to humanity have come about. But in this country, unfortunately, people take the least intelligent view possible of science; and an instance of this was afforded only a few days ago in a leading article in a Wellington journal, which held up scientific men to ridicule, seemingly only on the ground that they followed science. In fact, a man in New Zealand who attempted any scientific work without showing some immediate money returns for it is generally considered to be very much a fool. Now, unfortunately, this opinion is prevalent in all quarters, from the uneducated settler up to the governing classes, and it has a mischievous effect. For, to take only two things, there is a want clearly apparent in this country. In the case of the Fungi, for example, there are several even now becoming very noxious pests: he might instance the rust in wheat, or the *Fusicladium* (apple-scab, pear-scab). These are both bad pests, and the latter is going to play the mischief ere long with fruit-growing. Yet there is nobody in New Zealand who has studied Fungi systematically, and who is able to give authoritative and influential information to the colonists, because not the least encouragement is held out by the Government to scientific inquiry. Again, in the case of insect pests, who is there here able to advise the country with authority and influence on, say, such things as Phylloxera? Nobody: and those who do venture to say what their studies have led them to know are treated practically as either visionary or importunate. He hoped that an improvement in this respect would come about soon, perhaps even from the very necessity of the case. For his part, he desired very much to see the Government do what was urgently wanted—import a man, from England or elsewhere, competent to advise with full authority on both animal and vegetable pests—a man conversant with what had been done in other countries, and able to say what ought to be done here. But it is not only advice which would be required. For the officer he suggested ought to have full power to act in cases o necessity, as well as to instruct. He should be a man of both scientific and practical knowledge, a man well acquainted with both entomology and agriculture, and, besides, he ought not to be fettered and obstructed in the way too often seen with officers of our Government. Mr. Maskell expressed regret at having taken up so much of the time of the meeting; but the question which he ventured to raise was of great importance, and he trusted that before long some measure such as he suggested would be adopted.

The vote of thanks for the address having been carried,

The President expressed his obligations to Sir J. Hector and the members for their kindly appreciation of his services. In reply to Mr. Travers, he quoted from his address to show that he had mentioned the star-charts. Referring to the remarks of Mr. Maskell, he said that he (Mr. Maskell) was quite right. These things ought to receive more attention. Unfortunately, much of this kind of work, which was performed in other countries as a labour of love, would not be undertaken by an Englishman unless he could make money by it. In the village schools of Germany great pains were taken to make the children acquainted with everything injurious to agriculture; in fact, many of those children knew more about Nature than most of our University students did.

Second Meeting: *2nd July, 1890.*

C. Hulke, F.C.S., President, in the chair.

Papers.—1. "A Few Words on the Codlin-moths, *Carpocapsa pomonella*, L., and *Cacoecia excessana*, Walk.," by G. V. Hudson, F.E.S. (*Transactions*, p. 56.)

Mr. Travers considered this a valuable paper. He thought it was most important that an accurate account should be given, showing the manner in which these insects deposit their eggs, whether on the surface of the fruit or in the core, or where two apples are in contact, or on the leaf. The dipterous insect deposits the eggs on the skin, and makes an entrance there. In some districts where ants are common these injurious moths are disappearing; they are probably the natural enemies. It was almost impossible to get rid of such pests by Act of Parliament. Such investigations as Mr. Hudson was making were of far greater value.

Sir Walter Buller said that in England he had seen the first part of the manuscript of the work on New Zealand entomology which Mr. Hudson proposed bringing out, also plates, which were much admired. On the whole, the work was highly spoken of, and he was quite sure it would be a success, and a valuable contribution to our colonial literature.

Mr. Travers added that the use of the spray-distributor, properly charged, would be of great advantage in getting rid of these pests. They could be kept working for a considerable time in the proper season.

Mr. Hulke would like Sir Walter Buller and other members of the Society to assist him in urging the Government to subscribe for, say, a hundred copies of Mr. Hudson's work for distribution in our schools. It would be most valuable to both teachers and scholars.

Mr. Hudson said that this would be a great help to him, as it was not easy to get the required amount subscribed. He thanked the President and members for their complimentary remarks regarding his proposed work.

2. "On a New and Sensitive Barometer," by T. Wakelin, M.A.

Abstract.

The invention consisted of a long flexible indiarubber bag fixed halfway down a tube. The tube is fixed, air-tight, in a box having a capacity of a hundred times the tube, so that very slight variations of pressure would cause a considerable movement of the closed end of the bag up or down the tube, and enable registration of atmospheric disturbances to be made, which neither the mercurial nor the aneroid barometer was sensitive enough to show.

The President said that, theoretically, Mr. Wakelin's idea was a good one, but that indiarubber would not do for the moving part. He thought it would be better to have a very light thin glass tube inserted, floating in glycerine, contained in an annular reservoir in the external tube.

3. "Note on the Breeding-habits of the European Sparrow (*Passer domesticus*) in New Zealand," by T. W. Kirk, F.R.M.S., F.L.S. (*Transactions*, p. 108.)

Mr. Travers said that Mr. Kirk's views regarding the food of the sparrow did not agree with those of 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 contain insect-food or grain. If the increase were anything like what Mr. Kirk contends the air would be full of these birds. The increase really depends on the amount of food they 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 Acclimatization Society in 1866. Whilst 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 his 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 fed 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 so 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 these 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 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 United States 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.

4. Sir Walter Buller exhibited a huge kiwi from Stewart Island, which he referred to *Apteryx maxima* of M. Jules Verreaux (Bonap.: Compt. 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 recognized 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 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 Island; whilst *Apteryx oweni*, inhabiting the colder regions of the South, has also been found on the snow-line to the north of Cook 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. Gray 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 reconnecting 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 be no escape from the accepted rules of zoological nomenclature.

Mr. Maskell would like to know whether Sir Walter Buller considered size sufficient for specific difference in birds. He should not have thought that size was sufficient even to erect a variety upon. In his own observations of insect-life he did not consider size by itself as at all important.

Sir Walter Buller said that if the difference in size was sufficient and constant it was considered enough. In the present instance, however, there were other distinguishing features.

The President considered that, even if these birds were all of the same species, the fact of finding them so widely distributed and so different in size was most interesting.

Exhibit.—A specimen of the mantis shrimp was also exhibited, which on Monday last was dredged in the harbour by Mr. McIntyre, an employé of the Harbour Board. The shrimp is edible, and is considered a rare visitor in New Zealand waters. The mantis shrimp is found in large quantities in the Mediterranean Sea, and is highly appreciated among the inhabitants of Southern Europe as an article of food.

Third Meeting: *23rd July, 1890.*

C. Hulke, F.C.S., President, in the chair.

New Member.—J. W. Poynton.

Papers.—1. "Curiosities of Polynesian Speech," by E. Tregear, F.R.G.S. (*Transactions*, p. 531.)

Mr. E. D. Bell congratulated the author on the completion of a work which had occupied so much of his time—namely, the "Maori Comparative Dictionary." It was a great undertaking, and Mr. Tregear deserved praise for having carried out such a difficult and laborious work. Mr. Tregear's papers were highly interesting and valuable. The remarks in that just read regarding the absence of consonants and vowels in some of the Maori words were, he thought, quite new.

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 regarded this paper it was a most interesting one, not only on account of the subject, 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. (*Transactions*, p. 49.)

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 thes tridulating 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 *Cicada*. A few days after the female emerges she commences 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 regarded 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. H. W. Robinson would like to know if this insect was the same as that spoken of by Byron as the "shrill cicala of the pine."

Mr. Hudson: No doubt the same family: they are very common in Italy.

The President pointed out how absurd it was to call this insect the locust—it was quite different. Mr. Hulke here gave drawings on the board to show the difference. He had seen the stems of the bushes dotted with the borings of the small *Cicadæ*. No doubt the green twigs of trees also were served in the same manner.

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.

Fourth Meeting: *13th August, 1890.*

C. 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 Alexander McKay, F.G.S. (*Transactions*, p. 461.)

Views taken by the new process were afterwards shown with a magic lantern, and comparisons were made with those taken by the ordinary process.

Mr. W. T. L. Travers expressed the opinion that the discovery would completely revolutionize 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 were 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 recognize 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 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.

FIFTH MEETING: *8th October, 1890.*

C. Hulke, F.C.S., President, in the chair.

New Member.—W. Barton.

Papers.—1. "Further Coccid Notes; with Descriptions of New Species from New Zealand, Australia, and Fiji," by W. M. Maskell, F.R.M.S., Corr. Mem. Roy. Soc. of South Australia. (*Transactions*, p. 1.)

Mr. Maskell 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 a hundred and fifty 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 nowadays 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 trap-doors 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. 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 numbers 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 of so much damage 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. The beetle and other insects are also great pests to trees, and are easily introduced from other countries, so that any one who devotes his attention to the observation of the life-history of such objects is deserving of credit.

Mr. Tregear said that, although Mr. Maskell's researches had no doubt a great economic value, he felt sure that it was more for a love of science that Mr. Maskell devoted so much time and attention to this work.

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.

The President said that 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 Habits and Life-history of the New Zealand Glowworm," by G. V. Hudson, F.E.S. (*Transactions*, p. 43.)

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

Mr. Maskell: Has the light been microscopically examined? Could it possibly be phosphorescent 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 action 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 glowworm 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 that 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.

Sixth Meeting: *29th October, 1890.*

C. 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. (*Transactions*, p. 36.)

Mr. Maskell said 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 common in almost all branches of science to establish what were called species on grounds that seemed often 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 difference in colours seemed sufficient to account for thousands of so-called species, when probably the birds, or insects, or animals were really the same, or only 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 with such small differences, especially as so few agree as to colour, which depends so frequently on the formation of the human eye? If there were organic differences, that would be quite another matter.

Mr. Hudson would like to remind Mr. Maskell that domestic productions varied 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 required; hence domestic animals and plants had 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 from experience to judge. 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 could 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 recognized no distinction—to a horse every other horse was also a horse; every dog recognized his species in any other dog. If this were not so,—if grey 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, which would soon form a species that he thought all naturalists would acknowledge 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 Buller 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 woolshed on the East Coast. Could Sir Walter Buller 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.

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 arbitrary. 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 above 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 was 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 was not of much importance, and might be left to individual opinion, so long as it was 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 recognized. 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. For example, the red grouse (or brown ptarmigan), one of the commonest birds of Great Britain, is so variable in colour that scarcely two males can be found with precisely the same markings; and this was likewise the case with the common albatros and some other sea-birds. This variability of plumage became, then, a character of the species. But if you met 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 was a phase of colouring known as dimorphism, which obtained among some species of sea-birds—some individuals being dark and others white in one and the same species. Other birds, again, passed through several distinct phases of plumage in their progress from youth to maturity. These adolescent states, and the known instances of dimorphic coloration, did 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 President said he was glad that Sir Walter Buller's remarks, which were most interesting, had brought on such a general discussion. The great thing in the determination of species was to have the characters, whether of colour or otherwise, persistent, and this would no doubt be sufficient grounds for forming a species.

2. "Notes on the Entomology of the Inland Kaikouras," by G. V. Hudson, F.E.S.

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. McKay 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 period that by evolution fresh species had not as yet made their appearance.

The President took this opportunity of stating that, as agreed upon at a former meeting, he had, in company with Sir Walter 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.

Annual Meeting: *13th February, 1891.*

C. Hulke, F.C.S., President, in the chair.

New Member.—W. T. Cohen.

The annual report and balance-sheet were read and adopted.

Abstract.

During the past year six general meetings were held, which had been fairly well attended, and some interesting discussions had taken place on the papers read, as might 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 were elected during the year, the total number of members now on the books being a 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.

Election of Office-bearers for 1891.—*President*—E. Tregear; *Vice-presidents*—A. McKay, Hon. R. Pharazyn; *Council*—Sir J. Hector, Sir W. Buller, 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.

In the absence of the newly-elected President, Mr. Hulke remained in the chair, and thanked the members for the assistance they had afforded him during his term of office.

Papers.—1. "On a Deposit of Diatomaceous Earth at Pakaraka, Bay of Islands," by A. McKay, F.G.S. (*Transactions*, p. 375.)

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 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 microscopist's observations might sometimes come in usefully 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 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 peculiar-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 those 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 any one carefully examining the district where these deposits have been found.

2. "On the Botany of Antipodes Island," by T. Kirk, F.L.S. (*Transactions*, p. 436.)

3. "On the Botany of the Snares," by T. Kirk, F.L.S. (*Transactions*, p. 426.)

4. "On the Wandering Albatros; 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. (*Transactions*, p. 230.)

5. "Contributions to the Knowledge of the Fossil Flora of New Zealand," by Professor Dr. Constantin Baron von Ettingshausen, Hon. Mem. N.Z. Inst.; communicated by Sir James Hector. (*Transactions*, p. 237.)

6. "On *Pleurophyllum*, Hook. f.," by T. Kirk, F.L.S. (*Transactions*, p. 431.)

7. "Description of New Species of *Centrolepis*," by T. Kirk, F.L.S. (*Transactions*, p. 441.)

8. "On the Macrocephalous *Olearias* of New Zealand, with Description of a New Species," by T. Kirk, F.L.S. (*Transactions*, p. 443.)

9. "Notes on certain Species of *Carex* in New Zealand," by T. Kirk, F.L.S. (*Transactions*, p. 448.)

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 A. McKay, F.G.S.

13. "On *Belemnites australis* with Dicotyledonous Leaves," by A. McKay, F.G.S.

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

15. "On Lithological Characters in Sequence as a Means of Correlation and as Indicative of Age," by A. McKay, F.G.S.

Before the close of the meeting, Mr. Hulke called attention to a paper recently read by Mr. McKay on telescopic photography, and read extracts from a recent number of *Nature* showing how Mr. McKay's method was now being used in other parts of the world in astronomical photography. This, he added, must be very gratifying to the Society and to Mr. McKay.

AUCKLAND INSTITUTE.

First Meeting: *2nd June, 1890.*

James Stewart, C.E., President, in the chair.

New Members.—R. D. Duxfield, M.A., L. Ehrenfried, G. Fowlds, J. Goodall, C.E.

The President delivered the anniversary address.

Abstract.

After referring to the satisfactory progress of the society, the President referred to the very crowded state of the museum, and the necessity for more exhibiting-space to enable a proper classification of the collections on a scientific and educational plan. He then reviewed the financial position of the society, which he considered on the whole satisfactory, as it possessed very considerable endowments, and funded property that brought in an income that was secure; but still the society was mainly dependent on members' subscriptions for the maintenance of the museum. It must be borne in mind also, he said, that a museum was not a mere collection of curious things gathered together at little or no cost, or kept up by gifts or bequests of people of an antiquarian turn of mind. On the contrary, few educational institutions were more expensive in proper equipment and maintenance. The recently-acquired collection of stuffed mammals from Borneo, now exhibited, would show the value which must attach to a complete and systematic collection in natural history. These animals were taken by men subject to great risk and expense, and must be set up by artists having a perfect knowledge of the anatomy and natural appearance of the animals, as well as the requisite technical skill. But if a museum of natural-history science was costly, a technological one was far more so, and to attempt any real excellence in that direction was, he feared, beyond their present hopes. The work of the Institute during the twenty-two years of its existence was recorded in the annual volumes of the New Zealand Institute, and was, or ought to be, familiar in some degree, at least, to all members. Therefore he would not attempt any analysis of the society's work, or comparison with that of the other affiliated societies, further than to say that up to within a few years back we quite held our own, and, although our articles had latterly fallen off in numbers, they had always compared very favourably in useful matter with the whole. After referring to the high value of the work recorded in the annual volume of the Transactions of the New Zealand Institute, the President gave instances of the direct value to colonists of some of the papers, and cited the case of the scale-blight (*Icerya purchasi*), and the manner in which its destructive effects had been neutralized by sound entomological research, which led to the discovery and introduction of its natural enemy, *Vedalia cardinalis*. He next referred to the valuable nature of the Institute library, and urged that it should be made a thoroughly good reference library for all branches of scientific and technological literature, leaving the field of general literature to the public library, and of educational literature to the University library. He criticized the present education system as being too rigid, and not allowing each pupil to follow his own natural bent, and con-

sidered that too much time was devoted to useless detail and memory-work, especially in the subject of geography. The address referred to the Maori collection in the museum, and touched on the subject of why the Maori race was stationary and even retrograde, and attributed it chiefly to their communistic habits. It then referred to some economic matters, such as the conservation of the waste-forest products, to the Tarawera eruption, and to some recent application of science to the arts, particularly to electrical engineering.

SECOND MEETING: *16th June, 1890.*

James Stewart, C.E., President, in the chair.

Sir W. Fox delivered a popular lecture entitled "Reminiscences of Egypt."

The lecture was illustrated by numerous water-colour sketches taken by the author during his recent visit to Egypt. A unanimous vote of thanks was passed at the close of the lecture.

THIRD MEETING: *30th June, 1890.*

James Stewart, C.E., President, in the chair.

Paper.—"Language: or, The Formation of Words signifying Abstract Ideas," by F. D. Fenton.

FOURTH MEETING: *14th July, 1890.*

James Stewart, C.E., President, in the chair.

Mr. J. A. Pond gave a popular lecture on "The Foods of the Ancient Maori."

ABSTRACT.

His remarks were confined to the consideration of the means of subsistence that the Maoris possessed prior to the advent of Europeans; and he pointed out that it was a mistake to suppose that in ordinary circumstances they had a deficiency of food. At the same time, food was not so easily obtained as by the more fortunate inhabitants of the Polynesian islands. Their cultivations required great care and labour to produce an abundant crop, and, although the forests were full of edible rats, birds, &c., the hunters often had to exercise considerable patience in obtaining their spoil; while their supply of fish was dependent to a large extent on the seasons and weather. The lecturer described in detail the different kinds of food used by the Maoris, and quoted the best authorities to show how they were obtained and prepared. The mode of cultivating the kumara and taro was also fully explained, and some account was given of the many curious legends connected with those plants.

Fifth Meeting: *4th August, 1890.*

James Stewart, C.E., President, in the chair.

New Members.—H. Brown, W. Davies, P. L. Dignan, J. P. Macarthur, H. Thomson.

Papers.—1. "On the Microscopical Structure of Ohinemuri Gold," by Dr. Rudolf Haeusler. (*Transactions*, p. 335.)

2. "Note on the Habits of the Kingfisher (*Halcyon vagans*)," by J. W. Hall.

Abstract.

The author raised the question, Is it customary for the kingfisher to capture live birds? Because this winter he had seen one with a live white-eye in its mouth. The tree the kingfisher was perched upon was not many yards distant from him, and he distinctly saw the little wings flutter convulsively as the kingfisher was preparing to beat its prey against the branch. So it could not have been a dead bird casually picked up. Perhaps this, he said, was an application of the *lex talionis*, for, besides being mercilessly persecuted by the small boys with their catapults, the kingfisher was not infrequently captured by the common hawk. But sometimes the hawk does not come off best. One day at Parawai (Thames) a hawk sailed round the bend of a hill, followed (accidentally, he supposed) by a kingfisher. There at once arose a great outcry, and the hawk came again in sight, bearing the kingfisher in its talons. But, nothing daunted, the kingfisher with its pick-axe of a bill pegged away at the breast and abdomen of its captor to such good effect that the hawk was glad to liberate its prey, whereupon the kingfisher flew away apparently but little the worse for the encounter, and carrying with it, he need hardly say, the full sympathy of the on-lookers. A friend of the author had seen a kingfisher dive under water to escape the pursuit of a hawk.

3. "Takahe *versus* Kakapo;" a reply to Mr. Melland's paper in vol. xxii., Transactions N.Z. Institute, by Jas. Park, F.G.S. (*Transactions*, p. 112.)

A discussion arose, the speakers considering that, whatever may have been the origin of the booming noise attributed by Mr. Park to the *Notornis*, Mr. Melland was hardly justified in assigning it so confidently to the kakapo.

4. "On the Birds of the Kermadec Islands," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 216.)

In illustration of his paper, the author exhibited numerous skins and eggs of the species mentioned, collected by Mr. Bell, Captain Fairchild, and himself.

5. "The Age of Pulp: a Speculation on the Future of the Wood-fibre Industry," by the Rev. P. Walsh. (*Transactions*, p. 523.)

Sixth Meeting: *18th August, 1890.*

James Stewart, C.E., President, in the chair.

Professor F. D. Brown gave a popular lecture on "John Dalton and his Work."

ABSTRACT.

After giving a short sketch of the life of Dalton, the lecturer described the views that were held before his time with regard to chemistry, dwelling at some length on the "phlogistic" theory of Stahl. This was generally accepted by chemists for many years. The discoveries of Priestley and Cavendish, however, gave it a severe shock, and it was finally overturned by Lavoisier, who founded what may be called the new chemistry. Dalton threw himself eagerly into the path pointed out by Lavoisier, with the result of discovering what was the atomic theory, upon which the whole of modern chemistry was built. Dalton's theory was then described in detail, and it was pointed out how far it had been amplified by later observers. The general tendency of recent scientific thought in regard to atoms and the forces controlling them was also briefly alluded to.

SEVENTH MEETING: *15th September, 1890.*

James Stewart, C.E., President, in the chair.

Mr. J. T. Nott, B.A., gave a lecture on "The Remarkable Character of our Native Fauna."

ABSTRACT.

The remarkable character of the New Zealand fauna was considered chiefly from the point of view of geographical distribution, the views of Wallace, Hutton, and others being largely quoted.

EIGHTH MEETING: *6th October, 1890.*

James Stewart, C.E., President, in the chair.

New Member.—G. W. Bull.

Papers.—1. "On Spontaneous Division in Star-fish," by Professor A. P. W. Thomas.

2. "Notice of the Occurrence of the Basking Shark (*Selache maxima*, L.) in New Zealand," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 126.)

3. Professor Thomas exhibited a new and improved ribbon microtome recently obtained from England for the University College, and explained its mode of working.

4. "The Story of John Rutherford," by Archdeacon W. L. Williams. (*Transactions*, p. 453.)

Dr. Purchas asked whether it would not be possible to identify Rutherford's dwelling-place in New Zealand by the tattooing which he had received. He was of opinion that the Maoris had different kinds of tattooing in different districts; and if the tattoo represented in the portrait of Rutherford was reliable—and it appeared to him to be so—an expert in such matters ought to be able to name the tribe with which he resided. He agreed with Archdeacon Williams in disbelieving Rutherford's story of the capture of the "Agnes" and the massacre of the crew, for if this had really occurred in the East Cape district the Maoris must have had some traditions relating to it.

Mr. Stewart and other speakers also expressed their concurrence with Archdeacon Williams's views.

The President drew attention to the recent decease of Mr. R. C. Barstow, one of the past Presidents of the Institute, and for several years a member of the Council; and, on his motion, a resolution expressing the regrets of the Institute at Mr. Barstow's decease was unanimously passed.

NINTH MEETING: *20th October, 1890.*

James Stewart, C.E., President, in the chair.

Paper.—"Milk as a Vehicle of Disease," by Dr. E. Roberton. (*Transactions*, p. 570.)

TENTH MEETING: *3rd November, 1890.*

James Stewart, C.E., President, in the chair.

Papers.—1. "Immortality in the Animal World," by Professor A. P. W. Thomas, F.L.S.

2. "On New Species of *Araneæ*," by A. T. Urquhart. (*Transactions*, p. 128.)

3. "Note on the Thermal Springs in Lake Waikare," by H. D. M. Haszard. (*Transactions*, p. 527.)

4. "Further Notes on the Three Kings Islands," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 408.)

ELEVENTH MEETING: *17th November, 1890.*

James Stewart, C.E., President, in the chair.

Mr. E. A. Mackechnie gave a popular lecture on "The Study of Shakespeare."

TWELFTH MEETING: *1st December, 1890.*

Josiah Martin, Vice-President, in the chair.

Mr. C. P. Newcombe gave a popular lecture on "British Influence in South Africa."

ANNUAL GENERAL MEETING: *16th February, 1891.*

J. Stewart, C.E., President, in the chair.

ABSTRACT OF ANNUAL REPORT.

Thirteen new members have been elected during the year. On the other hand, twenty-four names have been withdrawn from the roll, leaving the total number at the present time 205.

The total revenue for the year has been £861 14s. 3d. The members' subscriptions have yielded £164 17s., and the invested funds of the Costley bequest £573 2s. 1d. The expenditure has been unusually heavy, and has absorbed most of the large balance in hand at the commencement of the year, the total amount being £987 8s. 9d., leaving a balance in hand of £79. The invested funds of the Institute amount to £10,735 1s. 10d.

Twelve meetings have been held during the year, at which twenty-two papers on various scientific and literary subjects were read.

Many interesting additions have been made to the Museum. A collection of Bornean animals purchased from Mr. C. F. Adams has attracted much attention. Some valuable Maori ethnological specimens have been purchased from Mr. Alma Baker, including some greenstone *meres*, canoe-carvings, &c. Captain Gilbert Mair has deposited in the Museum the whole of his Maori collection, admitted to be one of the most complete in New Zealand; and show-cases to be specially devoted to it are to be constructed. The Mackelvie collection of paintings and other art-treasures, for so many years lodged in the Museum, has been removed by the Trustees and placed in the Auckland Art Gallery.

Election of Officers for 1891.—*President* — Professor F. D. Brown; *Vice-presidents*—James Stewart, C.E., J. Martin, F.G.S.; *Council*—Rev. J. Bates, W. Berry, Rev. J. Campbell, C. Cooper, T. Humphries, E. A. Mackechnie, T. Peacock, J. A. Pond, Rev. A. G. Purchas, Professor A. P. W. Thomas, F.L.S., E. Withy; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—J. Reid.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

First Meeting: *7th May, 1890.*

J. T. Meeson, B.A., President, in the chair.

Paper.—"The Rainfall of New Zealand (Part I.)," by J. T. Meeson, B.A. (*Transactions*, p. 546.)

Professor Hutton agreed with most of Mr. Meeson's paper; and pointed out that, with the exception of the Bealey, all the meteorological observations were coastal. Further observations no doubt would show less average rainfall, and perhaps greater extremes of temperature. Forest-growth might be expected to give a fair idea of the general rain-record; and this is the case, for the amount of rainfall and forest-growth agree well, with but slight exceptions.

Mr. Meeson, in reply, stated that the Bealey and Rotorua were the only two inland stations, and that statistics were wanted not only as to rainfall, but as to other meteorological phenomena, and he thought that money might be better spent on such statistics than on the Signal Service Department.

Second Meeting: *5th June, 1890.*

J. T. Meeson, B.A., President, in the chair.

Paper.—1. "The Rainfall of New Zealand (Part II.)," by J. T. Meeson, B.A. (*Transactions*, p. 555.)

Professor Hutton considered Mr. Meeson's paper thorough and exhaustive; but thought the map of rainfall might be improved by showing lighter rainfall in the centre of Otago.

Mr. Suter (a visitor) believed that there was excessive precipitation in the Ruahine and Tararua districts. The rainfall there reminded him of the rain at the Mount Cook Hermitage.

Dr. Symes referred to the irregular distribution of the bush on Banks Peninsula and on the Southern Alps. In the latter district the bush is invariably found on the southern slopes of the spurs.

Mr. Danks thought that this might be explained by the lay of the strata. He had noticed that in places springs were to be found only on the southern slopes of the hills; and it was these sides that were bush-clad, whereas the other side was generally bare.

Professor Hutton pointed out that the northern slopes would naturally be drier, because they were exposed more directly to the sun.

2. Professor Bickerton gave a solution of Euclid I., 47, which he considered new.

THIRD MEETING: *3rd July, 1890.*

J. T. Meeson, B.A., President, in the chair.

Paper.—"On the Drift Formation of South Canterbury," by J. Hardcastle. (*Transactions*, p. 311.)

Mr. Laing considered that the evidence brought forward, based upon the red gravels, was insufficient to support the theory that there had been two glacial periods in New Zealand.

FOURTH MEETING: *7th August, 1890.*

J. T. Meeson, B.A., President, in the chair.

Paper.—"Notes on the Earthquake of 7th March, 1890, felt at Napier, Gisborne, and other Places," by G. Hogben, M.A. (*Transactions*, p. 473.)

Professor Hutton said that the paper was an extremely valuable one, as it followed the best methods of determination for the centrum and epicentrum. The direction of shock, as determined by seismograph, was now found to be extremely unreliable; and consequently the most important observations were those of time and amplitude. It was extremely important that seismographs should be employed for the determination of these. People outside of New Zealand spoke of it as a country of severe earthquakes; and it required definite evidence to remove the bad impression that was abroad. He agreed with Mr. Hogben that the method of co-ordinates was of little use for ascertaining the depth.

FIFTH MEETING: *4th September, 1890.*

R. W. Fereday, F.E.S., Vice-president, in the chair.

Paper.—"On the Murchison Glacier," by G. E. Mannering. (*Transactions*, p. 355.)

Professor Hutton considered Mr. Mannering's paper as the most important contribution to the geography of the alpine regions of New Zealand for the past twenty years.

SIXTH MEETING: *2nd October, 1890.*

J. T. Meeson, B.A., President, in the chair.

Papers.—1. "On the Timaru Loess Formation as a Register of Climate," by J. Hardcastle. (*Transactions*, p. 324.)

Professor Hutton criticized the paper adversely, and contended that the author had taken everything he had seen as proving his theory, and ignored or overlooked the evidences against it.

2. "Determination of the Origin of the Earthquake of the 5th December, 1881, felt at Christchurch," by G. Hogben, M.A. (*Transactions*, p. 465.)

3. "Note on the Disappearance of the Moa," by H. O. Forbes, F.R.G.S.; communicated by the Secretary. (*Transactions*, p. 373.)

Professor Hutton said that the fact that the Maoris in the South Island had no tradition regarding the hunting of the moa might be thus explained. The Maoris had several times been exterminated in the South Island by tribes from the North, and probably none of the ancestors of the present race had hunted the moa. The cave might have been shut up for two hundred years.

4. "Revised List of the Marine *Bryozoa* of New Zealand," by Professor F. W. Hutton. (*Transactions*, p. 102.)

5. "On Glacier-motion," by J. Hardcastle. (*Transactions*, p. 332.)

Annual Meeting: *6th November, 1890.*

J. T. Meeson, B.A., President, in the chair.

Papers.—1. "Descriptions of New Species of New Zealand Land and Fresh-water Shells," by H. Suter; communicated by the Secretary. (*Transactions*, p. 84.)

2. "Miscellaneous Notes on New Zealand Land and Fresh-water Molluscs," by H. Suter; communicated by the Secretary. (*Transactions*, p. 93.)

3. "Appendix to Paper on Drift Formation," by J. Hardcastle. (*Transactions*, p. 324.)

4. "On Avian Remains found under a Lava-flow near Timaru," by H. O. Forbes, F.R.G.S.; communicated by the Secretary. (*Transactions*, p. 366.)

5. "The Origin of the Earthquake of 27th December, 1888, felt in Canterbury and Westland," by G. Hogben, M.A. (*Transactions*, p. 470.)

6. "New Species of *Lepidoptera*," by E. Meyrick, B.A., F.Z.S. (*Transactions*, p. 97.)

The annual report and balance-sheet were read and adopted.

Abstract.

There is an advance of five in the number of papers read compared with the preceding year; and the membership has increased by twelve. At the meeting in May Mr. J. T. Meeson, B.A., was elected President in the place of Mr. S. H. Seager, resigned. Mr. R. W. Fereday was elected Vice-president in the place of Mr. Meeson.

The balance-sheet shows a total receipt of £96 17s. 6d., and a total expenditure of £72 7s. 5d., thus leaving a credit balance of £24 10s. 1d. There is a reserve fund of £52 10s.

Election of Officers for 1891.—*President*—Professor F. W. Hutton; *Vice-presidents* — J. T. Meeson, B.A., T. W. Naylor-Beckett; *Treasurer*—J. T. Meeson, B.A.; *Secretary*—

R. M. Laing, M.A., B.Sc.; *Council*—R. W. Fereday, F.E.S., H. R. Webb, F.R.M.S., Dr. Jennings, Dr. Symes, G. A. Mannering, F. Barkas.

The retiring President then gave the annual address.

Abstract.

The President expressed regret that the meetings of the Institute were not better attended by the members, and suggested that they might be made more attractive by a course of popular instruction. "The aim of the incorporation was, in 'The New Zealand Institute Act, 1867,' distinctly stated to be 'by means of lectures, classes, and otherwise to promote the general study and cultivation of the various branches and departments of art, science, literature, and philosophy'—a wide enough charter, surely. A society so encyclopædian in its nature might reasonably adopt as its motto, '*Humani nihil alienum*,' and ought not to have to complain of the want of public sympathy for its occupations and aspirations. Then what is wrong? Since the 4th August, 1868, when the inaugural address of the Institute was delivered, a large amount of useful work has been done by the members in the corner of one of the four fields of work above named. Whether owing to the attractive natural features of the colony, the novelty of its fauna and flora, the beautiful climate, inviting to the out-of-door observation of Nature's varied forms, the foundation of our Institute, or the accident of its first members being in many cases trained scientists and devoted students of Nature's mysteries, it is certain that, so far as biology and geology are concerned, there has been in New Zealand a large amount of independent observation and original research; and perhaps more valuable contributions to the sum-total of our knowledge of natural science have proceeded during the past fifty years from these remote islands than from any other of the younger colonies of the British Empire during the same period of time. And, although in zoology, botany, mineralogy, and geology much yet remains to be done in this newly-settled land—for some departments are yet untouched, and new varieties in well-known departments are daily being discovered—yet, as far as these sciences are concerned, the New Zealand Institute has indeed done noble work. But how about the numerous other branches of science? What has been done in astronomy, mathematics, physics and mechanics, economic and social science and hygiene, &c.? Very, very little, I fear. Yet the study of some of these things is of vital importance to every community, wherever situated and whatever its circumstances. For example, take social and economic science. Is it out of our province to consider the industrial complications which have recently fallen like a pestilence on every English-speaking community? Are we to sit, 'like the gods above us, careless of mankind,' while the din of social strife is on every side of us? We hear the most pernicious and, in many cases, the most absurd opinions expressed by men who from their position have great influence, and are regarded by many as leaders of thought. Surely we might profitably leave for a time our rocks and bones, and study and teach plutology! When social and economic fallacies are in the air of the whole world—like the influenza was a few months ago—why should we not at our meetings help to solve difficulties and discuss problems connected with the production and distribution of wealth, capital, labour, co-operation, competition, wages, and the functions of Government—problems which would surely be better considered for being removed from the arena of party strife, and handled by those whose usual occupations require that they should be thoughtful, impartial, and logical, as well as acquainted with the results of past experience and the teachings of recognized authorities and past history? Of the discussion of such questions it may be said there is already more than enough outside of our society; and, indeed, this is quite true. But I contend that we should approach them in a different spirit, and with more chance of eliciting the spark of truth. Again, it will be said, perhaps, that the introduction of vexed social and economic questions into our lecture-room would bring in strife. If so, more's the pity. For my part, however, for the sake of vitalizing our body, I should not regret the occasional departure of a little of that calm serenity which may be a mark of true philosophy, but is also a characteristic of death. Wherever there is life there is, at all events amongst the higher animals, always a certain amount of heat; and it is the apparent indifference of our Institute to subjects, such as these, of real and intense human interest, that perhaps has partly alienated from it public sympathy. Again, a more important subject than sanitary science or hygiene cannot well be conceived, and our colonies study it less than the Mother-country—perhaps because they think there is less urgency about it in sparsely-peopled lands, with abundant supplies, ordinarily, of good food, air, and water, and generally fine climate. But medical men know well that there are many interesting and most important questions as to the origin and prevention, prevalence and spread, of peculiar forms of disease even in the healthiest colonies, well deserving attention on the part of others than doctors. Consider, for example, the prevalence of anæmia among young people in New Zealand. Does this spring from exceptional indifference to and breach of hygeian law? Or have geological or meteorological facts something to do with it? Has the perpetual bath of sunshine to which we are subject, and which we so much enjoy, some disadvantages in forcing on too rapid development and otherwise? Is the large amount of ozone that we breathe an unmixed blessing? Is not our drinking-water frequently so soft as to lower the strength of the animal organism, and render it specially liable to the attacks of epidemics? Are any other of our new conditions of living here particularly unwholesome? Is the hardy Anglo-Saxon race, when transplanted here, to a lower latitude than that of its original habitat, deteriorating in physique somewhat? How do the anthropometric results come out, as drawn by Mr. Forbes from the figures collected at the Dunedin Exhibition, as regards young New-Zealanders? What do the annual statistics show as to the prevalence of insanity and suicide among us? Is the isolation of life so frequently endured in the remoter parts of the colony producing an exceptional amount of morbid mental action? To what circumstance did we owe our recent visitation of influenza, a few months after it broke out in the east of Europe? Were the germs of the disease brought by vessels, or conveyed by the winds in their terrestrial circulation? These and a thousand other kindred questions, in the absence of a Sanitary Institute amongst us, medical men and scientific specialists might advantageously meet together to discuss, and much outside interest would thereby be aroused."

The President advocated, as an aid to the Institute, the formation of a Field Naturalists' Club, and of sections composed each of a few of the members who are devoted to some special subject.

OTAGO INSTITUTE.

First Meeting: *13th May, 1890.*

Dr. Belcher, President, in the chair.

Papers.—1. "Description of a New Species of *Migas*, with Notes on its Habits," by P. Goyen, F.L.S. (*Transactions*, p. 123.)

2. "Descriptions of New Native Plants, with Notes on some Known Species," by D. Petrie, M.A., F.L.S. (*Transactions*, p. 398.)

3. "On the Outlying Islands south of New Zealand," by F. R. Chapman. (*Transactions*, p. 491.)

The Council formed itself into a committee to make arrangements, in connection with the visit of the Australasian Association for the Advancement of Science to New Zealand, for receiving and welcoming visiting members of the Association.

Second Meeting: *10th June, 1890.*

Dr. Belcher, President, in the chair.

New Member.—H. Webb.

Papers.—1. "Notes on the Etymology of the Word 'Penguin,'" by Dr. Belcher, Rector of the Boys' High School, Otago.

2. "On the Existence of the Cat in Ancient Italy," by Dr. Belcher, Rector of the Boys' High School, Otago.

3. "On a New Species of *Celmisia*," by F. R. Chapman. (*Transactions*, p. 407.)

A specimen of the plant described was exhibited.

Professor Parker exhibited a fine coloured cast of the head of a pigmy whale, *Neobalæna marginata*, presented to the Otago Museum by Dr. Starling, Hon. Curator of the Adelaide Museum.

Mr. Petrie exhibited specimens of a new species of *Olearia*, and some other native plants.

THIRD MEETING: *8th July, 1890.*

Dr. Hocken, Vice-president, in the chair.

New Members.—Vincent Pyke and A. Hamilton.

Paper.—"On the Geological Demonstration of the Glacial Extinction of the Moa," by the Rev. J. Christie.

The views held by the writer were severely criticized by some of the members who took part in the discussion on this paper.

Professor Parker exhibited a number of remains of the moa found in various parts of Otago, which seemed to point to its comparatively recent disappearance.

FOURTH MEETING: *12th August, 1890.*

Dr. Belcher, President, in the chair.

New Member.—Dr. Robert Fulton.

Paper.—"On the Philosophy of David Hume," by Dr. Salmond.

FIFTH MEETING: *9th September, 1890.*

Dr. Belcher, President, in the chair.

Papers.—1. "On the Moa, and the Probable Cause of its Extinction," by Vincent Pyke, M.H.R.

2. "On the Anatomy of the Red Cod (*Lotella bacchus*)," by J. M. Beattie, M.A.; communicated by Professor T. J. Parker, F.R.S. (*Transactions*, p. 71.)

SIXTH MEETING: *14th October, 1890.*

Dr. Belcher, President, in the chair.

Papers.—1. "Notes on the New Zealand *Squillidæ*," by Charles Chilton, M.A., B.Sc. (*Transactions*, p. 58.)

2. "On the Changes in Form of a Parasitic Isopod (*Nerocila*)," by Charles Chilton, M.A., B.Sc. (*Transactions*, p. 68.)

3. "On a New Parasitic Copepod," by G. M. Thomson, F.L.S. (*Transactions*, p. 227.)

4. "On Two Species of *Cumacea*," by G. M. Thomson, F.L.S.

5. "On the Origin of the Sternum," by Professor T. J. Parker, F.R.S. (*Transactions*, p. 119.)

ANNUAL MEETING: *18th November, 1890.*

Dr. Belcher, President, in the chair.

The retiring President, Dr. Belcher, read a paper "On the Dramatic Works of Ibsen."

The annual report and balance-sheet were then read and adopted.

ABSTRACT.

The balance-sheet shows a balance from last year of £76 2s. 1d.; subscriptions to date, £129 2s. 6d.; making total receipts £204 7s. 4d. Cash expenditure, £96 5s. 7d.; leaving a credit balance of £97 9s. The liabilities amount to £50. There is also a sum of £277 14s., fixed deposit, in the bank.

ELECTION OF OFFICERS FOR 1891.—*President*—Professor F. B. de Malbisse Gibbons; *Vice-presidents*—Rev. Dr. Belcher and Mr. C. W. Adams; *Council*—Professor T. J. Parker, Dr. Hocken, Dr. De Zouche, Dr. Scott, Messrs. F. R. Chapman, G. M. Thomson, and D. Petrie; *Secretary*—A. Hamilton.

After the business of the meeting was over, Mr. D. Brent mentioned that the Otago Institute was just twenty-one years old. On the 3rd July, 1867, Mr. J. S. Webb, who took a very active part in the founding 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 eighty names, and on looking over it he was surprised to find that twenty of them still belonged to the Institute. They were: Messrs. C. W. Adams, G. M. Barr, A. Bathgate, L. O. Beal, A. Beverley, D. Brent, R. Chapman, W. Fraser (Earnscleugh), Dr. Hocken, Jas. McKerrow, W. Martin (Green Island), A. C. Purdie, E. 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 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 Mr. J. S. Webb and Dr. Hocken were the first joint secretaries.

WESTLAND INSTITUTE.

Annual Meeting: *11th December, 1890.*

Abstract of Annual Report.

The Trustees report that there has been no diminution in the popularity of the Institute. The expenditure has been kept within the income. New books to the amount of £10 have been obtained. The Trustees record their thanks for grants of £20 from the Borough Council and £5 from the County Council, and also to the Borough Council for £10 towards the expense of fitting up the Museum. The number of members is seventy-six, being a slight increase on the last year. Ten ordinary meetings and one special meeting were held, which were well attended. About a hundred volumes have been added to the library. The Trustees record their thanks for numerous donations of newspapers. A Museum has been established, in which the exhibits returned from the South Seas Exhibition, and the other collections of the society, have been arranged by the Curators and Mr. W. G. Johnston. The accounts show that, including a balance from the previous year of £12 13s. 7d., the total income was £126 5s. 11d.; and £28 2s. 8d. is carried forward. The society also has £400 invested, and moneys due to it in excess of its liabilities amounting to £24 9s. 8d.

Election of Officers for 1891.—*President*—Mr. M. L. Moss; *Vice-president*—Captain G. W. Bignell; *Hon. Treasurer*—Rev. John Blackburne; *Council*—Messrs. Joseph Churches, T. O. W. Croft, Robert Cross, W. C. Fendal, W. L. Fowler, W. G. Johnston, A. H. King, John Nicholson, Robert Ross, M. Scanlan, J. N. Smythe, J. P. Will.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

First Meeting: *9th June, 1890.*

Dr. Spencer, F.L.S., President, in the chair.

Papers.—1. Inaugural address by the President, Dr. W. I. Spencer, F.L.S.

2. "On Two Neck-ornaments or Pendants made of Bone (found in Otago)," by A. Hamilton.

Mr. Hamilton also described the moa-hunters' encampments at the mouth of the Shag River, Otago, and showed specimens of flint knives and of skulls and bones of the moa found there by him.

Contributions to the Museum from the Kermadec Islands were exhibited, consisting of two skins of a beautiful tropic-bird (*Phaëton rubricaudus* ?), skins of the white-fronted tern and small white tern; also, the eggs of these birds. A skin, also, of a rare kind of mutton-bird was shown.

Second Meeting: *14th July, 1890.*

Dr. Spencer, F.L.S., President, in the chair.

Papers.—1. "On Health," by Robert C. Lamb.

2. "The Halo of Benvenuto Cellini," by Dr. Moore.

3. "A Description of some Newly-discovered Indigenous Plants, being a Further Contribution towards the making known the Botany of New Zealand," by W. Colenso, F.R.S., F.L.S., &c. (*Transactions*, p. 381.)

The author exhibited specimens of the plants described.

Mr. F. Rhodes presented the museum with a piece of silver-ore from the Kronberg Mine, in Norway.

Third Meeting: *11th August, 1890.*

Dr. Spencer, F.L.S., President, in the chair.

Papers. — 1. "Further Notes on Coloured Sheep," by Taylor White. (*Transactions*, p. 207.)

2. "On Vine-growing in Hawke's Bay," by the Rev. Father Yardin. (*Transactions*, p. 528.)

The President gave a description of fish-fungus.

Miss Browning presented the Institute with a book entitled "Vegetable Physiology," by "Vines."

Fourth Meeting: *8th September, 1890.*

Dr. Spencer, F.L.S., President, in the chair.

Paper.—"On Useless or Injurious Instincts in Insects," by Dr. Moore.

The President gave a very interesting account of the geological descent of the horse.

Fifth Meeting: *13th October, 1890.*

Dr. Spencer, F.L.S., President, in the chair.

Papers.—1. "On Rabbits, Weasels, and Sparrows," by Taylor White. (*Transactions*, p. 201.)

2. "On the Relation of the Kidnapper and Pohui Conglomerates to the Napier Limestones and Petane Marls," by H. Hill, B.A., F.G.S. (*Transactions*, p. 340.)

The President gave a very interesting account of the webs of spiders, and some description of these animals and their method of constructing their webs.

Sixth Meeting: *14th November, 1890.*

Dr. Spencer, F.L.S., President, in the chair.

Papers.—1. "Bush Notes; or, Short Objective Jottings," by the Rev. W. Colenso, F.R.S., F.L.S., &c. (*Transactions*, p. 477.)

2. "An Enumeration of Fungi recently discovered in New Zealand," by the Rev. W. Colenso, F.R.S., F.L.S., &c. (*Transactions*, p. 391.)

3. "On Rats and Mice," by Taylor White. (*Transactions*, p. 194.)

4. "A Description of some Newly-discovered Indigenous Plants, being a Further Contribution towards the making known the Botany of New Zealand," by W. Colenso, F.R.S., F.L.S., &c. (*Transactions*, p. 381.)

Annual General Meeting: *9th February, 1891.*

H. Hill, B.A., F.G.S., in the chair.

Abstract of Annual Report.

Six ordinary meetings have been held, which were fairly well attended. The number of papers read was twelve. The Council report the sale of the property upon which the sum of £100 was lent, and which had to be taken over. The nett amount obtained was £5 14s. 6d. A great improvement in the financial position is reported, and the special thanks of the society are due to the Honorary Treasurer and the then Honorary Secretary, Mr. A. V. Macdonald, for their efforts in effecting this.

No additions were made to the library, which was owing to the large amount due for books purchased during the last and previous years; but the Council hope that additions may be made during the coming year. The library has been catalogued. The number of members now on the roll is 100.

Election of Officers for 1891.—*President*—Mr. H. Hill; *Vice-president*—Mr. L. Lessong; *Treasurer*—Mr. J. S. Large; *Secretary*—Mr. Geo. White; *Auditor*—Mr. T. K. Newton; *Council*—Drs. Moore and Spencer, Messrs. J. W. Craig, H. H. Pinkney, P. S. McLean, and J. T. Carr.

Exhibits.—During the evening two interesting exhibits were placed before members. The first was a specimen of the bloom of *Crinum asiaticum*, concerning which there was quite a history to tell. Its introduction was due to Mr. Bidwill, whose name is well known to botanists, and who was the first European to ascend Tongariro. He visited Mr. Colenso at the Bay of Islands some fifty-four or fifty-five years ago, and on his return to Australia he sent over a number of seeds and bulbs. Of these only two tubers of *Crinum* grew, and when Mr. Colenso came to Hawke's Bay he brought these with him, and for twenty-five years watched and waited to see them bloom, but in vain. At last his patience was rewarded by a fine spike of bloom, and since then the plants have year after year sent up flower-stems. The exhibit was much admired. The other exhibit was a fine specimen of the star-fish, caught at the Spit by a fisherman, and sent to the Museum by Mr. Brugh. It was a large specimen, being about 18in. measured across the extended rays, of which there were eleven.

NELSON PHILOSOPHICAL SOCIETY.

First Meeting: *4th March, 1890.*

The Bishop of Nelson, President, in the chair.

Exhibits.—The Curator exhibited specimens of larva of *Eristalis,* beetle (*Othophagus granulatus*), and humble-bee (*Bombus terrestris*); also twelve Poonah figures, and a number of Indian curios, presented by Colonel Farrington; sand-plover, desert-chat, male and female wheatears, a little grebe, all from Palestine; an ibis, from New Guinea; a *Rhamphocelus jacopa* and a *Dendrochelidon mysticalis,* from Borneo, presented by the President; a duck-billed platypus (*Ornithorhynchus*), from Tasmania, presented by Mr. A. S. Atkinson; fossils from Awatere, presented by the Curator.

Papers.—1. "On a Specimen of the Great Ribbon-fish (*Regalecus argenteus*) taken in Nelson Harbour," by R. I. Kingsley. (*Transactions*, vol. xxii., p. 333.)

2. "Notes on Blights," by James Hudson, M.B. (*Transactions*, p. 111.)

The author exhibited two specimens of blight—*Dactylopius calceolariæ* and *Lecanium hispidum.*

Second Meeting: *7th July, 1890.*

The Bishop of Nelson, President, in the chair.

Exhibits.—Specimen of Burmese carving, presented by Mr. Snodgrass; eight volumes, some scientific instruments (prism, air-pumps, &c.), and two frames of Egyptian photographs, presented by the late Hon. Secretary, Dr. Coleman; a catfish, by Mr. McArtney; specimen of John Dory (*Zeus faber*), presented by the Curator. The Curator also exhibited a Fijian carved battle-axe; and the "Report of Observations of Eclipse of the Sun," from the Lick Observatory, by Professor Holden.

New Member.—W. E. Fleming.

Paper.—"Mount Cook and its Glaciers," by W. S. Curtis.

THIRD MEETING: *1st September, 1890.*

The Bishop of Nelson, President, in the chair.

New Members.—Revs. W. Evans and F. W. Isitt.

Exhibits.—Specimens of *Gorgonidæ*, or marine tree, from Big Bay, South Island, exhibited by Messrs. Lukins and Marris; hæmatite-iron pot from Parapara, presented by Mr. Washbourne; a number of fossil leaves in sandstone from the Port Hills, by Mr. T. B. Huffam; and stuffed specimens of *Hæmatopus longirostris*, or pied oyster-catcher, by Master Kempthorne.

The Hon. Curator reported that a new fern had been discovered by Mr. J. Campbell, of Nelson, and a full description of it, by Mr. Kirk, would be available in a short time.

Papers.—1. "Notes on *Sceloglaux albifacies*, the Laughing Owl of New Zealand," by R. I. Kingsley. (*Transactions*, p. 190.)

A specimen of this bird, stuffed, which was captured at the Tadmor, was exhibited, and presented to the Museum.

2. "Alaska," by T. B. Huffam.

The paper elicited considerable discussion. Numerous photographs of the scenery, natives, and objects of scientific interest of this wonderful and almost unexplored region were exhibited.

ANNUAL MEETING: *11th November, 1890.*

The Bishop of Nelson, President, in the chair.

New Members.—Messrs. Greenwood and L. R. Turnbull.

ABSTRACT OF ANNUAL REPORT.

The Hon. Secretary's report showed that there was a growing interest in the work of the Society. The papers read were original, and the meetings well attended. During the session five new members joined the Society; and Dr. Coleman, who for five years past had filled the position of Hon. Secretary, resigned, owing to his departure for England.

The Hon. Curator's report showed that the Museum was in good condition, and the list of donations compared most favourably with those of previous years.

The Hon. Treasurer's report showed a satisfactory credit balance.

ELECTION OF OFFICERS FOR 1891.—*President*—The Bishop of Nelson; *Vice-presidents*—A. S. Atkinson and Dr. Boor; *Hon. Secretary*—Sidney Black; *Hon. Curator*—R. I. Kingsley; *Hon. Treasurer*—Dr. Hudson; *Council*—J. Holloway, Dr. Mackie, Dr. Cressy, Rev. W. Evans, and Rev. F. W. Isitt.

Exhibits.—A large piece of greenstone, by the President; a boulder from Jackson's Bay, by the Hon. Curator: both exhibits were cut and polished at Aberdeen. Dr. Tatton presented a large fossil from Mid-Buller, West Coast. Specimen of mica, by Mr. Bayfeild. Mr. W. Martin exhibited a beautiful yellow parroquet (*Platycercus auriceps*), shot near the Reservoir, Brook Street, Nelson.

Papers.—1. "On a Remarkable Variety of *Asplenium umbrosum*, J. Sm.," by T. Kirk, F.L.S. (*Transactions*, p. 424.)

2. "On the Occurrence of *Danais plexippus* and *Sphinx convolvuli* (?) in Nelson," by R. I. Kingsley. (*Transactions*, p. 192.)

Specimens of these insects were exhibited by the Hon. Curator.

3. "Description of a Remarkable Variation in the Colour of *Platycercus auriceps*," by R. I. Kingsley. (*Transactions*, p. 192.)

APPENDIX.

METEOROLOGY.

Comparative Abstract for 1890 and Previous Years.

Stations.	Barometer at 9.30 a.m.		Temperature from Self-registering Instruments read in Morning for Twenty-four Hours previously.					Computed from Observations.		Rain.		Wind.		Cloud.
	Mean Reading.	Extreme Range.	Mean Temp. in Shade.	Mean Daily Range of Temp.	Extreme Range of Temp.	Max. Temp. in Sun's Rays.	Min Temp. on Grass.	Mean Elastic Force of Vapour.	Mean Degree of Moisture (Saturation = 100).	Total Fall in Inches.	No. of Days on which Rain fell.	Average Daily Force in Miles for Year.	Maximum Velocity in Miles in any 24 hours, and Date.	Mean Amount (0 to 10).
Auckland ...	30·020	1·140	59·6	12·9	42·0	147·0	29·0	0·370	71	46·100	176	...	.	5·8
Previous 26 years ...	29·982		59·1	..	...	.	.	0·388	73	42·240	185	...	.	
Wellington ...	29·978	1·174	55·8	13·8	50·0	139·0	27·0	0·330	72	45·230	165	226	680 on 18th Feb.	4·0
Previous 26 years .	29·923	.	54·6		. .	. .	. .	0·334	72	50·772	159	.		
Dunedin ...	30·140	1·516	51·1	11·8	53·0	140·0	26·0	0·302	79	27·984	155	132	570 on 29th Oct.	5·1
Previous 26 years	29·866		50·2	.	. .		.	0·277	74	31·916	161	.		

Average Temperature of Seasons, compared with those of the Previous Year.

Stations.	Spring. September, October, November.		Summer. December, January, February.		Autumn. March, April, May.		Winter. June, July, August.	
	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.
Auckland	58·3	58·3	66·5	65·8	60·5	60·3	52·8	54·2
Wellington	51·8	51·9	62·7	61·6	56·1	57·3	47·7	49·3
Dunedin	51·6	51·2	60·5	58·9	51·6	52·0	40·3	42·5

GENERAL REMARKS FOR 1890.

JANUARY.—Very fine in North; generally showery during middle of month over centre, and showery in South; winds on the whole moderate, and prevailed from S.W. and N.W.

FEBRUARY.—Very fine dry weather throughout, with moderate variable winds.

MARCH.—Generally fine weather, with pleasant showers, especially towards end of month. Earthquake over centre on 7th, at 5.30 p.m., slight.

APRIL.—In North heavy rain, especially in early part of month, and strong N.E. and N.W. winds; in South showery, but small total fall, and light winds. Earthquake over centre on 9th, at 4.5 a.m., smart.

MAY.—Generally showery unpleasant weather throughout. Slight earthquake in South on 1st, and meteor on 21st.

JUNE.—Showery, with intervals of fine weather; wind moderate.

JULY.—A very wet month, with prevailing N.E. and S.E. winds, and frequently strong. Slight earthquake over centre on 16th, at 9.30 a.m.

AUGUST.—In North and over centre showery weather, with strong N.E. and S.E. winds; in South fine, with moderate W. and S.W. winds. Slight shocks of earthquake on 15th, at 6.45 a.m., over centre.

SEPTEMBER.—In extreme North showery during middle of month, with strong N.E. winds; over centre showers with intervals of fine, and strong winds from N.W. and S.; in South, fine with moderate winds.

OCTOBER.—In North heavy rain, especially in latter part of month, and strong winds from N.E., N.W., and S.W., also thunder; over centre showery, but not excessive rain, and strong N.W. winds; in South frequent showers of rain, but not heavy fall; strong W. and S.W. wind during latter part of month.

NOVEMBER.—Generally fine weather, although rather showery in early part of month in South; rather windy from N.W. over centre.

DECEMBER.—In North, fine with little rain; over centre heavy rain in early part and showery during latter part of month, and strong N.W. winds; in South generally showery from S.W. and N.W.

EARTHQUAKES reported in NEW ZEALAND during 1890.

Place.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Gisborne	..	..	7*	..	..	..	..	..	..	..	..	..	1
Tauranga	..	..	7*	..	..	..	..	..	..	..	..	..	1
Opotiki	..	..	7*	..	..	..	..	..	..	..	..	..	1
Taupo	..	..	7*	..	..	..	..	..	..	..	..	..	1
Napier	..	..	7*	..	..	..	..	..	..	..	..	..	1
Wellington ..	..	..	7*	9*	..	..	16	15*	..	..	..	..	4
Rangitikei	..	..	..	..	..	..	16	..	..	..	..	..	1
Wanganui	..	..	..	..	..	..	..	15*	..	..	..	..	1
Palmerston North ..	..	..	7*	..	..	..	..	..	..	..	..	..	1
Timaru	..	..	..	..	..	..	..	18	..	..	..	..	1
Oamaru	25*	..	..	..	..	..	..	..	..	..	..	..	1
Queenstown ..	..	..	31*	..	1*	..	..	..	..	..	..	..	2
Arrowtown ..	..	..	31*	..	..	..	..	..	..	..	..	..	1
Reefton	..	..	..	..	..	..	15	..	..	..	..	..	1

NOTE.—The figures denote the day of the month on which one or more shocks were felt. Those with the asterisk affixed were described as *smart*. The remainder were only slight tremors, and no doubt escaped record at most stations, there being no instrumental means employed for their detection. These tables are therefore not reliable as far as indicating the geographical distribution of the shocks.

NEW ZEALAND INSTITUTE.

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Hooker, Sir J. D., K.C.S.I., C.B., M.D., F.R.S.
von Mueller, Baron Sir Ferdinand, K.C.M.G., M.D., F.R.S.
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1872.

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1873.

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1874.

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Newton, Alfred, F.R.S.

1875.

Sclater, Philip Lutley, M.A., Ph.D., F.R.S.

1876.

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1877.

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1878.

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1883.

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1885.

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1888.

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van Beneden, Professor J. P.
von Ettingshausen, Baron C.

1890.

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Pond, J. A. ,,
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Russell, J. B. ,,
Russell, T., London*
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Seegner, C., Auckland
Shaw, H. ,,
Shrewsbury, A., Parnell
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Smith, H. G. S., Wellington
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Wallis, Rev. Dr., Auckland
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Waymouth, J., Auckland
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Webster, J., Hokianga
Weetman, S., F.R.G.S., New Plymouth*
Whitaker, Sir F., Auckland
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Will, W. ,,
Williams, Ven. Archdeacon W. L., Gisborne
Williamson, C., Auckland
Wilson, H. M., Warkworth
Wilson, W. S., Auckland
Winks, J., Parnell
Withy, E., Remuera*
Worthington, H., Auckland
Wright, F. W., L.M.B., Toronto, Parnell.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

[Life-members distinguished thus *.]

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Anderson, G.
Anderson, J.
Anderson, W. J., LL.D.
Murray-Aynsley, H. P.
Murray-Aynsley, A. C.
Baines, A. C.
Barkas, F.
Bealey, S.
Beckett, T. W. Naylor, F.L.S.
Bickerton, Prof. A. W., F.C.S.
Binnsfield, Rev. J. N.
Bishop, R. W.
Blakiston, C. R.
Booth, G. T.
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Brown, R.
Bull, B.
Charlewood, W. T., B.A.
Chilton, C., M.A., B.Sc.*
Chrystall, W.
Colledge, J. L.
Collins, J.
Cook, Prof. C. H. H., M.A.
Craig, D.
Cunningham, P.
Danks, T.
Deans, J.*
Denniston, Mr. Justice
Dick, S. J.
Dixon, M.
Dobson, E., C.E.
England, R. W., jun., A.R.I.B.A.
Enys, J. D.
Fereday, R. W.
Garsia, Captain
Gibbs, W. M.
Gray, G., F.C.S.
Greenstreet, E. P.
Gresson, Hon. H. B.
Gresson, J. B., sen.
Hall, Sir John, M.H.R.
Hall, S. W.
Hall, T. W.
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Hunt, Dr.

Hutton, Prof. F. W., F.G.S.*
Irwood, A. R.
Ivey, W. E.
Izard, W., B.A.
Jennings, Dr.
Julius, C., The Right Rev.
King, G.
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Lohse, Miss J. S. C.
Loughrey, A.
Mannering, G. A.
McIntyre, G.
Meeson, J. T., B.A.
Meyrick, E., B.A., F.E.S.
Mollett, T. A.*
Monro, D. H.
Moorhouse, Dr.
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Mountfort, C. J.
Murphy, M., F.L.S.
Nalder, W. A.
Palmer, J.
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Shanks, C. B.
Sparks, W., jun.
Speight, R., M.A.
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Symes, W. H., M.D.*
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Townsend, J.
Veel, J. Colborne
Wakefield, C. M., F.L.S., F.E.S.
Webb, H. R., F.R.M.S.
Westenra, P.
Wilkin, R., jun.
Wilson, H.
Wood, L. B., M.A.
Wood, W. D.
Wright, T. G.

OTAGO INSTITUTE.

[* Life-members.]

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Bell, G.
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Black, Professor
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